

## Does income polarization affect economic growth? The case of the European regions

Ezcurra, Roberto

Postprint / Postprint

Zeitschriftenartikel / journal article

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### Empfohlene Zitierung / Suggested Citation:

Ezcurra, R. (2009). Does income polarization affect economic growth? The case of the European regions. *Regional Studies*, 43(2), 267-285. <https://doi.org/10.1080/00343400701808899>

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**Does income polarization affect economic growth?  
The case of the European regions**

Journal:	<i>Regional Studies</i>
Manuscript ID:	CRES-2006-0280.R1
Manuscript Type:	Main Section
JEL codes:	D30 - General < D3 - Distribution < D - Microeconomics, R11 - Regional Economic Activity: Growth, Development, and Changes < R1 - General Regional Economics < R - Urban, Rural, and Regional Economics
Keywords:	Income polarization, Economic growth, Regions, European Union

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3 **Does income polarization affect economic growth?**  
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6 **The case of the European regions**  
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9  
10 Roberto Ezcurra<sup>\*</sup>

11  
12 Department of Economics

13  
14 Universidad de Castilla-La Mancha

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17 Final version: June 2007  
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27 **¿Afecta la polarización de la renta al crecimiento económico?**  
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30 **El caso de las regiones europeas**  
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33  
34 Roberto Ezcurra<sup>†</sup>

35  
36 Department of Economics

37  
38 Universidad de Castilla-La Mancha

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41 First: November 06. Accepted: June 07  
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51 **Abstract (Spanish)**

52 Este trabajo examina la relación entre la polarización de la renta y el crecimiento  
53 económico en las regiones de la Unión Europea a lo largo del período 1993-2003. El  
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<sup>\*</sup> Postal address: Departament of Economics, Universidad de Castilla-La Mancha, Ronda de Toledo s/n.  
13071 Ciudad Real (Spain). E-mail: Roberto.Ezcurra@uclm.es.

60 <sup>†</sup> Postal address: Departament of Economics, Universidad de Castilla-La Mancha, Ronda de Toledo s/n.  
13071 Ciudad Real (Spain). E-mail: Roberto.Ezcurra@uclm.es.

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3 análisis llevado a cabo indica que el nivel de polarización de la renta influye  
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5 negativamente en el crecimiento regional. De hecho, este resultado es robusto a distintas  
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7 especificaciones alternativas que incluyen variables explicativas adicionales como el  
8  
9 nivel inicial de PIB por habitante, la estructura sectorial, el stock de capital humano, la  
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11 densidad de población o el potencial de mercado. Asimismo, cabe señalar que la  
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13 correlación negativa observada no depende del número de grupos utilizado para analizar  
14  
15 el grado de polarización de la renta en las regiones consideradas.  
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22 Key words: Polarización de la renta, crecimiento económico, regiones, Unión Europea.  
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## 27 **La polarisation des revenus affecte t'elle la croissance économique ?**

### 28 **Le cas des régions européennes**

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31 Roberto Ezcurra  
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#### 42 **Résumé**

43 Cet article étudie les relations entre la polarisation des revenus et la croissance  
44 économique dans les régions de l'Union Européenne entre 1993 et 2003. Les résultats  
45 indiquent que le niveau de la polarisation des revenus est associé de manière négative au  
46 développement régional. Ce résultat conforte en fait diverses autres spécifications y  
47 compris un certain nombre de variables explicatives additionnelles comme le PIB par  
48 habitant, le mix industriel, le capital humain, la densité de population ou le potentiel des  
49 marchés. En outre, il convient de noter que la corrélation négative observée entre la  
50 polarisation et les résultats économiques ne dépend pas du nombre de groupes utilisés  
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3 pour analyser le degré de stratification des revenus dans les régions échantillons.  
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8 Mots-clés : polarisation des revenus, croissance économique, régions, Union  
9  
10 Européenne.  
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12 Classification *JEL*: D30, R11.  
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15  
16 Wirkt sich eine Einkommenspolarisierung auf das Wirtschaftswachstum aus?  
17 Der Fall der europäischen Regionen  
18 Roberto Ezcurra  
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20

21  
22 **Abstract**

23 In diesem Artikel wird die Beziehung zwischen der Einkommenspolarisierung  
24 und dem Wirtschaftswachstum in den Regionen der Europäischen Union im  
25 Zeitraum von 1993 bis 2003 beschrieben. Die Ergebnisse weisen darauf hin,  
26 dass das Ausmaß der Einkommenspolarisierung in einer negativen Verbindung  
27 zum Regionalwachstum steht. Dieses Ergebnis ist darüber hinaus auch bei  
28 Verwendung von verschiedenen alternativen Spezifikationen robust, darunter  
29 eine Reihe zusätzlicher erklärender Variablen wie z. B. das anfängliche Pro-  
30 Kopf-Bruttoinlandsprodukt, der Branchenmix, das Humankapital, die  
31 Bevölkerungsdichte oder das Marktpotenzial. Darüber hinaus sollte beachtet  
32 werden, dass die beobachtete negative Korrelation zwischen der Polarisierung  
33 und der Wirtschaftsleistung nicht von der Anzahl der Gruppen abhängt, die zur  
34 Analyse des Ausmaßes der Einkommensstratifizierung innerhalb der  
35 untersuchten Regionen herangezogen werden.  
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41 *Key words:*

42 Einkommenspolarisierung  
43 Wirtschaftswachstum  
44 Regionen  
45 Europäische Union

46 *JEL classification:* D30, R11.  
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58 **Abstract**

59 This article examines the relationship between income polarization and economic  
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3 growth in the regions of the European Union over the period 1993-2003. The results  
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5 indicate that the level of income polarization is negatively associated with regional  
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7 growth. This finding is in fact robust to various alternative specifications including a  
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9 number of additional explanatory variables, such as initial per capita GDP, industry  
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11 mix, human capital stock, population density or market potential. Furthermore, it should  
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13 be noted that the observed negative correlation between polarization and economic  
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15 performance does not depend on the number of groups used to analyse the degree of  
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17 income stratification within the sample regions.  
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27 *Key words:* Income polarization, economic growth, regions, European Union.  
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30 *JEL classification:* D30, R11.  
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## 32 33 **1. Introduction**

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36 Over the last fifteen years there have been numerous studies on spatial disparities in the  
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38 European Union (EU) using a variety of different approaches (see ECKEY and TÜRK  
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40 (2006) for a recent review of this literature). Various reasons contribute to explain the  
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42 interest surrounding this issue. Among them, it is worth mentioning the major advances  
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44 made over the last two decades in economic growth theory, coinciding with the  
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46 introduction of endogenous growth models in the mid 1980s. The assumptions  
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48 underlying these models ultimately allow for the reversal of the neoclassical prediction  
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50 of convergence, and lead to the conclusion that the faster growth of rich economies  
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52 causes territorial imbalances to increase over time (BARRO and SALA-I-MARTIN,  
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54 1995). In fact, the self-sustained and spatially selective nature of economic growth has  
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60 been stressed by the models of the “new economic geography” (OTTAVIANO and

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3 PUGA, 1998). According to these theories, increasing returns and agglomeration  
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5 economies would explain the accumulation of activity and income in the more dynamic  
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7 areas, which would lead in the final instance to spatial divergence. Academic debate  
8  
9 aside, however, the increasing relevance of this topic in the EU has much to do with the  
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11 strong emphasis placed on achieving economic and social cohesion in the context of the  
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13 current economic integration process, especially since the signing of the Single Act and  
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15 the Maastricht agreements. This directly raises the need to reduce the differences in  
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17 terms of development across the European regions (EUROPEAN COMMISSION,  
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19 2004).

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24 The literature on spatial disparities within the EU has highlighted the impact of various  
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26 factors on regional growth. They include the sectoral composition of economic activity  
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28 (NEVEN AND GOUYETTE, 1995), structural change processes (PACI, 1997),  
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30 infrastructure endowment (GIL *et al.*, 2002), human capital stock (RODRÍGUEZ-POSE  
31  
32 and VILALTA-BUFI, 2005), technology and innovation capacity (BILBAO-OSORIO  
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34 and RODRÍGUEZ-POSE, 2004), spatial externalities (LÓPEZ-BAZO *et al.*, 2004),  
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36 European regional policy (RODRÍGUEZ-POSE and FRATESI, 2004a), market  
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38 potential (BRÜLHART *et al.*, 2004) or social capital (BEUGELSDIJK and VAN  
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40 SCHAIK, 2005). However, the possible influence of personal income distribution on  
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42 economic performance in the EU has received hardly any attention in the literature. In  
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44 fact, to the best of our knowledge, the only exception in this respect is the work of  
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46 MARTINO and PERUGINI (2006), who analyse the relationship between income  
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48 inequality and economic growth in the EU regions. Following this line of research, this  
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50 article examines the role played by income polarization in explaining regional growth  
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52 processes in the EU. To investigate this issue, we have estimated the level of income  
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54 polarization registered by the European regions, which provides relevant information  
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3 when it comes to assessing the degree of social cohesion in the EU. In this respect, it is  
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5 worth mentioning that the ultimate aim of this research is to achieve a deeper  
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7 understanding of the nature of the observed spatial disparities in the European setting, in  
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9 order to draw some useful implications for EU regional policy design.  
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12 Before going any further, a word of warning is necessary to alert readers about the  
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14 conceptual differences that exist between the notion of polarization and that of  
15  
16 inequality. In relation to this, JENKINS (1996, p.34) points out that “polarization  
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18 provides a challenge for our thinking about how we assess income distributions, since  
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20 the measurement tools economists have developed focus almost exclusively on changes  
21  
22 in income levels and dispersion.” In particular, it is important to emphasize that, unlike  
23  
24 polarization measures, the conventional indices of inequality commonly employed in  
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26 the literature are of no use when distinguishing whether the population is clustered  
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28 around the average of the distribution or around two or more separate poles (ESTEBAN  
29  
30 and RAY, 1994; WOLFSON, 1994). Accordingly, inequality and polarization capture  
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32 different features of the distribution object of analysis, and can move in opposite  
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34 directions. For an illustration of this idea, we can consider the following example  
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36 (ANDERSON, 2004). Let us assume that the distribution under study,  $f$ , can be  
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38 expressed as an equally weighted mixture of normals  $N(\mu_i, \sigma_i^2)$ , with  $i=1,2$ . This  
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40 means that  $\sigma_f^2 = 0.5(\sigma_1^2 + \sigma_2^2 + (\mu_1 - \mu_2)^2)$ . In this situation, increased polarization,  
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42 interpreted as any combination of reductions in sub-population variances and increased  
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44 distance between sub-population averages, can be seen either to increase, leave  
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46 unchanged, or decrease inequality, as measured by the variance of  $f$ . This example  
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48 shows clearly that inequality and polarization are two different concepts that should be  
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50 examined separately when analysing income distributions.  
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Previous studies on the link between income distribution and economic performance



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3 have focused mainly on the role played by income inequality (e.g. ALESINA and  
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5 RODRIK, 1994; PERSON and TABELLINI, 1994; BENABOU, 1996; LI and ZOU,  
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7 1998; FORBES, 2000; MARTINO and PERUGINI, 2006), thus ignoring the possible  
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9 influence in this context of the degree of income stratification in the economies under  
10  
11 consideration. Nevertheless, it needs to be said that there are various theoretical  
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13 arguments that suggest the potential relevance of polarization in this framework. Thus,  
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15 as pointed out by ESTEBAN and RAY (1994), income polarization gives rise to the  
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17 generation of social tensions. This is especially important, since several studies have  
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19 stressed the negative impact of social unrest on economic performance (e.g. VENIERIS  
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21 and GUPTA, 1986; BENHABIB and RUSTICHINI, 1996). Furthermore, polarization  
22  
23 processes are characterized by the diminution of the middle class in income  
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25 distributions (e.g. HERRIGAN and HAUGEN, 1988; BEACH *et al.*, 1998). This may  
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27 have a negative impact on economic growth, since middle class consensus promotes  
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29 economic development by supporting political stability, enhancing public service  
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31 endowment and improving access to education (EASTERLY, 2001a,b). These  
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33 arguments highlight the need to tackle empirically the analysis of the relationship  
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35 between income polarization and economic growth, as has been done in this article.  
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43 We were able to undertake our study thanks to the use of the European Community  
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45 Household Panel (ECHP). The ECHP, which was constructed under Eurostat  
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47 coordination, is the only homogeneous survey of its kind covering the 15 EU member  
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49 states prior to the 2004 and 2007 enlargements, and with the capacity to supply  
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51 regionally disaggregated data on personal income distribution (EUROSTAT, 1996). The  
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53 analysis performed in this paper is based on this source and covers 61 NUTS-1 regions  
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55 in eight EU countries during the period 1993-2003<sup>i</sup>. It is important to note in this respect  
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60 that the level of territorial disaggregation and time frame considered in the article are

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3 decisively conditioned by the availability of data from the ECHP, a point that should be  
4 taken into consideration when assessing the results obtained in the empirical analysis<sup>ii</sup>.  
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8 The rest of the article is structured as follows. The next section presents an overview of  
9  
10 the main theoretical arguments that can be used to justify the possible influence of  
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12 income polarization on economic growth. After establishing the theoretical framework  
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14 in which to fit our study, Section 3 examines the growth patterns of the EU regions  
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16 during the sample period, and provides evidence on their degree of income polarization.  
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18 Section 4 employs various alternative specifications of a reduced-form growth model to  
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20 analyse the impact of income polarization on economic growth in the EU regions,  
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22 paying particular attention to the robustness of the results obtained. Finally, section 5  
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24 draws the main conclusions and the policy implications of the research.  
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## 30 **2. Income polarization and economic growth: Theoretical and** 31 **empirical background** 32 33

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36 The theoretical literature on the relationship between income distribution and  
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38 macroeconomic performance has expanded enormously in recent years, coinciding with  
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40 the resurgence of interest in the determinants of economic growth at the beginning of  
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42 the 1990s (AGHION *et al.*, 1999; EICHER and TURNOVSKY, 2003). The underlying  
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44 theory of this line of research is that income distribution can affect investment levels in  
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46 physical and human capital, which in turn determinates the growth rate of the economy.  
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51 Within this framework, a great number of authors have investigated the impact of  
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53 income inequality on economic growth through different mechanisms that often work in  
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55 opposite directions (e.g. PEROTTI, 1996; BARRO, 2000). Empirical research is  
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57 therefore key to understanding the nature of this relationship. Thus, the last decade has  
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59 seen the publication of various works that examine this issue using country data. Studies  
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3 based on cross-sectional approaches report a negative correlation between income  
4 inequality and economic growth (ALESINA and RODRIK, 1994; PERSSON and  
5 TABELLINI, 1994; CLARKE, 1995; BENABOU, 1996), which represents a challenge  
6 for the traditional equity/growth trade-off. Nevertheless, other researchers have found a  
7 positive relationship using panel data models (LI and ZOU, 1998; FORBES, 2000). It  
8 should be noted, however, that all these studies are based on different international  
9 databases compiled from information on income distribution in various countries. As a  
10 consequence, the authors themselves acknowledge that the data employed lacks  
11 homogeneity, which inevitably casts some doubt on the robustness of the results  
12 obtained (BENABOU, 1996; ATKINSON and BRANDOLINI, 2001). A possible  
13 solution to these problems can be found in the use of regional data. Following this  
14 strategy, a small number of works have examined the relationship between income  
15 inequality and economic growth with data from the US states (PARTRIDGE, 1997,  
16 2005; PANIZZA, 2002) or the European regions (MARTINO and PERUGINI, 2006).  
17 Nevertheless, the findings of these contributions are not conclusive. In this respect,  
18 PANIZZA (2002) has highlighted that specification changes and slight differences in  
19 the method used to measure income inequality may affect the results of the econometric  
20 analysis.

21  
22 In any event, these studies do not take into account that there are various aspects of the  
23 income distribution that cannot be captured by the conventional inequality indices  
24 employed in the econometric analyses carried out. Specifically, these measures do not  
25 help in distinguishing whether the population is clustered around the average or around  
26 two or more separate poles (LEVY and MURNANE, 1992; WOLFSON, 1994), which  
27 impedes to quantify with accuracy the level of polarization of the distribution under  
28 consideration. Nevertheless, as we will show later, there are several theoretical

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3 arguments suggesting that polarization may, in some cases, be more relevant than  
4 inequality for economic growth. This is because inequality, unlike polarization, does not  
5 properly capture the degree of social tension associated with a specific distribution  
6 (ESTEBAN and RAY, 1994). For a better understanding of this idea, let us consider an  
7 income distribution divided into two well defined groups characterized by substantial  
8 intra-group homogeneity and inter-group heterogeneity. A society in this kind of  
9 situation would be likely to register a high level of social tension. At the same time,  
10 however, the degree of income dispersion may be relatively low. Readers who are  
11 sceptical of this point are advised to consult the example included in the introduction to  
12 identify the conceptual differences between inequality and polarization.  
13  
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15 This issue is particularly relevant in the present context, since numerous studies have  
16 stressed the links between social tension, political instability and macroeconomic  
17 performance (e.g. VENIERIS AND GUPTA, 1986; ALESINA and PEROTTI, 1996;  
18 BENHABIB and RUSTICHINI, 1996). As already mentioned, income polarization  
19 generates social tension, which tends to increase socio-political instability. In turn, there  
20 are various reasons why a high level of socio-political instability should have a negative  
21 impact on economic growth (BARRO, 1991; ALESINA *et al.*, 1996). On the one hand,  
22 it should be noted that individual investment decisions are affected by the degree of  
23 uncertainty about the political and legal environment. Furthermore, socio-political  
24 instability disrupts market activities and labour relations, and may therefore have  
25 negative repercussions on aggregate productivity.  
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28 Additionally, it is worth mentioning that the recent popularity of the notion of  
29 polarization is originally linked to the shrinking of the middle class observed in several  
30 developed countries from the late 1970s onwards (e.g. HARRIGAN and HAUGEN,  
31 1988; LEVY and MURNANE, 1992). At this juncture it is pertinent to recall that the  
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3 importance of a large middle class for economic development is well documented in the  
4 literature (LANDES, 1998; EASTERLY, 2001a). For example, ADELMAN and  
5 NORRIS (1967, p.30) point out that “in the economic development of Western Europe,  
6 the middle classes were a driving force.” In fact, these authors mention that “it is clear  
7 from many country studies that the growth of a robust middle class remains of crucial  
8 importance in contemporary low-income nations.” According to these arguments, a  
9 higher share of income for the middle class is associated with more investment, better  
10 economic policies and, therefore, higher growth rates (EASTERLY, 2001b).

11 From a methodological point of view, it should be emphasized that the empirical  
12 analyses carried out so far to investigate the impact of the middle class size on  
13 economic performance supplement the information provided by conventional inequality  
14 measures with the employment of quantile income shares (e.g. ALESINA and  
15 PEROTTI, 1996; PANIZZA, 2002; PARTRIDGE, 2005). However, as clearly  
16 highlighted by WOLFSON (1994), these indicators do not provide an accurate picture  
17 of possible changes in the middle class. Accordingly, formal polarization indices should  
18 be used in this context, as has been done in this paper.

### 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 **3. Regional growth and income polarization in the EU**

43 This article aims to examine the relationship between income polarization and regional  
44 growth in 61 EU regions over the period 1993-2003. There are at least two reasons to  
45 justify the analysis of this issue in the case of the EU regions. On the one hand, as  
46 mentioned in the introduction, as far as we are aware, the possible impact of income  
47 polarization on economic performance has not been examined to date in any of the  
48 numerous works devoted to investigating the determinants of EU regional growth.  
49 Accordingly, our study will allow us to complete the literature on spatial disparities in  
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3 the European context. On the other hand, and leaving this aside, the use of regional data  
4 is particularly advisable in this type of analysis, since cross-country studies on the  
5 relationship between income distribution and macroeconomic performance are affected  
6 by the problems raised by the quality and comparability of the microdata employed  
7 (PANIZZA, 2002).  
8  
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### 10 11 12 13 14 15 16 **3.1. Growth patterns in the EU: A regional typology** 17

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19 Taking our objective into account, we began our analysis by examining the growth  
20 patterns of the sample regions during the study period. According to this strategy, we  
21 proceeded to construct a spatial typology based on the relationship between the regional  
22 growth rates for the time frame considered and the regional distribution of per capita  
23 GDP in 1993. Before commenting our results it should be noted that, following the  
24 approach adopted among others by BEUGELSDIJK and VAN SCHAIK (2005) and  
25 RODRÍGUEZ-POSE and VILALTA-BUFI (2005), all the data used in our analysis  
26 were normalized nationally. Thus, the growth rates and initial per capita GDP were  
27 expressed in relation to the national average in each case. This allows us to remove from  
28 the results of the analysis the influence of the distortions associated with the national  
29 dimension, the potential importance of which has been repeatedly pointed out in the  
30 literature (QUAH, 1996; EZCURRA *et al.*, 2005). This data transformation also has the  
31 advantage of minimizing spatial autocorrelation problems (RODRÍGUEZ-POSE, 1999;  
32 GIL *et al.*, 2004). Nevertheless, since regional data are normalized nationally, it should  
33 be mentioned that our study provides no information about the possible presence of  
34 convergence and divergence processes at the country level. This is not a major  
35 drawback in the present context, however, given that most of the current regional  
36 inequality in terms of per capita GDP in the EU is within, rather than across, member  
37 states (PUGA, 2002).  
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[INSERT FIGURE 1 AROUND HERE]

Figure 1 summarizes the results obtained when we classified the sample regions into four categories according to their initial level of development and their growth rate throughout the time interval considered (RODRÍGUEZ-POSE and VILALTA-BUFI, 2005). As can be observed:

- 10 regions (19% of the population in 1993) registered growth rates above the national average over the study period, despite having a level of per capita GDP above the national average in 1993 (“Winning regions”). This group includes the regions of northern and central Italy, as well as several areas scattered across the various countries, such as South East in the United Kingdom, Noreste in Spain or Centre-Est in France. The trend followed by some of these regions is linked to certain tertiary activities with high productivity levels (EUROPEAN COMMISSION, 1999). Likewise, this category also includes several regions characterized by the presence of a relatively dynamic manufacturing sector, which has been decisive in consolidating their relevant positions in today’s increasingly competitive and integrated markets (RODRÍGUEZ-POSE, 1998).
- 17 regions (26% of the population in 1993), while starting the period with a low level of per capita GDP with respect to their national average, achieved above-average economic growth between 1993 and 2003 (“Catching-up regions”). This is the case of some of the least favoured areas of Spain and Greece, western and southern France, several central and southern regions of the United Kingdom and the *Länder* of the former German Democratic Republic. Despite their heterogeneity, it is interesting to note that most of these regions experienced



1  
2  
3 over the sample period a transfer of productive resources from agriculture and  
4 manufacturing towards services. Taking into account existing differences in  
5  
6 sectoral productivities, this process of structural change enabled them to narrow  
7  
8 their economic development gap with the national average (PACI, 1997; GIL *et*  
9  
10  
11  
12  
13 *al.*, 2002).

- 14  
15 • 18 regions (34% of the population in 1993) which, despite having begun the  
16 period with above national average per capita GDP, registered slower than  
17 average growth throughout the time interval considered (“Falling behind  
18 regions”). This group is formed by some of the main urban centres of Europe,  
19 such as Brussels, Berlin, Hamburg, Île de France or Lazio. Although there are  
20 some exceptions, the rate of economic growth in most of these regions has been  
21 high enough over the last few decades to place them currently among the most  
22 developed areas of the EU. The lack of dynamism registered by these regions  
23 between 1993 and 2003 may have to do with the possible presence in these large  
24 urban centres of congestion costs as a result of excessive agglomeration  
25 (THISSE, 2000), which may have had a negative effect on their economic  
26 growth rate.  
27  
28
- 29 • 16 regions (21% of the population in 1993) exhibit below-national-average  
30 initial levels in both per capita GDP and rate of economic growth (“Losing  
31 regions”). This group includes several areas with a relatively important presence  
32 of manufacturing activities, currently immersed in a variety of industrial  
33 reconversion processes (CUADRADO-ROURA *et al.*, 2000). As examples we  
34 might mention northern England or Wales in the United Kingdom, Wallonia in  
35 Belgium, or Niedersachsen in Germany. This group also includes a number of  
36 regions located in the southern periphery of the EU with relatively large  
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3 agricultural sectors. Such is the case, for example, of Sicilia and Sardegna in  
4  
5 Italy, or Kentriki Ellada in Greece.  
6

7  
8 Despite the fact that any attempt to fix a specific number of regional categories in this  
9  
10 context inevitably represents a simplified view of the facts, the typology just presented  
11  
12 provides a reasonably realistic representation of the trends registered by the EU regions  
13  
14 between 1993 and 2003. Although the nature of this analysis implies that the  
15  
16 conclusions should be treated with caution, the study carried out reveals that the sample  
17  
18 regions exhibited a heterogeneous behaviour in terms of economic performance during  
19  
20 the study period, which gives a clear indication of the complexity of regional growth  
21  
22 patterns in the EU (RODRÍGUEZ-POSE, 1998).  
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### 28 **3.2. The measurement of income polarization**

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31 Regardless of all other considerations, the regional typology drawn from Figure 1  
32  
33 clearly shows that there were relatively major differences in the growth patterns of the  
34  
35 regions considered over the period 1993-2003. In order to investigate the issue in more  
36  
37 detail, this article aims to examine the possible contribution of income polarization to  
38  
39 regional growth in the EU. In this respect, it needs to be said that, to best of our  
40  
41 knowledge, this factor has so far remained unexplored in the large body of existing  
42  
43 research into the determinants of European regional growth processes.  
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47  
48 In order to achieve our aim, we need to estimate the degree of polarization of income  
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50 distribution registered by the various sample regions. In this respect, it should be  
51  
52 mentioned that throughout the last decade different authors have derived a set of  
53  
54 polarization indices that might be employed for the purposes of the present article  
55  
56 (WOLFSON, 1994; WANG and TSUI, 1999; CHAKRAVARTY and MAJUMDER,  
57  
58 2001). Within this framework, we decided to use the polarization measures proposed by  
59  
60 ESTEBAN and RAY (1994) and ESTEBAN *et al.* (2007), since this approach is the

only one in which the analysis explicitly incorporates the error generated when partitioning the original distribution into various groups in order to quantify the level of polarization.

According to ESTEBAN and RAY (1994), the degree of polarization of a distribution  $f$  into a given number of groups can be obtained by means of the following expression:

$$P^{ER}(\delta, \rho) = \sum_{i=1}^n \sum_{j=1}^n p_i^{1+\delta} p_j |\mu_i - \mu_j| \quad (1)$$

where  $\mu_i$  and  $p_i$ , respectively, denote the conditional mean and the population share of group  $i$ . Likewise,  $\delta$  is a parameter that captures the degree of sensitivity of  $P^{ER}$  to polarization, the value of which falls in the interval  $[1, 1.6]$  in order to be consistent with a set of axioms (see ESTEBAN and RAY (1994) for further details). As can be observed from expression (1), the level of polarization in the distribution under consideration depends on the average income gaps between the various groups and their relative sizes. Before going any further, it is worth noting that the proposed measure of polarization bears an obvious likeness to one of the indicators most commonly used in the traditional literature on inequality, the Gini index,  $G$ . Nevertheless, the fact that in expression (1)  $p_i$  is raised to  $(1+\delta)$  means that the measure of polarization will, in practice, follow a different pattern from that of the Gini index. In particular, the higher the value adopted by  $\delta$ , the greater the conceptual division between the inequality and polarization measures.

Before applying this measure, however, it is first necessary to define a simplified representation of the original distribution into a set of  $n$  exhaustive and mutually exclusive groups,  $\rho = (z_0, z_1, \dots, z_n; \mu_1, \dots, \mu_n; p_1, \dots, p_n)$ , the boundaries of which are given by income intervals of the form  $[z_{i-1}, z_i]$ , for  $i = 1, \dots, n$ . This will involve a certain degree of error, however, as this partition will generate some loss of information,

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2  
3 depending on the level of income dispersion in each of the various groups considered.  
4  
5 Taking this into account, the generalized measure of polarization proposed by  
6  
7 ESTEBAN *et al.* (2007) is obtained after correcting the  $P^{ER}$  index applied to the  
8  
9 simplified representation of the original distribution with a measure of the grouping  
10  
11 error,  $\varepsilon(f, \rho)$ . That is,  
12  
13

$$14 \quad P^{EGR}(f, \delta, \rho, \lambda) = P^{ER}(\delta, \rho) - \lambda \varepsilon(f, \rho) \quad (2)$$

15  
16 where  $\lambda \geq 0$  is a parameter representing the weight assigned to the error term in  
17  
18 expression (2).  
19  
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21

22  
23 Nonetheless, it is important to bear in mind that when dealing with income distributions,  
24  
25 there are no unanimous criteria for establishing the precise demarcation between the  
26  
27 different groups. To address this problem, ESTEBAN *et al.* (2007) use the algorithm  
28  
29 proposed by DAVIES and SHORROCKS (1989) in order to find the optimal partition  
30  
31 of the original distribution into a given number of groups,  $\rho^*$ . This means selecting the  
32  
33 partition that minimizes the Gini index value of within-group inequality,  
34  
35  $G(f) - G(\rho^*)$ <sup>iii</sup>. Given that  $\varepsilon(f, \rho^*) = G(f) - G(\rho^*)$ , the generalized measure of  
36  
37 polarization proposed by Esteban *et al.* (2007), therefore, can be expressed as:  
38  
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41

$$42 \quad P^{EGR}(f, \delta, \rho^*, \lambda) = P^{ER}(\delta, \rho^*) - \lambda [G(f) - G(\rho^*)] \quad (3)$$

### 43 44 45 46 47 **3.3. Empirical evidence for the European regions**

48  
49 Following the above methodology, we estimated the level of income polarization  
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51 registered by the EU regions, using the information provided by various partitions of the  
52  
53 original distributions into two, three and four groups. In order to check the robustness of  
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55 the results, different degrees of sensitivity to polarization were considered in our  
56  
57 analysis. Specifically,  $\delta = 1, 1.3, 1.6$ . Likewise, as in ESTEBAN *et al.* (2007), in all  
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1  
2  
3 cases  $\lambda = 1$ <sup>iv</sup>.  
4

5  
6 Before discussing the results, it should be noted that the various partitions used were  
7  
8 obtained by applying the algorithm proposed by DAVIES and SHORROCKS (1989),  
9  
10 thus minimizing within-group dispersion. In relation to this, it needs to be said that  
11  
12 when the different income distributions of the sample regions are divided into two  
13  
14 groups according to this procedure, it is possible to explain on average 70% of the total  
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16 inequality measured by the Gini index. In turn, the three-group partition provides a 16%  
17  
18 increase in explanatory power, given that average between-group inequality is in this  
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20 case 86% of overall dispersion. Finally, when the various income distributions are  
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22 classified into four groups, the differences between them explain 92% on average of  
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24 total inequality, which is 6% more explanatory power than the three-group  
25  
26 classification.  
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34 [INSERT TABLE 1 AROUND HERE]  
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39 Table 1 presents the set of generalized measures of polarization calculated for each  
40  
41 region in the two-, three-, and four-group cases, taking net per capita income of the  
42  
43 various households in 1993 as the reference variable in the analysis. In order to provide  
44  
45 additional information on the results, Table A1 in the Appendix also shows the values  
46  
47 of the two  $P^{EGR}$  components according to expression (3): the polarization of the  
48  
49 simplified representations of the original distribution, and the degree of within-group  
50  
51 dispersion. As can be observed in Table 1, within each partition there is clearly a strong  
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53 similarity between the various regional rankings generated from the different values  
54  
55 assigned to the polarization sensitivity parameter  $\delta$  (see Table A2 in the Appendix for  
56  
57 further details). Furthermore, it is worth noting that, although there are certain  
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3 differences in the case of some specific regions depending on the partition considered,  
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5 all the measures calculated can be seen to coincide in showing a considerable variation  
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7 in the degree of polarization within the sample regions. Thus, for example, in the case of  
8  
9 a partition of the original distributions into two groups and with  $\delta = 1.3$ ,  $P^{EGR}$  ranges  
10  
11 between 0.055 for Sachsen-Anhalt and 0.149 for Açores, which clearly highlights the  
12  
13 relevance of regional disparities in this context. In any event, it should be mentioned  
14  
15 that close observation of the values shown in Table 1 reveals that, despite some  
16  
17 exceptions can be observed, the least stratified income distributions tend to be found in  
18  
19 central and northern regions of the EU, while the areas with the highest polarization  
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21 levels are located mainly in the southern periphery.  
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25

26  
27 Having reached this point, it is worth pausing for a moment to analyse the relationship  
28  
29 between polarization and inequality in the EU regions. To this end, we decided to  
30  
31 examine the degree of statistical association between the generalized measures of  
32  
33 polarization calculated above and various indices commonly used in the literature to  
34  
35 capture the level of dispersion of the distribution object of analysis. In this way, we aim  
36  
37 to shed light on the empirical relevance of polarization in relation to the more usual  
38  
39 concept of inequality.  
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44 Before continuing any further, it is worth recalling that the results of inequality studies  
45  
46 may differ, at times substantially, according to which measures are employed in the  
47  
48 analysis (SEN, 1973). Given the obvious difficulty that arises from the fact that  
49  
50 different indicators may give different orderings of the distribution to be compared, it  
51  
52 seems reasonable to check the robustness of our results against various inequality  
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54 measures. Specifically, in this article we decided to consider the information provided  
55  
56 by the following indicators: the Gini index,  $G$ ; the two measures proposed by Theil  
57  
58 (1967) in the information theory context,  $GE(0)$  and  $GE(1)$ ; and the normative index  
59  
60

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3 derived by Atkinson (1970) with values of the inequality aversion parameter equal to  
4 0.5 and 2,  $A(0.5)$  and  $A(2)$ . It should be noted that all the indices selected are  
5  
6 independent of scale and population size, and they all fulfil the Pigou-Dalton transfer  
7  
8 principle for the whole definition domain of income (COWELL, 1995).  
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15 [INSERT TABLE 1 AROUND HERE]  
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20 Table 1 displays the Kendall's rank correlation coefficients between these inequality  
21  
22 measures and  $P^{EGR}$ . As can be observed, the estimated coefficients are positive and  
23  
24 statistically significant in all cases. Nevertheless, the magnitude of the values obtained  
25  
26 reveals clearly that there are differences between the regional rankings generated  
27  
28 from  $P^{EGR}$  and the various inequality measures. In fact, this finding does not depend on  
29  
30 the number of groups considered in the analysis or the value assigned to the polarization  
31  
32 sensitivity parameter  $\delta$ . Furthermore, it is interesting to note how the degree of  
33  
34 association between inequality and polarization decreases as  $\delta$  increases. The analysis  
35  
36 carried out therefore suggests that, beyond the conceptual distinction mentioned in the  
37  
38 introduction, there are differences between polarization and inequality in the EU  
39  
40 regions. This conclusion reinforces the need for separate approaches to the study of  
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42 these two phenomena, which is consistent with the perspective adopted in this article.  
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49 In any event, the question that emerges at this point is whether there exists a possible  
50  
51 link between the economic performance of the regional categories established in the  
52  
53 previous subsection and their level of income polarization. In order to investigate this  
54  
55 issue, it is useful to check for any potential differences in the degree of income  
56  
57 polarization characterizing the regions of the various groups. To this end, an analysis of  
58  
59 the variance of the different polarization measures calculated was performed, taking the  
60

1  
2  
3 regional typology drawn from Figure 1 as the reference. As a prior step, following the  
4 strategy adopted in subsection 3.1, the various polarization indices were normalized  
5 according to the national average. This is particularly advisable in the present context,  
6 because of the major role played by the national component in explaining the spatial  
7 distribution of personal income in the EU regions (EZCURRA and PASCUAL, 2005).  
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17 [INSERT TABLE 2 AROUND HERE]  
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22 The results, which are summarized in Table 2, are very similar for the different  
23 polarization measures estimated above, irrespective of the specific partition considered  
24 in each case and the value assigned to the parameter  $\delta$ . Thus, the various F tests carried  
25 out reveal statistically significant differences in the average polarization levels of the  
26 various regional categories considered. It is particularly interesting to observe how the  
27 most dynamic regions during the sample period (“Winning regions” and “Catching-up  
28 regions”) display below-national-average income polarization in 1993. This does not  
29 hold for the other two categories. Indeed, the relative low growth over the study period  
30 experienced by the “Falling behind regions” and “Losing regions” coincides with  
31 above-national-average levels of income polarization in 1993.  
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#### 46 **4. Econometric analysis**

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49 The empirical evidence presented above suggests the possible presence of a relationship  
50 between income polarization and economic growth in the EU regions. In order to  
51 complete the results obtained so far, this section is devoted to a more detailed  
52 investigation of the issue, using a reduced-form growth model, which can be written in  
53 matrix notation as:  
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$$\Delta Y_{t_0,t_1} = \alpha + \beta P_{t_0} + X_{t_0} \phi + \varepsilon \quad (4)$$

where  $\Delta Y$  is the vector of the annual growth rates of per capita GDP between  $t_0$  and  $t_1$  in the regions considered ( $t_0 = 1993$  and  $t_1 = 2003$ ),  $P$  is the value of the polarization measure used to capture the level of income stratification within each region, and  $X$  is a set of additional variables controlling for other factors that are assumed to influence regional growth. Finally,  $\varepsilon$  is the disturbance term. Note that, following standard practice in the convergence literature, this model is based on the assumption that economic growth is converging to an equilibrium growth path that is a function of the initial conditions (DURLAUF and QUAH, 1999; MAGRINI, 2004).

Before continuing, it is worth pausing for a moment to describe the series of variables that make up the matrix  $X$ . In this respect, while the choice of these variables is theoretically well grounded, it ultimately depends on the availability of reliable statistical data for the geographical setting on which our study is focused. Thus, following the convention in the literature on economic growth, the initial level of per capita GDP was used to control for economic convergence across regions (BARRO and SALA-I-MARTIN, 1991, 1992). The inclusion of this variable in the model allows us to determine whether poor regions grew faster than richer ones during the study period, thus providing information on the dynamics of regional disparities in our sample between 1993 and 2003.

In addition, we examined the role played in this context by regional specialization. In fact, the influence of the sectoral composition of economic activity on regional growth processes is well known in the literature (see NEVEN and GOUYETTE (1995), PACI (1997) or GIL *et al.* (2002), for evidence on the EU case). Hence, it is reasonable to consider the possibility of a relationship between the productive structure of the different regions and their economic performance during the study period. Accordingly,



1  
2  
3 our model includes the regional employment shares in agriculture, manufacturing,  
4 market services and non-market services at the beginning of the study period. Note,  
5  
6 moreover, that, despite the process of convergence in regional productive structures that  
7  
8 has characterized the European economy during recent decades, considerable  
9  
10 differences persist in the patterns of regional specialization across the EU regions  
11  
12 (EZCURRA *et al.*, 2006).  
13  
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15  
16  
17 It is also worth mentioning that the literature has repeatedly stressed the theoretical  
18  
19 importance of human capital in explaining economic growth (MANKIW *et al.*, 1992;  
20  
21 BARRO and SALA-I-MARTIN, 1995). Specifically, economies characterized by  
22  
23 higher human capital endowment are considered to have greater development potential  
24  
25 than those with insufficient and inadequate human resources. Likewise, it should be  
26  
27 noted that the relationship between income distribution and human capital investment  
28  
29 decisions has been highlighted in various studies (GALOR and ZEIRA, 1993). This is  
30  
31 of particular relevance in the context of this article, since it raises the possibility that the  
32  
33 polarization measures may be capturing the effect of differences in human capital stock  
34  
35 levels on regional growth. For this reason, we considered the possibility of controlling  
36  
37 our estimations for this factor. This is no easy task, however, due to lack of reliable  
38  
39 comparable data on human capital for the European regions at the beginning of our  
40  
41 study period. In order to overcome this important limitation, we decided to follow the  
42  
43 strategy adopted by RODRÍGUEZ-POSE and VILALTA-BUFI (2005) and use the  
44  
45 ECHP to obtain information on the educational stock of the various regions considered  
46  
47 in the analysis. Thus, for every region in the sample, we calculated the percentage of  
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49 survey respondents with completed secondary and tertiary education at the beginning of  
50  
51 the study period, and introduced these variables into model (4).  
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59 We also analysed the possible influence in this context of agglomeration economies  
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3 (FUJITA and THISSE, 2002). To this end, we considered the information provided by  
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5 two different variables: population density and market potential. In this respect, it is  
6  
7 worth mentioning that population density is widely used in the literature to measure the  
8  
9 degree of concentration of economic activity in a given area (LÓPEZ-BAZO, 2003).  
10  
11 Additionally, a market potential index was estimated for each region to capture the fact  
12  
13 that the potential demand for goods and services in a given location is influenced by its  
14  
15 accessibility to consumers (HANSON, 1998). The “new economic geography” models  
16  
17 lend theoretical support for the use of an index of this type (KRUGMAN, 1992), while  
18  
19 various recent studies have underlined its empirical relevance (BRÜLHART *et al.*,  
20  
21 2004). In this article, the market potential of each region was defined, according to  
22  
23 HARRIS (1954), as the sum of the purchasing power of all other EU regions weighted  
24  
25 by the inverse distance, to capture the effect of transport costs.  
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31  
32 It is worth mentioning that, as in the previous sections, all data on the variables used in  
33  
34 the econometric analysis were normalized nationally. In relation to this, it should be  
35  
36 noted that this data transformation eliminates the possible influence of country-specific  
37  
38 factors, thus reducing the potential impact of the omitted-variable bias in the results.  
39  
40 Likewise, an important advantage of the chosen specification is that there should be no  
41  
42 direct endogeneity, since all the explanatory variables are measured at the beginning of  
43  
44 the study period (PARTRIDGE, 1997, 2005; LI and ZOU, 1998; RODRÍGUEZ-POSE  
45  
46 and VILALTA-BUFI, 2005). For this reason, Ordinary Least Squares (OLS) were used  
47  
48 in the estimations carried out. Taking into account that the inclusion of multiple control  
49  
50 variables may cause multicollinearity problems, we decided to estimate various  
51  
52 alternative versions of model (4) to test for robustness (PANIZZA, 2002; PARTRIDGE,  
53  
54 2005).  
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[INSERT TABLE 3 AROUND HERE]

Table 3 reports the results obtained when the measure of generalized polarization is calculated for each region from a partition of the income distribution into two groups. As can be observed, the inclusion of the degree of income polarization in our reduced-form growth model yields interesting results. Specifically, the estimated coefficients on the  $P^{EGR}$  index are negative and statistically significant in all cases, which means that high initial income polarization is correlated with low economic growth in the ensuing years. This result is in fact robust to the inclusion in the analysis of additional explanatory variables. In any event, it needs to be said that the estimates carried out reveal that the impact of income polarization on economic growth decreases as the value assigned to the polarization sensitivity parameter  $\delta$  increases.

With respect to the control variables mentioned above, Table 3 indicates that the coefficient on the initial per capita GDP is negative and statistically significant in the various specifications considered, signalling the existence of a process of regional convergence in terms of development within the sample countries. This is consistent with the information provided by Figure 1, according to which 58% of the regions considered tend to fall into the “Catching-up” or “Falling behind” categories. The analysis carried out also reveals that industry mix is a relevant factor when it comes to explaining regional performance in the European context. Specifically, regions specializing in manufacturing activities at the beginning of the sample period registered low growth rates in relative terms over the following years, which highlights the numerous problems raised by industrial reconversion processes in the EU (EUROPEAN COMMISSION, 1999). In turn, the presence of a relatively large non-market service sector has a negative impact on economic performance. This result is consistent with the

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2  
3 empirical evidence presented by RODRÍGUEZ-POSE and FRATESI (2004b), who  
4 stress the fact that European peripheral regions with high levels of public employment  
5 registered moderate growth rates during the last two decades. Additionally, the  
6 information provided by Table 3 suggests the possible influence of the educational  
7 stock of the various regions in this context. In fact, the two human-capital controls are  
8 positively correlated with the dependent variable, although only the percentage of  
9 population with tertiary education is statistically significant. Finally, it is worth  
10 mentioning that the two variables used to capture the relevance of agglomeration  
11 economies, population density and market potential, are not statistically significant. In  
12 any event, these results should be viewed with some degree of caution in light of the  
13 values of the condition numbers.  
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29 As mentioned above, endogeneity should not be a direct concern in this context, since  
30 the explanatory variables are measured in all cases at the beginning of the sample  
31 period. Nevertheless, it is worth noting that the initial per capita GDP that appears on  
32 the right hand side of model (4) is also used to calculate the dependent variable (LI and  
33 ZOU, 1998; FORBES, 2000). Taking this into consideration, and following  
34 PARTRIDGE (2005), we decided to remove the initial per capita GDP level from the  
35 list of regressors in model (4). There are in fact various additional reasons to justify this  
36 alternative specification. Specifically, from a theoretical point of view, it should be  
37 recalled that the analysis of the convergence hypothesis based on cross-sectional growth  
38 regressions has been criticized by QUAH (1993) as an example of the Galton's fallacy,  
39 highlighting that the effect of initial per capita GDP on economic growth could be  
40 simply spurious (DURLAUF and QUAH, 1999). In addition, the initial per capita GDP  
41 is likely to be correlated with the majority of the remaining regressors, which might  
42 make it difficult to analyse the true effect of the different explanatory variables on  
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3 economic performance. As can be checked in columns 7 and 8 in Table 3, the results  
4  
5 when the initial per capita GDP is omitted from the analysis are very similar to those  
6  
7 just described. In particular, from the point of view of this article, the most relevant  
8  
9 issue is that the polarization indices remain negative and statistically significant.  
10  
11

12  
13 Additionally, we considered the possibility that our results may be driven by the  
14  
15 presence of outliers. Nevertheless, the information supplied by the standardized  
16  
17 residuals from the different estimated versions of model (4) indicates that the observed  
18  
19 negative correlation between income polarization and economic growth is not caused by  
20  
21 potential outliers. Additionally, it must not be overlooked that the presence of spatial  
22  
23 dependence in the error term of model (4) could bias our results (ANSELIN, 1988). For  
24  
25 this reason, we proceeded by performing a spatial autocorrelation test proposed by  
26  
27 KELEJIAN and ROBINSON (1992, 1997), which is particularly suitable for relatively  
28  
29 large geographical units such as NUTS-1 regions. To calculate this test, it was first  
30  
31 necessary to construct a spatial weights matrix capturing the degree of interdependence  
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33 between the various regions. Specifically, we considered a row-standardized spatial  
34  
35 weights matrix based on the squared inverse distance between the centroids of the  
36  
37 sample regions. In relation to this, it should be mentioned that this spatial weights  
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39 matrix is exogenous to the model, which precludes the identification problems raised by  
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41 MANSKI (1993). However, as can be observed in Table 3, the results of this test lead in  
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43 all cases to the acceptance of the null hypothesis of absence of residual spatial  
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45 dependence in the various estimated versions of model (4).  
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53 From a theoretical point of view, it is worth noting that the observed correlation  
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55 between income polarization and economic performance may be sensitive to the number  
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57 of groups employed to construct the simplified representation  $\rho^*$  used to calculate  
58  
59  $P^{EGR}$ . Taking this into account, the estimates were repeated using the various  
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3 generalized measures of polarization obtained above for the three- and four-group cases  
4 (see Table 1), as an alternative to the two-group classification used so far in this section.  
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8 In this respect, the information provided by Tables 4 and 5 shows that the estimated  
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10 coefficients on the different polarization measures continue to be negative and  
11  
12 statistically significant in all cases. Therefore, the negative relationship detected  
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14 between income polarization and economic growth does not depend on the specific  
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16 number of groups employed to characterize the income distribution in the European  
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18 regions.  
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25 [INSERT TABLE 4 AROUND HERE]  
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29 [INSERT TABLE 5 AROUND HERE]  
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34 Having reached this point, it should be recalled that, according to expression (3), the  
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36 value of  $P^{EGR}$  is derived from two factors: the polarization level of the simplified  
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38 representation of the original distribution, and the degree of within-group dispersion  
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40 weighted by the parameter  $\lambda$ . In order to complete our previous results, we examined  
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42 the influence on economic performance of these two components of the generalized  
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44 measure of polarization proposed by ESTEBAN *et al.* (2007). To this end, we  
45  
46 considered several alternative specifications of model (4), including  $P^{ER}$  and  $\varepsilon$  instead  
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48 of  $P^{EGR}$  in the list of regressors. The results obtained are summarized in Table 6. As can  
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51 be observed,  $P^{ER}$  and  $\varepsilon$  are statistically significant in all cases, confirming the  
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53 relevance of both factors in this context. Specifically, the analysis carried out shows that  
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55 the level of polarization of the simplified representation of the original distribution is  
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57 negatively correlated with regional growth, regardless of the number of groups  
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3 considered and the value assigned to the parameter  $\delta$ . Likewise, our estimates indicate  
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5 that internal cohesion has a positive impact on economic performance, which reveals  
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7 the importance of the degree of income dispersion in explaining regional growth  
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9 processes in the EU.  
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15 [INSERT TABLE 6 AROUND HERE]  
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## 18 **5. Conclusions**

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21 Throughout the preceding pages, we have examined the possible link between income  
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23 polarization and economic performance in 61 EU regions during the period 1993-2003.  
24  
25 As far as we are aware, this factor had never before been considered in any of the  
26  
27 numerous works devoted to explaining regional growth processes in the European  
28  
29 setting. Nevertheless, as we have shown, there are various theoretical arguments that  
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31 suggest that income polarization may affect economic growth. To study this issue, we  
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33 have estimated the degree of income polarization registered within the EU regions by  
34  
35 applying the approach proposed by ESTEBAN and RAY (1994) and ESTEBAN *et al.*  
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37 (2007). The different measures calculated show that polarization levels vary  
38  
39 considerably across the EU. In this respect, it is worth mentioning that, despite some  
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41 exceptions can be observed, the regions with the most polarized income distributions  
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43 tend to be located mainly in the southern periphery of the Union.  
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50 Although the limited time-frame and the nature of the study implies that any  
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52 conclusions should be treated with caution, our analysis indicates that economic growth  
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54 is negatively correlated with the level of income polarization at the beginning of the  
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56 study period. This finding is in fact robust to the inclusion in the analysis of additional  
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58 explanatory variables, such as the initial level of per capita GDP, the sectoral  
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3 composition of economic activity, human capital stock, population density and market  
4 potential. Likewise, the observed negative correlation between income polarization and  
5 economic growth does not depend on the number of groups used to analyse the degree  
6 of income stratification within the sample regions.  
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12 The analysis carried out in this article raises a series of implications of potential interest  
13 to European regional policy-makers, whose ultimate goal is to guarantee economic and  
14 social cohesion within the EU by reducing territorial imbalances (EUROPEAN  
15 COMMISSION, 2004). The empirical evidence presented in this respect appears to  
16 suggest that public intervention through programs planned to reduce the degree of  
17 polarization in the income distribution may help to boost regional growth, which is a  
18 possibility that has so far remained unexplored by EU regional policy designers.  
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20 Nevertheless, this recommendation should be considered with some degree of caution,  
21 since it cannot be overlooked that the redistribution of resources could introduce  
22 distortions in individual investment decisions, which might ultimately hamper economic  
23 growth (ALESINA and RODRIK, 1994; PERSON and TABELLINI, 1994). Prior to the  
24 introduction of specific redistributive policies, therefore, a detailed analysis should be  
25 made of their potential effect on economic performance.  
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43 Additional extensions to our work are not difficult to conceive. Some of them relate  
44 directly to the improvement of existing data on income distribution within the various  
45 EU regions. As we have been able to observe in this article, the recent development of  
46 the ECHP is an important step towards this objective. However, the time frame covered  
47 by the ECHP is relatively short, which prevents the long term analysis of the  
48 relationship between income polarization and economic growth, and limits the  
49 possibility of applying panel data techniques in this context. Likewise, future research  
50 should pay particular attention to the need to analyse the various theoretical mechanisms  
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3 explaining the influence of the degree of income polarization on the economic  
4 performance of EU regions. This would allow us to identify exactly the channels  
5 through which income polarization affects economic growth, which is an issue  
6 especially relevant from the economic policy perspective.  
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## 12 **Acknowledgments**

13  
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15 The authors would like to thank two anonymous referees for their helpful comments and  
16 suggestions. The usual disclaimer applies. Financial support from Spanish MEC  
17 (Project SEJ2005-08738-C02-01 and Programme Juan de la Cierva) is gratefully  
18 acknowledged.  
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## Appendix

The data on income distribution within the EU regions used in this article were taken



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3 from the European Community Household Panel (ECHP). The ECHP is a harmonized  
4 cross-national longitudinal survey focusing on social and economic conditions in the  
5 EU, conducted in various member states under the control of the Statistical Office of the  
6 European Communities (Eurostat, 1996). It includes regionally disaggregated data on  
7 income, work and employment, poverty and exclusion, education, housing, health, and  
8 other social indicators of living conditions. It is important to note that Eurostat (1998,  
9 1999) has checked the reliability of the ECHP data against other national sources.  
10 Although existing methodological differences must be taken into account in such  
11 comparisons, the results obtained confirm the quality of the ECHP data.  
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25 The ECHP is based on a representative panel of individuals and households in the 15  
26 EU member states prior to the 2004 and 2007 enlargements. Note, however, as already  
27 stated in the introduction, that the time frame considered in the article is restricted by  
28 the scope of the ECHP. In this respect, it is worth mentioning that, while the ECHP  
29 survey was first conducted 1994, the personal income data refer to the situation of  
30 individuals and households in 1993. For this year there is information in the survey  
31 corresponding to 149,306 individuals and 71,367 households.  
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42 In order to achieve the aims of the article, we aggregated the ECHP data for 61 NUTS-1  
43 regions belonging to eight countries: Belgium, Germany, Spain, France, Greece, Italy,  
44 Portugal and the United Kingdom (see Table 1 for further details)<sup>v</sup>. The reason for using  
45 NUTS-1 regions in the analysis is that no finer level of territorial disaggregation is  
46 provided by the ECHP. This should be taken into account when assessing our findings  
47 since, as occurs in any analysis based on spatial data, the level of territorial  
48 disaggregation used may influence on the results (MAGRINI, 2004).  
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58 Additionally, the data on GDP, population and sectoral employment used in the analysis  
59 are drawn from the Cambridge Econometrics European regional database. The Eurostat  
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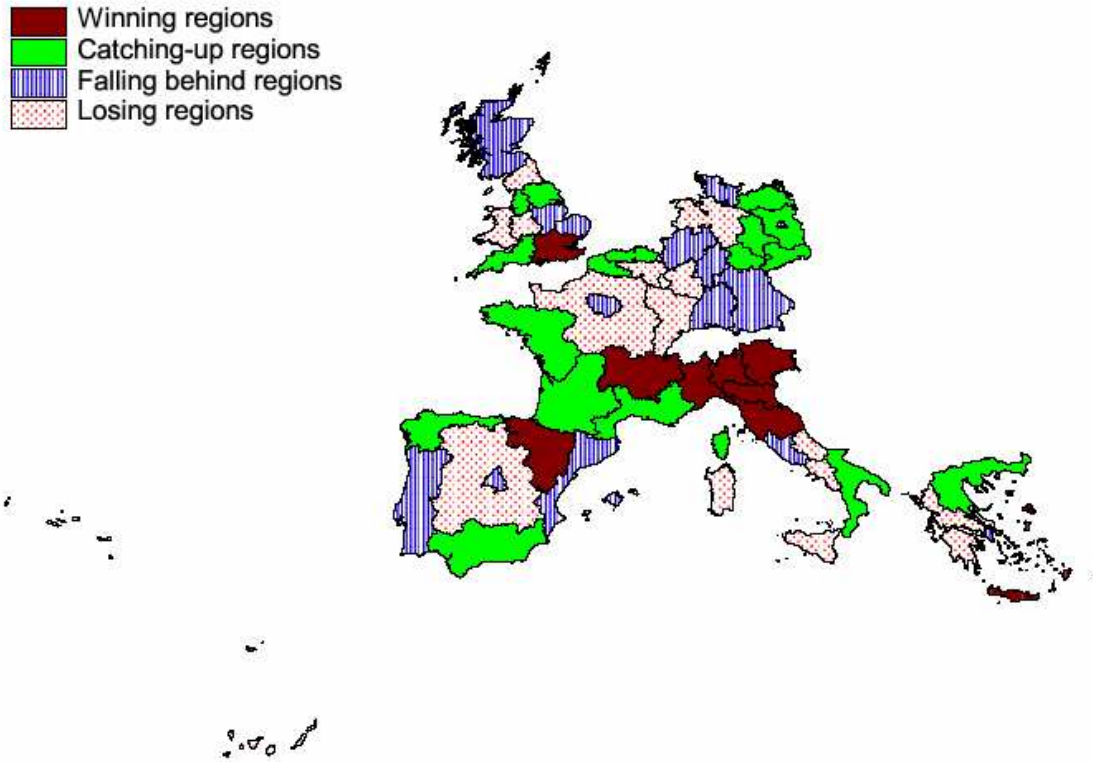
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3 Regio database is the prime source of raw data for the Cambridge Econometrics  
4 database. However, Regio is seriously lacking in some respects, especially in the case of  
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6 certain specific countries. For this reason, and in order to achieve comprehensive  
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8 coverage, Cambridge Econometrics has opted to complete Eurostat data with more  
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10 detailed information from national statistics offices.  
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## Figures and Tables

Figure 1: Growth patterns in the EU throughout the period 1993-2003: A regional typology.



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Table 1: Income polarization in the European regions.

Partition Region	Generalized measure of polarization ( $P^{EGR}$ index)								
	Two groups			Three groups			Four groups		
	$\delta=1$	$\delta=1.3$	$\delta=1.6$	$\delta=1$	$\delta=1.3$	$\delta=1.6$	$\delta=1$	$\delta=1.3$	$\delta=1.6$
Bruxelles-Brussels (be1)	0.134	0.092	0.058	0.152	0.098	0.060	0.169	0.087	0.052
Vlaams Gewest (be2)	0.119	0.082	0.053	0.127	0.081	0.048	0.111	0.067	0.038
Région Wallonne (be3)	0.123	0.083	0.052	0.134	0.086	0.051	0.116	0.069	0.038
Baden-Württemberg (de1)	0.122	0.084	0.053	0.126	0.080	0.048	0.112	0.068	0.039
Bayern (de2)	0.130	0.090	0.059	0.137	0.091	0.057	0.116	0.070	0.040
Berlin (de3)	0.119	0.082	0.052	0.123	0.078	0.046	0.107	0.064	0.035
Brandenburg (de4)	0.114	0.077	0.047	0.122	0.077	0.044	0.109	0.065	0.036
Bremen (de5)	0.107	0.073	0.046	0.111	0.070	0.040	0.103	0.064	0.038
Hamburg (de6)	0.138	0.096	0.063	0.132	0.084	0.049	0.119	0.071	0.040
Hessen (de7)	0.141	0.100	0.067	0.142	0.095	0.062	0.117	0.070	0.039
Mecklenburg-Vorpommern (de8)	0.107	0.072	0.044	0.109	0.068	0.038	0.098	0.058	0.032
Niedersachsen (de9)	0.125	0.086	0.055	0.128	0.082	0.049	0.113	0.068	0.038
Nordrhein-Westfalen (dea)	0.132	0.091	0.059	0.135	0.087	0.052	0.119	0.072	0.041
Sachsen (ded)	0.098	0.065	0.038	0.109	0.068	0.038	0.095	0.055	0.029
Sachsen-Anhalt (dee)	0.085	0.055	0.030	0.098	0.062	0.036	0.089	0.053	0.030
Schleswig-Holstein (def)	0.112	0.075	0.045	0.133	0.088	0.056	0.111	0.066	0.037
Thüringen (deg)	0.094	0.063	0.039	0.101	0.064	0.038	0.087	0.051	0.028
Rheinland-Pfalz and Saarland (dex)	0.117	0.081	0.052	0.118	0.075	0.044	0.102	0.060	0.033
Noroeste (es1)	0.133	0.091	0.057	0.146	0.095	0.058	0.122	0.072	0.039
Noreste (es2)	0.128	0.088	0.056	0.135	0.086	0.051	0.118	0.071	0.039
Comunidad de Madrid (es3)	0.139	0.098	0.065	0.144	0.094	0.058	0.125	0.076	0.044
Centro (es4)	0.141	0.098	0.063	0.149	0.095	0.057	0.128	0.077	0.043
Este (es5)	0.136	0.095	0.062	0.142	0.090	0.054	0.124	0.075	0.042
Sur (es6)	0.148	0.103	0.068	0.157	0.102	0.062	0.134	0.080	0.045
Canarias (es7)	0.168	0.121	0.083	0.166	0.106	0.064	0.148	0.091	0.053
Île de France (fr1)	0.163	0.116	0.080	0.173	0.114	0.072	0.153	0.096	0.057

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4	Bassin Parisien (fr2)	0.128	0.087	0.054	0.139	0.088	0.052	0.123	0.074	0.041
5	Nord - Pas-de-Calais (fr3)	0.155	0.116	0.074	0.152	0.097	0.058	0.134	0.081	0.045
6	Est (fr4)	0.118	0.080	0.050	0.129	0.083	0.050	0.109	0.063	0.034
7	Ouest (fr5)	0.119	0.082	0.053	0.120	0.076	0.045	0.106	0.063	0.035
8	Sud-Ouest (fr6)	0.164	0.118	0.082	0.175	0.115	0.074	0.156	0.099	0.061
9	Centre-Est (fr7)	0.136	0.095	0.062	0.141	0.090	0.054	0.124	0.075	0.043
10	Méditerranée (fr8)	0.148	0.103	0.068	0.153	0.098	0.059	0.132	0.079	0.044
11	Voreia Ellada (gr1)	0.170	0.120	0.079	0.177	0.116	0.072	0.153	0.094	0.054
12	Kentriki Ellada (gr2)	0.157	0.109	0.070	0.163	0.104	0.062	0.145	0.089	0.052
13	Attiki (gr3)	0.130	0.089	0.056	0.141	0.091	0.055	0.122	0.073	0.041
14	Nisia Aigaiou, Kriti (gr4)	0.143	0.098	0.062	0.157	0.101	0.061	0.137	0.083	0.046
15	Nord Ovest (it1)	0.122	0.083	0.051	0.128	0.080	0.045	0.114	0.068	0.038
16	Lombardia (it2)	0.111	0.074	0.045	0.125	0.080	0.047	0.111	0.067	0.038
17	Nord Est (it3)	0.118	0.080	0.048	0.132	0.084	0.050	0.115	0.069	0.038
18	Emilia-Romagna (it4)	0.119	0.081	0.051	0.127	0.082	0.050	0.111	0.067	0.037
19	Centro (it5)	0.112	0.075	0.045	0.120	0.075	0.042	0.109	0.066	0.037
20	Lazio (it6)	0.140	0.097	0.062	0.147	0.097	0.057	0.125	0.074	0.040
21	Abruzzo-Molise (it7)	0.129	0.088	0.054	0.136	0.085	0.050	0.120	0.071	0.039
22	Campania (it8)	0.137	0.093	0.059	0.145	0.092	0.055	0.127	0.076	0.043
23	Sud (it9)	0.139	0.095	0.059	0.149	0.094	0.055	0.129	0.077	0.042
24	Sicilia (ita)	0.158	0.109	0.071	0.166	0.109	0.068	0.140	0.083	0.046
25	Sardegna (itb)	0.144	0.097	0.058	0.166	0.108	0.066	0.143	0.086	0.048
26	Continente (pt1)	0.164	0.116	0.077	0.167	0.108	0.065	0.146	0.088	0.050
27	Açores (pt2)	0.203	0.149	0.107	0.200	0.133	0.085	0.174	0.109	0.065
28	Madeira (pt3)	0.167	0.121	0.085	0.162	0.106	0.065	0.143	0.088	0.051
29	North (uk1)	0.118	0.081	0.051	0.124	0.078	0.046	0.108	0.064	0.036
30	Yorkshire and Humberside (uk2)	0.132	0.090	0.055	0.145	0.093	0.055	0.124	0.073	0.040
31	East Midlands (uk3)	0.131	0.090	0.057	0.136	0.087	0.051	0.117	0.070	0.038
32	East Anglia (uk4)	0.139	0.096	0.062	0.140	0.089	0.053	0.123	0.074	0.041
33	South East (uk5)	0.147	0.102	0.066	0.151	0.096	0.057	0.132	0.080	0.045
34	South West (uk6)	0.139	0.096	0.062	0.139	0.088	0.051	0.125	0.076	0.043
35	West Midlands (uk7)	0.149	0.104	0.067	0.145	0.092	0.053	0.130	0.078	0.044
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North West (uk8)	0.131	0.090	0.056	0.142	0.091	0.054	0.123	0.074	0.041
Wales (uk9)	0.150	0.106	0.070	0.154	0.101	0.062	0.131	0.079	0.044
Scotland (uka)	0.144	0.100	0.064	0.145	0.092	0.053	0.132	0.080	0.045
<i>Average</i>	0.134	0.093	0.060	0.141	0.090	0.054	0.124	0.074	0.042
<i>Standard deviation</i>	0.020	0.016	0.013	0.019	0.013	0.009	0.017	0.011	0.007
<i>Minimum</i>	0.085	0.055	0.030	0.098	0.062	0.036	0.087	0.051	0.028
<i>Maximum</i>	0.203	0.149	0.107	0.200	0.133	0.085	0.174	0.109	0.065

Note: All the values were calculated for 1993. NUTS codes in parentheses.

Table 2: Kendall's rank correlation coefficients between  $P^{EGR}$  and various inequality measures.

Partition	Generalized measure of polarization ( $P^{EGR}$ )					
	Two groups		Three groups		Four groups	
Inequality indices	$\delta = 1$	$\delta = 1.6$	$\delta = 1$	$\delta = 1.6$	$\delta = 1$	$\delta = 1.6$
$G$	0.753***	0.665***	0.870***	0.758***	0.878***	0.807***
$GE(0)$	0.622***	0.525***	0.718***	0.627***	0.739***	0.668***
$GE(1)$	0.680***	0.597***	0.792***	0.706***	0.798***	0.745***
$A(0.5)$	0.675***	0.582***	0.790***	0.689***	0.813***	0.746***
$A(2)$	0.215**	0.184**	0.281***	0.259***	0.266***	0.242***

Note: \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

Table 3: Analysis of the variance of polarization measures.

Generalized measure of polarization ( $P^{EGR}$ )						
Partition	Two groups		Three groups		Four groups	
Regional category	$\delta = 1$	$\delta = 1.6$	$\delta = 1$	$\delta = 1.6$	$\delta = 1$	$\delta = 1.6$
Winning regions <sup>(a)</sup>	0.930	0.913	0.934	0.918	0.943	0.944
Catching-up regions <sup>(a)</sup>	0.970	0.954	0.978	0.967	0.973	0.966
Falling behind regions <sup>(a)</sup>	1.036	1.053	1.033	1.050	1.040	1.047
Losing regions <sup>(a)</sup>	1.035	1.043	1.028	1.031	1.019	1.019
F-test	3.41**	3.13**	3.39**	3.04**	2.88**	2.33*

Notes: (1) \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%. (2) <sup>(a)</sup> Average value of the polarization measure in the category in question. Regional indices were normalized according to the national average.



Table 4: Regional growth and income polarization in the two-group case.

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	2.569*** (0.524)	2.108*** (0.381)	2.820*** (0.527)	2.388*** (0.408)	4.036*** (1.243)	3.591*** (1.245)	4.115*** (1.260)	3.607*** (1.247)
$P^{EGR}(f, \delta = 1, \rho^*)$	-1.569*** (0.501)		-1.302*** (0.398)		-1.301*** (0.407)		-1.527*** (0.426)	
$P^{EGR}(f, \delta = 1.6, \rho^*)$		-1.108*** (0.358)		-0.886*** (0.285)		-0.825*** (0.302)		-0.998*** (0.308)
Per capita GDP			-0.518*** (0.178)	-0.502*** (0.176)	-0.574* (0.300)	-0.600* (0.309)		
Emp. share in agriculture					-0.191 (0.139)	-0.211 (0.143)	-0.117 (0.136)	-0.135 (0.139)
Emp. share in manufacturing					-0.698*** (0.229)	-0.676*** (0.239)	-0.697*** (0.232)	-0.671*** (0.243)
Emp. share in market services					0.349 (0.590)	0.348 (0.616)	-0.178 (0.667)	-0.196 (0.696)
Emp. share in non-market services					-1.327*** (0.456)	-1.352*** (0.464)	-1.097** (0.434)	-1.112** (0.440)
Pop. share with secondary education					0.301 (0.297)	0.320 (0.309)	0.238 (0.292)	0.255 (0.302)
Pop. share with tertiary education					0.415***	0.420***	0.459***	0.466***

					(0.133)	(0.138)	(0.135)	(0.141)
Population density					-0.132	-0.134	-0.147	-0.149
					(0.116)	(0.117)	(0.109)	(0.110)
Market potential					0.121	0.117	-0.050	-0.067
					(0.301)	(0.307)	(0.306)	(0.312)
F-test	9.79***	9.58***	6.31***	6.23***	5.23***	5.08***	4.97***	4.85***
Test for spatial dependence	0.768	0.747	0.629	0.622	10.997	10.630	8.160	7.861
Condition number	18.71	13.42	22.77	16.36	94.40	92.41	89.14	87.53
R-squared	0.183	0.178	0.289	0.276	0.538	0.520	0.507	0.487

Notes: (1) The dependent variable is in all cases the annual growth rate of the sample regions during the study period. (2) All the variables were normalized according to the national average. (3) Standard errors in parentheses. The reported standard errors are based on the heteroskedasticity consistent estimator of the covariance matrix of the regression coefficients proposed by White (1980). (4) \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

Table 5: Regional growth and income polarization in the three-group case.

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	2.712*** (0.575)	2.238*** (0.410)	2.990*** (0.574)	2.563*** (0.437)	4.196*** (1.284)	3.565*** (1.277)	4.303*** (1.310)	3.591*** (1.281)
$P^{EGR}(f, \delta = 1, \rho^*)$	-1.712*** (0.554)		-1.451*** (0.445)		-1.512*** (0.411)		-1.763*** (0.435)	
$P^{EGR}(f, \delta = 1.6, \rho^*)$		-1.238*** (0.387)		-1.032*** (0.309)		-0.961*** (0.282)		-1.161*** (0.291)
Per capita GDP			-0.539*** (0.183)	-0.531*** (0.179)	-0.526* (0.280)	-0.510* (0.289)		
Emp. share in agriculture					-0.180 (0.135)	-0.186 (0.137)	-0.112 (0.132)	-0.117 (0.132)
Emp. share in manufacturing					-0.718*** (0.230)	-0.680*** (0.242)	-0.720*** (0.228)	-0.677*** (0.242)
Emp. share in market services					0.270 (0.564)	0.197 (0.586)	-0.216 (0.625)	-0.262 (0.639)
Emp. share in non-market services					-1.262*** (0.457)	-1.193** (0.471)	-1.043** (0.439)	-0.963** (0.449)
Pop. share with secondary education					0.278	0.276	0.217	0.210

					(0.304)	(0.318)	(0.298)	(0.312)
Pop. share with tertiary education					0.441***	0.455***	0.485***	0.497***
					(0.128)	(0.131)	(0.129)	(0.130)
Population density					-0.138	-0.143	-0.152	-0.157
					(0.118)	(0.119)	(0.111)	(0.113)
Market potential					0.152	0.180	0.001	0.038
					(0.306)	(0.317)	(0.312)	(0.320)
F-test	9.54***	10.23***	6.35***	6.79***	5.96***	5.83***	5.71***	5.69***
Test for spatial dependence	0.739	0.740	0.605	0.606	12.018	11.547	9.277	9.171
Condition number	20.97	15.24	25.52	18.60	95.40	92.35	89.84	87.42
R-squared	0.173	0.172	0.290	0.284	0.547	0.528	0.522	0.505

Notes: (1) The dependent variable is in all cases the annual growth rate of the sample regions during the study period. (2) All the variables were normalized according to the national average. (3) Standard errors in parentheses. The reported standard errors are based on the heteroskedasticity consistent estimator of the covariance matrix of the regression coefficients proposed by White (1980). (4) \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

Table 6: Regional growth and income polarization in the four-group case.

Independent variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	2.470*** (0.537)	2.113*** (0.502)	2.576*** (0.542)	2.277*** (0.483)	4.335*** (1.399)	3.815** (1.456)	4.537*** (1.432)	4.007*** (1.482)
$P^{EGR}(f, \delta = 1, \rho^*)$	-1.470*** (0.514)		-1.068** (0.424)		-1.336*** (0.464)		-1.618*** (0.451)	
$P^{EGR}(f, \delta = 1.6, \rho^*)$		-1.113** (0.478)		-0.755* (0.385)		-0.776* (0.445)		-1.066** (0.443)
Per capita GDP			-0.508*** (0.186)	-0.522*** (0.186)	-0.448 (0.293)	-0.567* (0.283)		
Emp. share in agriculture					-0.233* (0.138)	-0.250* (0.137)	-0.181 (0.134)	-0.182 (0.136)
Emp. share in manufacturing					-0.815*** (0.251)	-0.750*** (0.259)	-0.841*** (0.244)	-0.771*** (0.256)
Emp. share in market services					0.037 (0.573)	0.083 (0.609)	-0.374 (0.634)	-0.433 (0.650)
Emp. share in non-market services					-1.368*** (0.482)	-1.431*** (0.488)	-1.204** (0.460)	-1.233** (0.471)
Pop. share with secondary education					0.334 (0.306)	0.384 (0.328)	0.286 (0.297)	0.331 (0.315)
Pop. share with tertiary education					0.459***	0.453***	0.493***	0.492***

					(0.136)	(0.152)	(0.136)	(0.154)
Population density					-0.141	-0.138	-0.152	-0.151
					(0.121)	(0.124)	(0.116)	(0.120)
Market potential					0.176	0.176	0.053	0.005
					(0.300)	(0.310)	(0.300)	(0.310)
F-test	8.17***	5.43**	4.92**	4.82**	5.05***	3.98***	5.12***	3.74***
Test for spatial dependence	0.748	0.798	0.611	0.665	11.660	11.230	9.768	9.265
Condition number	20.10	16.69	24.68	20.44	99.49	96.71	92.30	90.37
R-squared	0.139	0.116	0.235	0.217	0.525	0.491	0.509	0.464

Notes: (1) The dependent variable is in all cases the annual growth rate of the sample regions during the study period. (2) All the variables were normalized according to the national average. (3) Standard errors in parentheses. The reported standard errors are based on the heteroskedasticity consistent estimator of the covariance matrix of the regression coefficients proposed by White (1980). (4) \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

Table 7: The relationship between regional growth and the two components of  $P^{EGR}$ : polarization of the simplified representation of the original distribution and within-group dispersion.

Two-group partition				
$P^{ER}(\delta = 1, \rho^*)$	$P^{ER}(\delta = 1.6, \rho^*)$	$\varepsilon(f, \rho^*)$	R-squared	Controls
-1.655*** (0.583)			0.150	NO
	-1.458*** (0.537)		0.137	NO
		-1.169* (0.585)	0.064	NO
-1.551*** (0.450)			0.543	YES
	-1.370*** (0.425)		0.535	YES
		-1.353** (0.514)	0.520	YES
Three-group partition				
$P^{ER}(\delta = 1, \rho^*)$	$P^{ER}(\delta = 1.6, \rho^*)$	$\varepsilon(f, \rho^*)$	R-squared	Controls
-1.659*** (0.586)			0.147	NO
	-1.396*** (0.504)		0.138	NO
		-1.026* (0.611)	0.053	NO
-1.541*** (0.453)			0.542	YES
	-1.242*** (0.395)		0.530	YES
		1.166** (0.521)	0.521	YES
Four-group partition				
$P^{ER}(\delta = 1, \rho^*)$	$P^{ER}(\delta = 1.6, \rho^*)$	$\varepsilon(f, \rho^*)$	R-squared	Controls
-1.526*** (0.542)			0.135	NO
	-1.334**		0.115	NO

	(0.555)			
		-1.415**	0.084	NO
		(0.684)		
	-1.421***		0.530	YES
	(0.471)			
	-1.110**		0.510	YES
	(0.482)			
		-1.583***	0.540	YES
		(0.468)		

Notes: (1) The dependent variable is in all cases the annual growth rate of the sample regions during the study period. (2) All the variables were normalized according to the national average. (3) Standard errors in parentheses. The reported standard errors are based on the heteroskedasticity consistent estimator of the covariance matrix of the regression coefficients proposed by White (1980). (4) \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%. (5) Control variables include initial per capita GDP, employment share in agriculture, manufacturing, market and non-market services, population share with secondary and tertiary education, population density and market potential.



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Table A1: Decomposition of the  $P^{EGR}$  index.

Partition Component Region	Two groups				Three groups				Four groups			
	$P^{ER}$ index		Error		$P^{ER}$ index		$\epsilon(f, \rho^*)$		$P^{ER}$ index		Error	
	$\delta=1$	$\delta=1.3$	$\delta=1.6$	$\epsilon(f, \rho^*)$	$\delta=1$	$\delta=1.3$	$\delta=1.6$	$\epsilon(f, \rho^*)$	$\delta=1$	$\delta=1.3$	$\delta=1.6$	$\epsilon(f, \rho^*)$
Bruxelles-Brussels (be1)	0.251	0.209	0.176	0.118	0.206	0.152	0.114	0.054	0.200	0.118	0.082	0.030
Vlaams Gewest (be2)	0.208	0.172	0.142	0.090	0.168	0.122	0.090	0.041	0.135	0.091	0.062	0.024
Région Wallonne (be3)	0.220	0.181	0.149	0.097	0.179	0.130	0.095	0.044	0.143	0.096	0.065	0.027
Baden-Württemberg (de1)	0.208	0.170	0.139	0.086	0.168	0.122	0.090	0.042	0.136	0.092	0.063	0.024
Bayern (de2)	0.219	0.180	0.148	0.089	0.179	0.133	0.099	0.042	0.140	0.094	0.064	0.024
Berlin (de3)	0.206	0.168	0.138	0.086	0.165	0.120	0.088	0.042	0.131	0.087	0.058	0.024
Brandenburg (de4)	0.205	0.168	0.138	0.091	0.166	0.120	0.088	0.044	0.134	0.090	0.061	0.025
Bremen (de5)	0.181	0.148	0.120	0.075	0.146	0.105	0.076	0.036	0.124	0.085	0.058	0.021
Hamburg (de6)	0.225	0.184	0.150	0.087	0.176	0.128	0.093	0.044	0.142	0.094	0.063	0.023
Hessen (de7)	0.227	0.186	0.153	0.086	0.185	0.138	0.104	0.043	0.141	0.094	0.064	0.025
Mecklenburg-Vorpommern (de8)	0.187	0.152	0.124	0.080	0.149	0.108	0.078	0.040	0.121	0.081	0.055	0.023
Niedersachsen (de9)	0.212	0.174	0.143	0.087	0.170	0.124	0.091	0.042	0.137	0.092	0.062	0.024
Nordrhein-Westfalen (dea)	0.223	0.183	0.150	0.091	0.179	0.131	0.097	0.044	0.144	0.097	0.066	0.025
Sachsen (ded)	0.182	0.148	0.121	0.084	0.148	0.107	0.077	0.039	0.118	0.079	0.053	0.023
Sachsen-Anhalt (dee)	0.163	0.133	0.108	0.078	0.136	0.100	0.074	0.038	0.110	0.074	0.050	0.021
Schleswig-Holstein (def)	0.204	0.166	0.136	0.092	0.171	0.126	0.094	0.038	0.134	0.090	0.061	0.024
Thüringen (deg)	0.163	0.132	0.108	0.069	0.132	0.095	0.069	0.031	0.105	0.069	0.046	0.018
Rheinland-Pfalz and Saarland (dex)	0.192	0.157	0.128	0.076	0.154	0.111	0.080	0.036	0.123	0.082	0.054	0.021
Noroeste (es1)	0.234	0.192	0.158	0.101	0.191	0.140	0.104	0.046	0.149	0.099	0.066	0.027
Noreste (es2)	0.221	0.182	0.149	0.093	0.179	0.130	0.095	0.044	0.143	0.096	0.064	0.025
Comunidad de Madrid (es3)	0.233	0.191	0.158	0.094	0.187	0.137	0.101	0.043	0.150	0.101	0.069	0.025
Centro (es4)	0.244	0.201	0.166	0.103	0.196	0.143	0.105	0.048	0.156	0.104	0.070	0.028
Este (es5)	0.236	0.194	0.161	0.099	0.188	0.137	0.101	0.047	0.151	0.101	0.068	0.026
Sur (es6)	0.254	0.209	0.174	0.106	0.205	0.150	0.111	0.048	0.163	0.109	0.074	0.029

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5	Canarias (es7)	0.281	0.234	0.196	0.113	0.220	0.160	0.117	0.054	0.178	0.121	0.083	0.030
6	Île de France (fr1)	0.286	0.240	0.203	0.124	0.230	0.171	0.129	0.057	0.185	0.128	0.089	0.032
7	Bassin Parisien (fr2)	0.231	0.190	0.157	0.103	0.187	0.137	0.101	0.049	0.151	0.102	0.070	0.028
8	Nord - Pas-de-Calais (fr3)	0.257	0.218	0.176	0.102	0.203	0.148	0.109	0.051	0.163	0.110	0.075	0.029
9	Est (fr4)	0.210	0.172	0.142	0.092	0.171	0.124	0.091	0.042	0.134	0.089	0.059	0.025
10	Ouest (fr5)	0.200	0.164	0.134	0.081	0.159	0.115	0.084	0.039	0.128	0.085	0.057	0.022
11	Sud-Ouest (fr6)	0.288	0.242	0.206	0.124	0.235	0.175	0.134	0.060	0.188	0.131	0.092	0.031
12	Centre-Est (fr7)	0.231	0.189	0.156	0.094	0.185	0.134	0.098	0.044	0.150	0.101	0.069	0.026
13	Méditerranée (fr8)	0.252	0.208	0.172	0.104	0.202	0.147	0.108	0.049	0.161	0.108	0.073	0.029
14	Voreia Ellada (gr1)	0.289	0.239	0.198	0.119	0.233	0.171	0.127	0.056	0.185	0.125	0.086	0.032
15	Kentriki Ellada (gr2)	0.267	0.219	0.181	0.110	0.213	0.154	0.112	0.050	0.174	0.118	0.081	0.029
16	Attiki (gr3)	0.231	0.190	0.156	0.101	0.188	0.137	0.101	0.047	0.150	0.101	0.068	0.028
17	Nisia Aigaiou, Kriti (gr4)	0.256	0.210	0.174	0.112	0.208	0.152	0.112	0.051	0.166	0.111	0.075	0.029
18	Nord Ovest (it1)	0.216	0.177	0.145	0.094	0.173	0.125	0.091	0.045	0.140	0.094	0.063	0.025
19	Lombardia (it2)	0.205	0.168	0.139	0.094	0.168	0.122	0.090	0.043	0.135	0.091	0.062	0.024
20	Nord Est (it3)	0.215	0.176	0.145	0.097	0.176	0.128	0.094	0.044	0.140	0.094	0.063	0.025
21	Emilia-Romagna (it4)	0.207	0.169	0.138	0.087	0.169	0.124	0.092	0.042	0.134	0.090	0.061	0.024
22	Centro (it5)	0.203	0.166	0.136	0.092	0.164	0.119	0.086	0.044	0.134	0.091	0.062	0.025
23	Lazio (it6)	0.240	0.197	0.162	0.100	0.194	0.143	0.104	0.047	0.152	0.101	0.067	0.027
24	Abruzzo-Molise (it7)	0.224	0.183	0.150	0.095	0.180	0.130	0.094	0.045	0.145	0.096	0.064	0.025
25	Campania (it8)	0.238	0.195	0.161	0.102	0.192	0.139	0.102	0.047	0.155	0.104	0.070	0.027
26	Sud (it9)	0.247	0.202	0.167	0.108	0.199	0.145	0.105	0.051	0.159	0.106	0.072	0.030
27	Sicilia (ita)	0.270	0.222	0.183	0.112	0.220	0.162	0.121	0.053	0.170	0.113	0.076	0.031
28	Sardegna (itb)	0.263	0.216	0.177	0.119	0.218	0.160	0.119	0.053	0.173	0.116	0.078	0.030
29	Continente (pt1)	0.277	0.229	0.190	0.113	0.220	0.161	0.118	0.053	0.176	0.119	0.081	0.031
30	Açores (pt2)	0.326	0.272	0.229	0.123	0.257	0.190	0.141	0.057	0.207	0.141	0.098	0.033
31	Madeira (pt3)	0.274	0.228	0.191	0.107	0.215	0.158	0.118	0.053	0.172	0.117	0.080	0.029
32	North (uk1)	0.205	0.168	0.138	0.087	0.165	0.120	0.087	0.041	0.132	0.088	0.060	0.024
33	Yorkshire and Humberside (uk2)	0.233	0.191	0.157	0.101	0.190	0.138	0.101	0.045	0.150	0.099	0.066	0.026
34	East Midlands (uk3)	0.224	0.183	0.150	0.094	0.180	0.130	0.095	0.044	0.144	0.096	0.064	0.026
35	East Anglia (uk4)	0.231	0.189	0.154	0.092	0.184	0.133	0.097	0.044	0.147	0.098	0.065	0.024
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South East (uk5)	0.248	0.203	0.166	0.101	0.198	0.143	0.104	0.047	0.159	0.107	0.072	0.027
South West (uk6)	0.232	0.190	0.156	0.094	0.184	0.133	0.096	0.045	0.149	0.100	0.067	0.024
West Midlands (uk7)	0.246	0.201	0.165	0.097	0.194	0.140	0.102	0.048	0.156	0.104	0.069	0.026
North West (uk8)	0.230	0.188	0.155	0.099	0.187	0.135	0.099	0.044	0.149	0.100	0.067	0.026
Wales (uk9)	0.246	0.201	0.166	0.096	0.198	0.145	0.107	0.045	0.156	0.104	0.070	0.026
Scotland (uka)	0.247	0.203	0.168	0.104	0.196	0.143	0.104	0.051	0.160	0.108	0.073	0.028
<i>Average</i>	0.231	0.190	0.157	0.097	0.187	0.136	0.100	0.046	0.150	0.100	0.068	0.026
<i>Standard deviation</i>	0.031	0.027	0.023	0.012	0.024	0.018	0.014	0.006	0.020	0.014	0.010	0.003
<i>Minimum</i>	0.163	0.132	0.108	0.069	0.132	0.095	0.069	0.031	0.105	0.069	0.046	0.018
<i>Maximum</i>	0.326	0.272	0.229	0.124	0.257	0.190	0.141	0.060	0.207	0.141	0.098	0.033

Note: All the values were calculated for 1993. NUTS codes in parentheses.

Table A2: Kendall's rank correlation coefficients between the  $P^{EGR}$  indices obtained with different values of the polarization sensitivity parameter.

Partition	Two groups	Three groups	Four groups
$\delta = 1, \delta = 1.3$	0.947***	0.938***	0.938***
$\delta = 1, \delta = 1.6$	0.898***	0.867***	0.869***
$\delta = 1.3, \delta = 1.6$	0.942***	0.925***	0.914***

Note: \* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%.

## Notes

<sup>i</sup>NUTS is the French acronym for “Nomenclature of Territorial Units for Statistics”, a hierarchical classification of subnational spatial units established by Eurostat. In this classification NUTS-0 corresponds to country level and increasing numbers indicate increasing levels of subnational disaggregation.

<sup>ii</sup>See the Appendix for further details on the regions and data employed in the article.

<sup>iii</sup>Note that in this case there is no overlapping between the various groups, since the decomposition of the Gini index into between-group and within-group inequality is exact (PYATT, 1976).

<sup>iv</sup>This choice is due to the fact that, as mentioned above, the formulation of  $P^{ER}$  is similar to that of the Gini index. The second term in expression (3) is in fact the difference between two Gini indices. It is therefore reasonable to select in empirical analyses a value of  $\delta$  equal to the unit (DURO, 2005).

<sup>v</sup>It is worth mentioning that Rheinland-Pfalz and Saarland are considered as a single region in the ECHP. In turn, lack of regional data in the ECHP has obliged us to exclude from our study the French overseas departments and Northern Ireland.