Dynamics of regional income inequality in Europe and impact of EU regional policy and EMU

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Abstract

This paper analyzes the evolution of per capita income inequality among European regions during the period 1977-2003. After examining the trend in inequality measured with conventional inequality indices, I consider two types of variations within the income distribution. First, interregional inequality is decomposed in its between-country and within-country components. Second, using a rank-size function, I check whether inequality varies with regions' ranks in the income distribution. Overall, inequality has decreased since 1977, owing to a decrease in between-country inequality, and despite an increase in within-country since the mid-1990s. Inequality has moreover been greater among low-income regions than among high-income regions. I then examine whether the establishment of EMU, and changes in some demographic, macroeconomic, and policy-related factors help explain the aforementioned inequality variations. The panel analysis suggests that EMU has so far contributed to a reduction in regional inequality in richer EU countries, while it has exacerbated regional disparities among poorer countries.

- *Keywords*: income inequality, European Union, EMU, regional disparities
- *JEL Codes*: R11, O52, E65

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1 Introduction

Regional disparities and inequalities in Europe have been the object of extensive research over the last decade[1]. Several factors can explain this widespread interest. First, the revival of growth theory (Romer, 1990; Aghion and Howitt, 1998) was contemporaneous to a growing empirical literature on economic convergence (Sala-i-Martin, 2006; Barro and Sala-i-Martin, 1991, 1992, 1995; Quah, 1997, 1996; de la Fuente, 2000). Most of the empirical literature reports that, in Europe, the process of absolute convergence observed for decades has slowed down almost to an halt during the 1980s and early 1990s (Boldrin and Canova, 2001; Neven and Gouyette, 1995; Magrini, 1999), at a time when economic integration was pursued further. Second, reducing regional disparities has been one of the most explicit and resolute goals of the European Union (EU)[2], which has consequently devoted an increasing share of its budget to its regional policy.

Concerns about the impact of economic integration on regional disparities have been revived by the establishment of the Single Market and of the Economic and Monetary Union (EMU). So far, most of the debate on the impact of the common currency has been focused on national economic conditions. Thus, the convergence criteria (price stability, low interest rate, stable exchange rates, and limited government debts and deficits) that countries need to satisfy in order to qualify for the common currency and the Cohesion Fund eligibility criteria[3] are based on national macroeconomic variables[4]. Meanwhile, impact of the euro on European regions has received much less intention, even though it is also very critical to guarantee the economic and social cohesion sought by the European Union (Martin, 2001; Thirlwall, 2000).

The current literature offers various and often conflicting models to explain whether regional

[1]Braunerhjelm et al. (2000); Puga (1999); Boldrin and Canova (2001); Basile et al. (2001); Neven and Gouyette (1995); Crespo-Cuaresma et al. (2002); Dunford (1993) among others.

[2]Article 158 of the Treaty establishing the European Community for instance states that "the Community shall aim at reducing disparities between levels of development of the various regions and the backwardness of the least favored regions or islands, including rural areas".

[3]The Cohesion fund was established in 1994 to contribute to the fulfilment of the conditions of economic convergence as set out in Article 104c of the Treaty establishing the European Community.

[4]Countries qualify for the Cohesion funds when their per capita gross national products (GNP), measured in purchasing power parities, of less than 90 % of the Community average.

disparities will or will not disappear with further economic integration. Optimal Currency Area theory[5] considers that the adoption of a common currency brings both advantages and disadvantages. Lower transaction costs provide more price transparency and less exchange rate uncertainty, which ultimately promotes economic growth in the monetary union. But the absence of independent exchange rate and monetary policy would make it harder to tackle asymmetric shocks given the current lack of labor mobility across EU countries and regions. For proponents of neoclassical precepts, disparities are bound to disappear because of diminishing returns to capital. By promoting free movements of factors of production, further integration would lead to a more efficient resource allocation, and thus economic growth. To contrast with this approach, contributions to the new economic geography theory argue that, by promoting trade and factor mobility, deeper economic integration will create new opportunities of economies of scale, activity specialization and economic agglomeration, which could generate regional disparities in growth and factor accumulation, and thus economic divergence (Krugman, 1991a,b).

On empirical grounds, the literature on the EMU has not yet eliminated these theoretical doubts. On the one hand, EMU is expected to bring more macroeconomic stability, notably in Southern EU countries, which could promote a more equal income distribution. But on the other hand, labor market rigidities, notably in Southern Europe, would make these countries more vulnerable to asymmetric shocks (Ardy et al., 2002; Barry and Begg, 2003; Barry, 2003; Begg, 2003). Padoa-Schioppa (1987) also concluded that the increased competition induced by further integration and improved price transparency could put more pressure on the less developed member states, which could ultimately lead to more inequalities. Yet, the loss of competition could internally induce a reduction in regional disparities in those countries, as only the more advanced regions in the country compete on the international market (Petrakos and Saratis, 2000).

To assess the impact of EMU on regional cohesion, this paper investigates the dynamics of regional income inequality among 197 European regions between 1977 and 2003. The

[5](Kenen, 1969; Mundell, 1961; McKinnon, 1962; Mongeli, 2002).

empirical analysis focuses on per capital income distribution as opposed to personal income distribution, because the former is a more appropriate scale to examine the effects of economic integration (such as EMU) on income disparities. The overall level of systemic inequality is measured with indices commonly used to study personal income disparities (Atkinson, 2003; Partridge et al., 1996; Beblo and Knaus, 2001; Heshmati, 2004) but, until recently, rarely employed to assess regional aggregate income distribution. This method does not however detect whether inequality is greater among some subgroups of regions, and smaller among other ones. To address this issues, the dynamics of per capita income distribution are studied in two complementary ways. First, I check whether within or between-country inequalities drives inequality across European regions. Using a rank-size function, I then follow Fan and Casetti (1994)'s approach and examine the extent to which inequality varies with a region's rank within the income distribution.

Finally, the role played by EMU in shaping interregional income inequality is more specifically assessed with a panel data analysis that relates inequality measures to national demographic, macroeconomic and policy characteristics.

The paper is organized as follows. Section 2 discusses the data and methodology used to measure interregional inequality. Section 3 presents the evolution of interregional inequality. Section 4 looks at variation in inequality between and within countries, as well as variation within the income distribution. The panel analysis of the determinants of inequality is carried out in Section 5. Finally, Section 6 summarizes the main conclusions.

2 Data and methodology

I examine the distribution of per capita income across EU regions between 1977 and 2003. Inequality measures are calculated for 197 NUTS2[6] regions from the following 13 EU countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Netherlands, Portugal,

[6]NUTS (Nomenclature of Territorial Units for Statistics) corresponds to Eurostat's classification of subnational spatial units where NUTS0 refers to country level data and increasing numbers indicate increasing levels of subnational disaggregation.

Spain, Sweden, the UK. Ireland and Luxembourg are not included because each was categorized as one region in the nomenclature; thus it is impossible to calculate within-country inequality. All of the countries are included in the analysis from 1977 to 2003, regardless of when they joined the EU. Like Ezcurra and Rapún (2006), I exclude the region of Groningen in the Netherlands, because a change in the Dutch national accounting method in the mid 1980s creates an artificial jump in the inequality measures[7]. I also exclude Eastern Länder in Germany in order to keep the sample of regions constant. The possible impact of these Länder on inequality is discussed in the next section.

The GDP data are compiled by Cambridge Econometrics which provides a balanced panel of European regional data. The GDP variable is expressed in Purchasing Power Parity (PPP) because market exchange rate do not account for differences in relative prices across countries. Each region' PPP per capita GDP has been scaled relative to EU15 average PPP per capita income. I also use time series instead of random years because the latter might not be representative of the overall evolution of inequality in Europe.

3 Inequality dynamics: 1977-2003

3.1 Trend in overall inequality

The trend of overall inequality is captured with seven of the most commonly used inequality measures: (1)Gini Index, (2)General Entropy measure with parameter 1 (GE(1), also referred as income-weighted Theil index), (3)General Entropy measure with parameter 0 (GE(0), also referred as population-weighted Theil index), (4)Coefficient of Variation (COV), (5)Standard Deviation of the logs (SDL), (6)Gibrat Index, (7)Pareto index (Clementi and Gallegati, 2005, 2006; Guilmi et al., 2003). The formulas used to compute these measures are reported in Appendix A. I use a rank-size function to obtain an additional inequality measure, namely the power-law exponent. This technique is usually applied in urban economics where cities

[7]Before the reform, the revenue from gas and oil of the North Sea were allocated to the region of Groningen, while afterwards, the revenues were distributed to the whole country.

are ranked according to their populations in order to assess the level of urban concentration[8]. In the context of this paper, a region's size is captured by its PPP per capita income. The rank-size function describes the relation between a region's per capita income and its ranking when regions are ordered in descending order (i.e. the wealthiest region in the sample has a rank equal to one and the least favored a rank equal to 197). To obtain the power-law exponent, I regress logged per capita income (y) on logged rank[9]:

$$\ln y = a + q \ln rank. \tag{1}$$

The absolute value of the slope (q) is referred as power law exponent, and corresponds to a measure of inequality: the higher the absolute value of q the more unequal the income distribution across regions.

Figure 1 illustrates the temporal patterns of the aforementioned inequality indices. All of the indices show a remarkably similar trend of EU-wide inequality over time. Overall, inequality has decreased between 1977 and 2003. The Gini index, COV and SDL measures decreased respectively by 10%, 8.78% and 10.91% while the Generalized Entropy measures fell by 21% over the same 26 years. The larger decrease in the GE(0) measure which is more sensitive to changes at the bottom of the income distribution, provides evidence that less-favored regions have partly caught up with richer regions. These results are very close to the findings of Duro (2004), despite slight differences in the number of regions included in the analysis[10].

Several phases can be discerned within the 26 years covered in this study. After a sharp fall in inequality between 1979 and 1982, the mid 1980s were marked by an increase in regional disparities. This increase suggests that inequality shows a countercyclical pattern[11]. After a short fall between 1986 and 1989, inequality rose again in the early 1990s (as European

[8]Midelfart et al. (2003); Krugman (1996); Nitsche (2005); Gabaix (1999); Brakman et al. (1999)

[9]The associated R-squared range from 0.800 to 0.8517.

[10]Duro (2004) includes German Eastern Länder after 1991 and includes Austria, Finland and Sweden from 1995 to 1997.

[11]See Artis et al. (1997) for European business cycles peak and through

economies were heading towards the 1993 recession), and dramatically dropped between 1992 and 1993. Since then, regional disparities have kept a downward trajectory, and have experienced a much smaller variation than in the 1980s. One should also note that the smoother trend begins in 1993, which coincides with the ratification of the Maastricht Treaty and the adjustment period before the establishment of EMU.

To make more sense out of these statistics, the EU inequality measures need to be compared to some benchmark so that one can determined whether inequality has been high or low. One possible gauge is the United States (US) which have similar economic and population sizes. Moreover, since the US constitute a more integrated economy than the EU, it could be used to predict future trend in regional inequality in Europe. Inequality has been consistently wider among European regions than among US states. In 1989 for instance, Fan and Casetti (1994) estimate that the coefficient of variation was 0.1865, the Shannon entropy index (similar to the GE(1) index) reached 0.0238, and the power-law exponent equaled 0.1941. The 1989 values of the same measures computed for EU regions are 0.288 for the coefficient of variation, 0.0393 for the GE(1) index, and 0.2663 for the power-law exponent. In the same year, Ram (1992) found that the GE(0) index among US states was equal to 0.012, which corresponds to one third of the European GE(0) index plotted in Figure 1. Similarly, Boldrin and Canova (2001) find that European regional inequalities are twice those of the USA when measured either by the standard deviation of per capita income or the ratio of the top to bottom decile of regions. So if one accepts the US as a reference point, regional disparities in Europe should be viewed as quite wide.

Besides differences in level, the EU and USA have experienced different trends. Fan and Casetti (1994) find that inequality in the USA decreases between 1950 and 1975 and then increased from 1975 and 1989. More recently, Tsionas (2000) finds that, between 1977 and 1996, there has been no sigma-convergence among US states. The absence of reduction in disparities across US states in the 1990s thus contrasts with the downward trend observed in Europe.

So far, the analysis provides a general overview of inequality among EU regions but does

not offer any insights about disparities that could exist among or within countries. This issue is addressed in Section 3.2 which compares national inequality levels and trends.

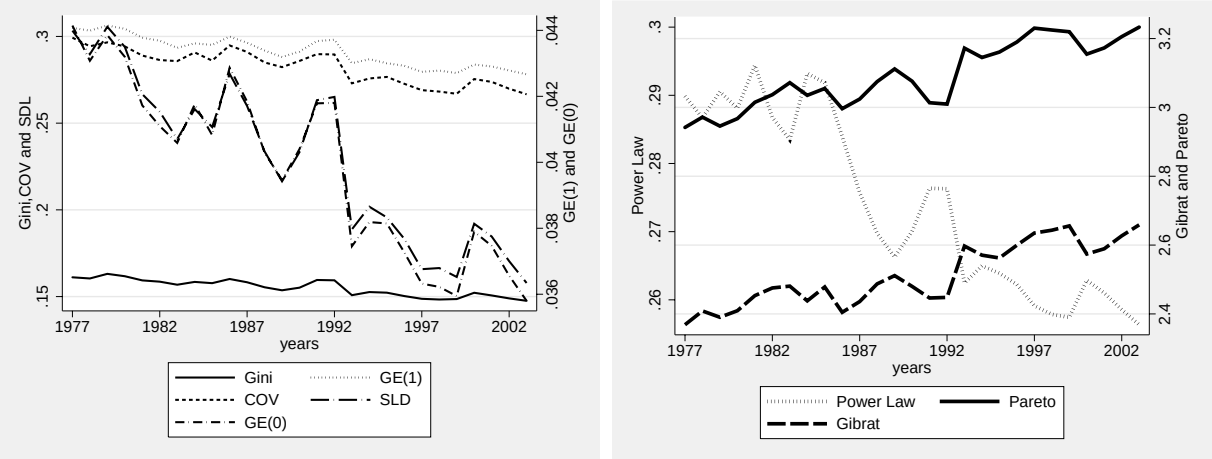

Figure 1: Inequality across EU regions

3.2 National inequality trends

3.2.1 Comparison of the level of inequality in EU countries

The next three figures plot the evolution of three main inequality measures by country. Figure 2 presents the GE(1) index by country, Figure 3 the GE(0) index, and Figure 4 the Gini index. Levels of inequality vary significantly from one country to another. Belgium emerges as the country that has consistently experienced the highest levels of inequality. Denmark and France have the lowest levels of inequality. These two facts support the conclusion of Felsenstein and Portnov (2005) that it is incorrect to assume that small countries exhibit smaller regional disparities. Sweden is the only country where the level of inequality varies significantly with the inequality measure. Sweden would be considered a low-inequality country based on the Gini and GE(1) indices, but a high-inequality country according to its GE(0) index, which suggests that inequality exists mostly in the low tail of the income distribution.

Countries can also be distinguished by the range their inequality measures take. Austria, Greece, the Netherlands and Portugal have experienced wider ranges of inequality levels, while

inequality has been more stable in France, Denmark, Spain, and Germany. It is important to keep in mind that German inequality measures presented for Germany do not include Eastern Länder. The estimations in Duro (2004) confirm that inequality increases sharply once these German regions are added to the population of regions. One year after the 1990 reunification, the GE(0) index had increased by 45%, the GE(1) index had increased by 36.6%, and the Gini index rose by 10%. Yet the author notes that, soon after the German reunification, inequality fell sharply in the early 1990s. Because Cambridge Econometrics database does not include PPP per capita income for these regions prior to 1997, I am not able to replicate Duro (2004)'s finding. Yet, I do obtain that, for 1997 to 2003 inequality measures (EU-wide measures and German measures) rise if Eastern Länder are included, but only by a small percentage (less than 2% after 1998). Given the data limitation and the small percentage change aforementioned, excluding these 12 Eastern German regions should not affect the robustness of this paper's conclusions.

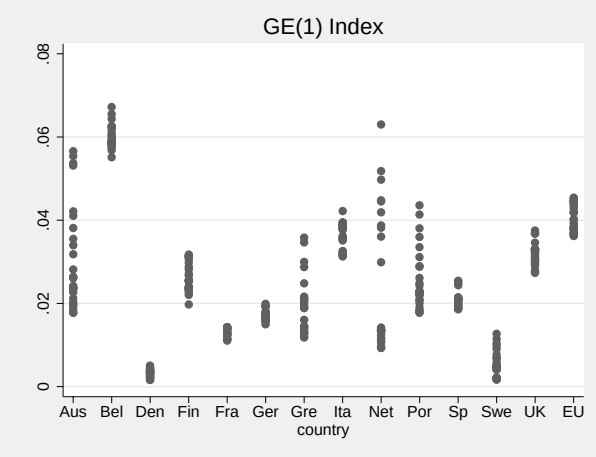

Figure 2: Interregional inequality measured by the GE(1) index, by country and for the EU, 1977-2003
Note: Each data point represents one year and country.

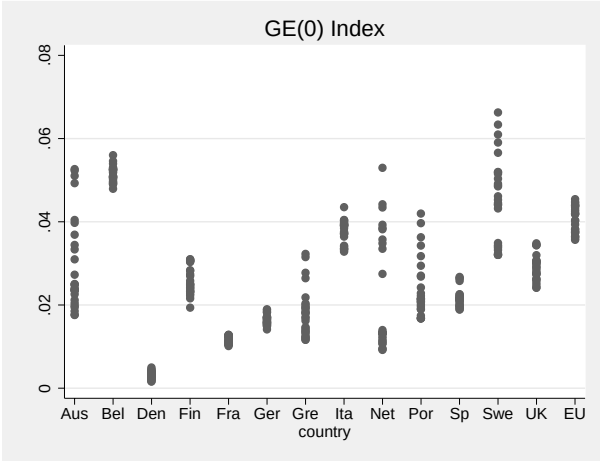

Figure 3: Interregional inequality measured by the GE(0) index, by country and for the EU, 1977-2003
Note: Each data point represents one year and country.

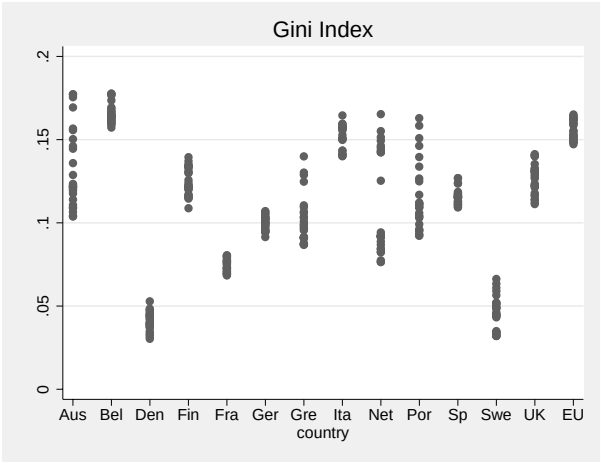

Figure 4: Interregional inequality measured by the Gini index, by country and for the EU, 1977-2003
Note: Each data point represents one year and country.

3.2.2 Trends in each EU countries

To get a better sense of the evolution of national income inequality, Figures 5 and 6 illustrate the same inequality estimates from a different perspective, by plotting inequality measures for each country against time. Countries have experienced trends very different from the one depicted in Figure 1, and can be classified in five categories: those who experienced (1)a decrease in inequality, (2)an increase in inequality, (3)a U-shaped trend, (4)an inverted U-shaped trend, and (5)no clear trend. Because all of the inequality measures depict the same trend in each country, the following comments and statistics are thus based only on the GE(1)

index.

Four countries have experienced significant decrease in inequality over the last three decades: Austria (decrease by 60%), Greece (decrease by 65%), Portugal (decrease by 40%) and Italy (decrease by 15%). The fall in inequality was steeper in Austria and Italy in the 1980s. In Greece, the sharp drop in inequality occurs with the early 1980s, which coincides with its accession to the EU, with a major increase in government spending on welfare policies (Manessiotis and Reischauer, 2001). Inequality fell in Portugal at a relative constant pace between 1977 and 1995, before slightly increasing between 1995 and 1998. Regional disparities in Germany, Sweden and the United Kingdom have on the other hand widened. The GE(1) index grew by 22% in Germany (with and without the Eastern Länder), by 34% in the UK, and by 561% in Sweden. This dramatic surge in Swedish inequality happened mostly after 1995. Inequality in the next three countries has displayed a non-linear trend. Inequality in France is characterized by an inverted U-shaped trend, as it leveled off at higher levels between 1985 and 1995. The trends in Finland and the Netherlands have the opposite shape, as inequality decreased sharply in the early 1980s, and increased again in the late 1990s. One should also note that the recent increase was more pronounced in Finland. Finally, Denmark, Belgium and Spain have not experienced any clear trend in their inequality levels. Regional disparities were stable in Denmark until 1988, and then increased until the mid-1990s before returning to their initial levels. Inequality among Spanish provinces peaked in 1981-1983, before sharply falling between 1985 and 1995, and have since slightly increased. Regional disparities have remained high and stable in Belgium.

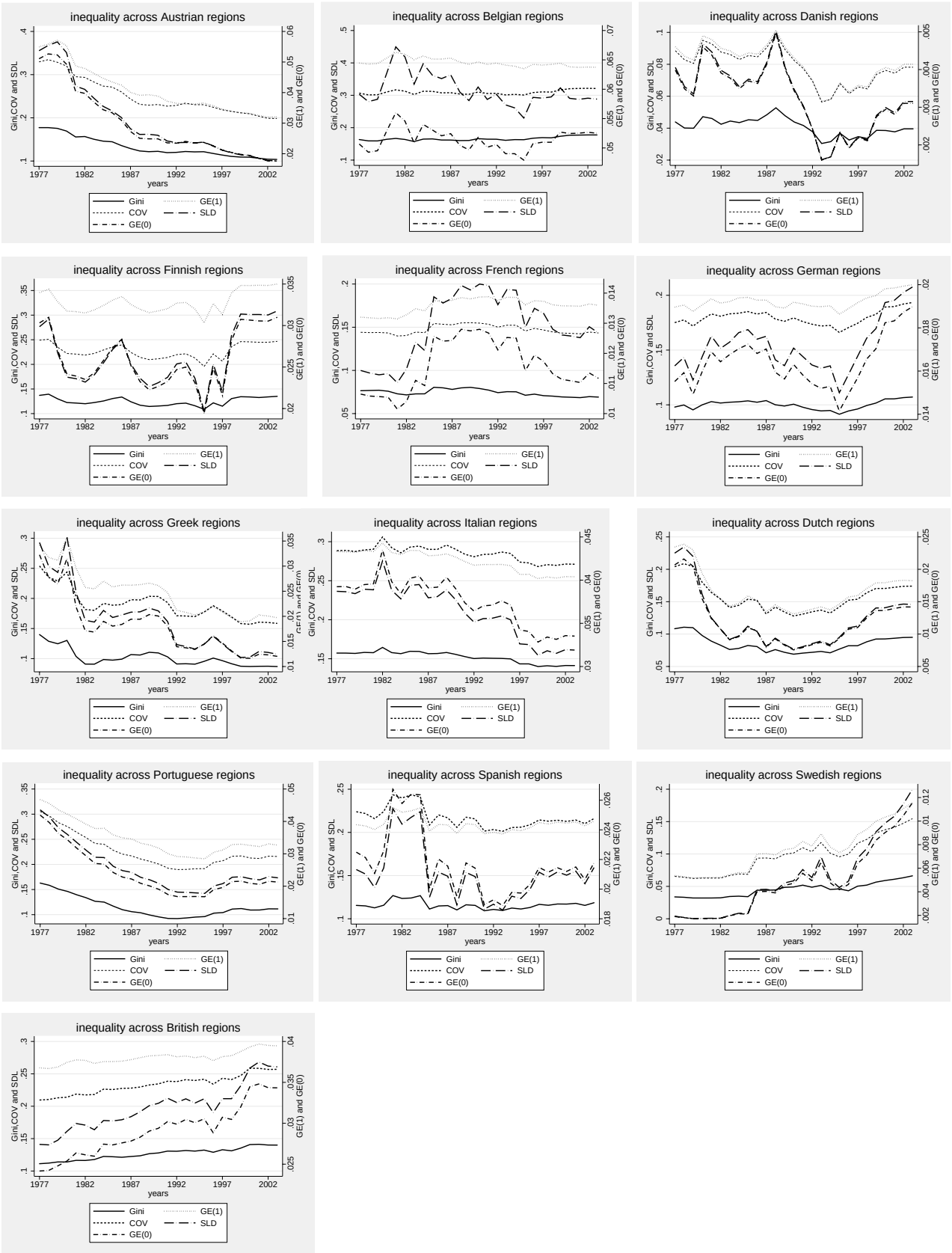

Figure 5: Inequality within EU countries

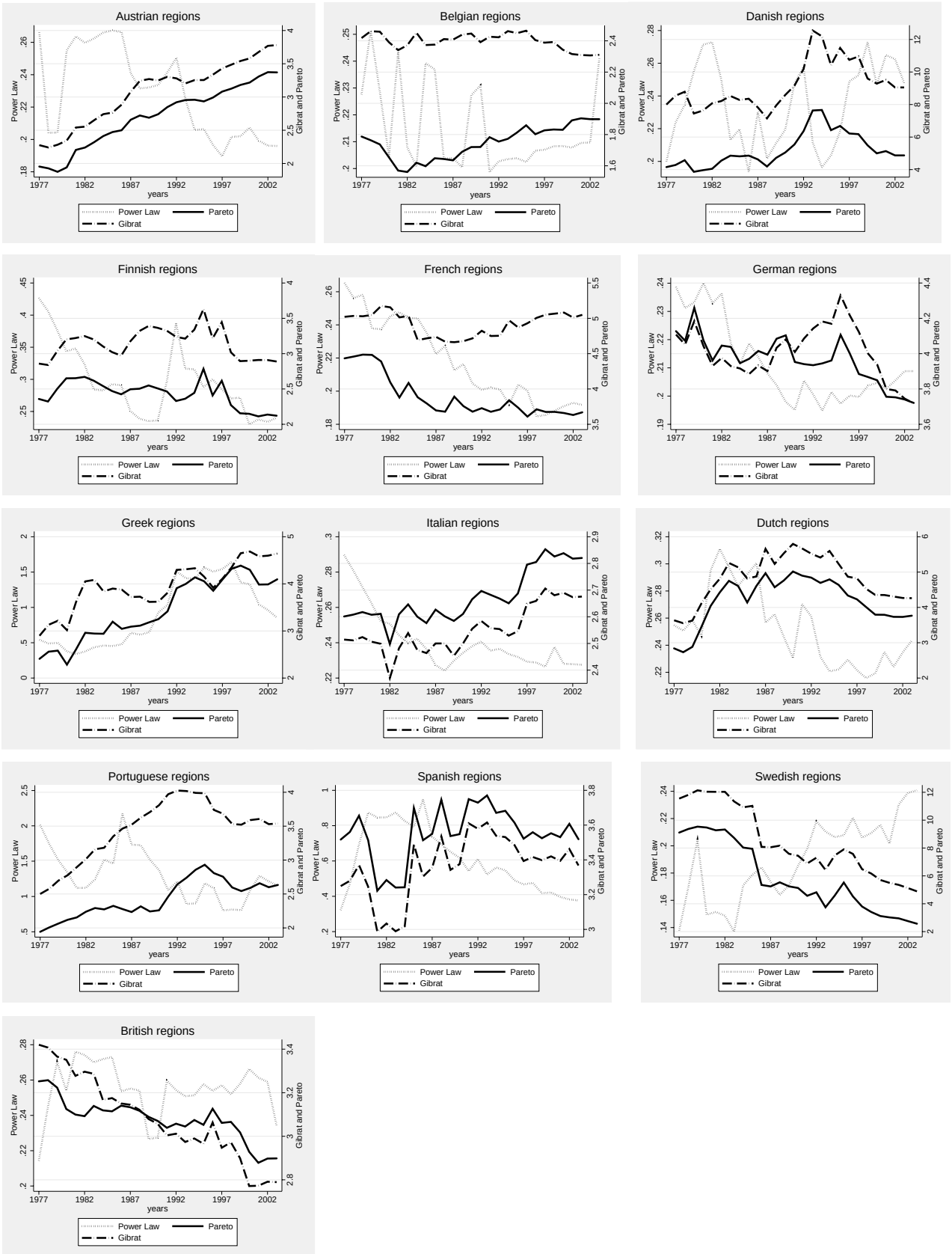

Figure 6: Inequality within EU countries: Pareto, Gibrat and Power law indices

4 Inequality variations

The conventional inequality measures used in Section 3 capture the overall spread of per capita income distribution, but do not provide any insight about variation within the distribution. In addition to variation across countries and over time, inequality among European regions can be further analyzed with two complementary approaches. First one can distinguish inequality within and between-countries. Second, I check whether inequality is homogenous throughout the income distribution or whether it varies with a region's ranking.

4.1 Inequality decomposition

The decomposition of inequality is carried out using the GE(1) index because, like the other Generalized Entropy measures, it is conform to five key axioms (presented in Appendix B) that one usually requires inequality measures to meet (Cowell, 2000; Bouguignon, 1979; López-Rodríguez and Faiña, 2006; Litchfield, 1999). The Generalized Entropy class of measures can easily be decomposed into within-group and between-group inequality: $I_{total} = I_{between} + I_{within}$. The decomposition is based on GE(1) instead of the GE(0), because the latter attributes more weight to the bottom of the distribution (i.e. to the poorer regions), while the former applies equal weight across the distribution. I checked the robustness of the results presented in this section by performing the same analysis with the GE(0) index, and the results were very similar.

Figure 7 represents the evolution of the overall GE(1) index and its between and within components over time. It clearly appears that the level of overall inequality is mostly due to within inequality. As indicated in Figure 8, within-country inequality accounted for 60% of overall inequality until 1995[12]. Its share in total inequality then started to increase until it

[12]Because this increase in within-country inequality started in 1995, and coincides with the increase in inequality among Swedish regions, I checked whether the trend of the within component could have been driven by the evolution of domestic inequality in Sweden. When the decomposition is estimated without

reached 70% by 2003. Yet, it is the between-country inequality that explains the variation in overall inequality. It is clear, for instance, on Figure 7 that the increase in inequality in the early 1990s was due to a rise in between-country inequality. Moreover, since 1995, the decrease in between-country inequality was large enough to offset the slight increase in within-country inequality, and to cause a decrease in overall inequality. This reduction in inequality between EU countries has been mostly driven by the success of Cohesion countries (Spain, Portugal, Ireland and to a lesser extent Greece) at converging with the rest of the EU (European Commission, 2001).

Even though US inequality has followed a different trend, its decomposition into between and within inequalities suggests a pattern similar to European inequality decomposition. Most of the inequality among US states also comes from within-group inequality. When the 49 contiguous US states are grouped into four regions, the share of within-group inequality oscillates between 73% and 87.5% from 1950 to 1989 (Fan and Casetti, 1994).

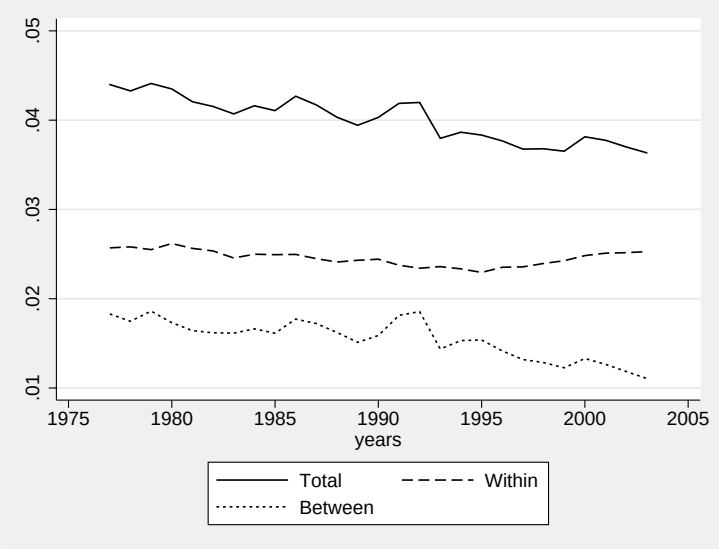

Figure 7: Decomposition of the GE(1) index

Sweden, the increase in the late 1990s persists.

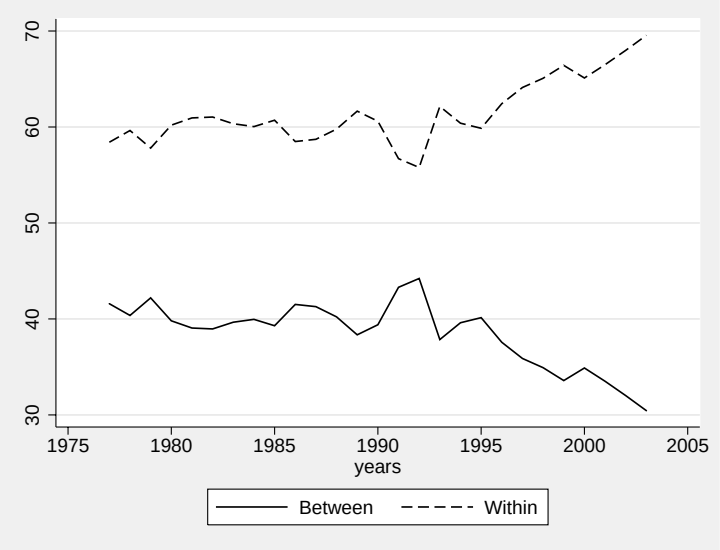

Figure 8: Shares of between and within inequality in the GE(1) index

4.2 Does inequality varies with a region's rank in the income distribution?

The decomposition performed in the previous section suggests that inequality between countries is much lower than among regions from the same country. Besides checking variation of inequality with the size of the geographic units (countries or regions) considered, inequality could also vary among groups of regions depending on these regions' positions in the income distribution.

The rank-size function used in Section 3 to compute the power-law exponent provides only a measure of the overall systemic inequality, because it assumes that inequality between all of the regions follows the same law. If inequality was similar throughout the income distribution, points on the scatterplot would form a straight line, with a slope equal to the power law exponent. Yet, when logged regional PPP per capita incomes are plotted against logged ranks (Figure 9), the slope (i.e. the power-law exponent) tends to be steeper at lower ranks (ranks between 110 and 197 for this paper). This implies that, like for US states (Fan and Casetti, 1994), inequality is higher among low-income regions than among high-income regions.

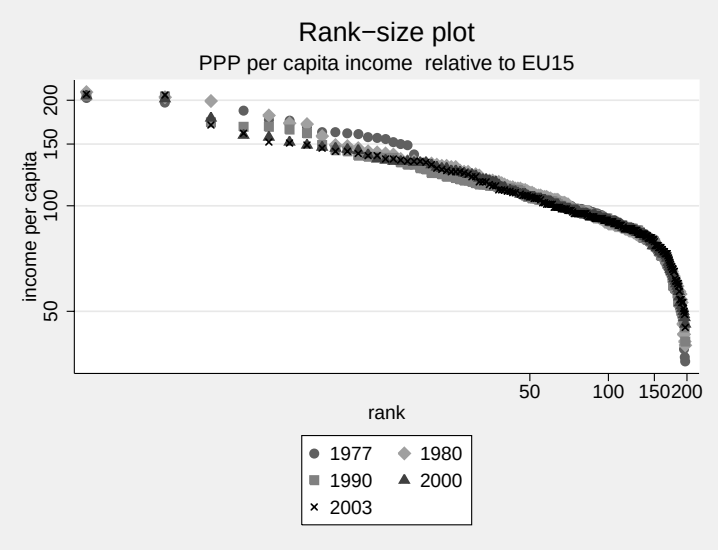

Figure 9: Rank-size plots

This non-linearity can be further studied by expanding the rank-size equation. Fan and Casetti (1994) suggest making the slope a function of the rank or the rank squared, so that the rank-size specification can be rewritten as:

$$\ln y = a + q_0 \ln rank + q_1 rank * \ln rank \tag{2}$$

$$\ln y = a + q_0 \ln rank + q_1 rank^2 * \ln rank \tag{3}$$

In both specifications, a negative and significant coefficient q_1 implies that, as the rank gets larger, inequality increases with the rank. As reported in Table 1, inequality does increase with the rank, but this effect has decreased over time, with the exception of the second half of the 1990s. Both sets of estimates for q_1 are smaller in absolute value than those obtained by Fan and Casetti (1994) for US states, which suggests that the disparities between high-income regions and low-income regions are more acute in Europe than in the US.

The findings presented in Section 4 have strong policy implications. First, the predominance of within-country inequality over between-country inequality suggests that structural policies

Table 1: Estimates of the expanded rank-size function

	q as a function of r			q as a function of r^2		
	q_1	p-value	Wald Chi square	q_1	p-value	Wald Chi square
1977-1979	-0.0147	0.064	404.5	-3.70E-05	0.051	1260.46
1980-1984	-0.0012	0	6308.21	-5.09E-06	0	40300.57
1985-1989	-0.0012	0	2047.39	-4.71E-06	0	16530.16
1990-1994	-0.0011	0	7480.46	-4.76E-06	0	2618.32
1995-1999	-0.0013	0	506.26	-4.75E-06	0	13256.08
2000-2003	-0.0011	0	4107.71	-5.72E-06	0	6796.46

designed to reduce economic and social disparities within the EU should be elaborated at the regional level, and not at the national level. Moreover, given that more inequality exists among the least favored European regions, funding should be extensively concentrated on regions at the bottom of the income distribution. These two conclusions call into question the current set-up of EU regional policy. Beyond its apparent desire to reduce interregional income inequalities, EU aid is not necessarily correlated with regional development gap or development potential (Fayolle and Lecuyer, 2000). Only objective-1 funds (which represented 70% of the funds allocated to the Structural Funds program between 1989 and 1999) are truly devoted to the poorest regions, those of which per capita GDP is below 75% of the EU average[13]. To further discuss the efficacy of the current EU regional policy it would be also interesting to examine whether the Cohesion Fund[14] received by Spain, Portugal, Greece and Ireland, has induced the reduction in between-country inequality, since its creation coincides with the recent downward trend in between-country inequality.

[13]Objectives 2 and 3 concern aid for industry-restructuring that affects mostly regions that were formerly prosperous, while the remaining objectives target "social cohesion".

[14]According to regulation No 1164/94 of 16 May 1994, a Member State is eligible for Cohesion Fund if it has a per capita gross national product (GNP), measured in purchasing power parities, of less than 90 % of the Community average.

5 EMU and inequality: A panel analysis

In this section, the analysis goes beyond the description of variation in income inequality over time and across countries, and examines possible explanations for the evolution described in Sections 3 and 4. More specifically, I check whether EMU has contributed to the recent decrease in inequality. So far there has been no consensus in the literature about the possible effect of monetary union on inequality and cohesion within the EU (Barry and Begg, 2003; Begg, 2003). On the one hand, further economic expansion is thought to favor core countries at the expense of the periphery because, according to the new economic geography[15], economic activity would tend to concentrate further in core regions and countries. Moreover, by inducing deeper industrial specialization, EMU might increase the risk of asymmetric shocks (Midelfart et al., 2003; Ardy et al., 2002). Yet Begg (2003) notes that, so far, the core countries have suffered from the advent of euro, and have experienced slower growth than countries at the periphery of the EU. On the other hand, Ardy et al. (2002); Begg (2003) argue that EMU could lead to more cohesion (i.e. less inequality) because it will promote macroeconomic stability in countries that had previously poor inflation records, such as Greece and Portugal. These countries might however be penalized by the lack of flexibility of their labor markets (Ardy et al., 2002; Barry and Begg, 2003; Begg, 2003), which would make them more vulnerable to asymmetric shocks. Barry and Begg (2003) conclude that the effects of EMU will be more pronounced in countries that to change the most in order to participate in EMU.

The explanatory variables considered fall into four broad categories: demographics, macroeconomic stability, fiscal policy, and EU integration. The first three groups of explanatory variables have been commonly used in papers studying the determinants of personal income distribution (Gustafson and Johansson, 1999; Halsag and Taylor, 1993). The demographic variables are the percentage of the national population that less than 15 year-old ($Young$) and over 65 year-old (Old), the female labor force participation rate ($FLFPR$), the share of employment in agriculture[16] ($Agri$), the share of employment in manufacture ($Manuf$).

[15]Fujita et al. (1999); Martin (2002); Brülhart and Tortensson (1996); Puga (1999).
[16]Bourguignon and Morrisson (1998); Breen and Garcia-Peñalosa (2005).

Large manufacturing sectors are usually associated with better salaries and more job security than services jobs (W.N. Grubb, 1989; Gustafson and Johansson, 1999), while young workers usually face less job security. Income is likely to be less equally distributed among people over 60-65 year old because pension payments are most of the time earning-related, and thus reflect cumulated unequal earnings (Beblo and Knaus, 2001). Owing to Mincer's observation that women married in low-income families tend to be more active in the labor market than wives of high income men (Mincer, 1962), I expect female labor force participation rate to have a negative effect on inequality.

In Section 3, plots of inequality measures suggest that inequality tends to rise during economic downturns. Business cycles tend indeed to be associated with reversal in inequality trends (Sala-i-Martin, 2006; Gramlich, 1974). Thus, following Blinder and Esaki (1978) and Breen and Garcia-Peñalosa (2005), I include some controls for macroeconomic stability, namely the growth rate of real GDP ($Growth$), the inflation rate ($Inflation$) and the unemployment rate ($Unempl$). I use social transfers as a percentage of GDP ($Social$) as a policy variable (Gustafson and Johansson, 1999; Beblo and Knaus, 2001). The effect of EMU on inequality is first captured by a dummy variable that is equal to 1 when a country has adopted the common currency[17] and zero otherwise. Moreover, because countries had to satisfy convergence criteria[18] in order to enter the third stage of EMU and adopt the euro, the

[17] 1999 for Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, and 2001 for Greece.

[18] The four main criteria are based on Article 121(1) of the European Community Treaty.

- Price stability. In practice, the inflation rate of a given Member State must not exceed by more than 1 percentage points that of the three best-performing Member States in terms of price stability during the year preceding the examination of the situation in that Member State.
- Government finances. In practice, the Commission, when drawing up its annual recommendation to the Council of Finance Ministers, examines compliance with budgetary discipline on the basis of the following two criteria:
  - the annual government deficit: the ratio of the annual government deficit to gross domestic product (GDP) must not exceed 3% at the end of the preceding financial year.
  - government debt: the ratio of gross government debt to GDP must not exceed 60% at the end of the preceding financial year.
- Exchange Rates. The Member State must have participated in the exchange-rate mechanism of the European monetary system without any break during the two years preceding the examination of the situation and without severe tensions. In addition, it must not have devalued its currency (i.e. the

effect of EMU could have been felt prior to 1999. I therefore include one dummy variable ($Maastricht$) that takes a value of 1 from 1993 to 2003 (and 0 otherwise), to capture the effect of the Treaty of the European Union which entered into force in 1993 and started the negotiations on monetary union. I also add a dummy variable to capture the effect of the Stability and Growth Pact (SGP) that was adopted in 1997 to ensure that countries would keep respecting the convergence criteria before and after adopting the common currency. This variable takes a value equal to 1 for 1997 and the subsequent years. Finally, to distinguish the effects of EMU from those of EU trade integration, I proxy the latter with the share of intra-EU trade ($EUtrade$) in total trade:

$$Intra - EUtrade_{i,t} = \frac{X_{i,t}^{EU} + M_{i,t}^{EU}}{X_{i,t} + M_{i,t}} \tag{4}$$

where trade is measured as the sum of exports (X) and imports (M).

To determine whether changes in these variables can be used to predict changes in inequality, inequality is estimated as a function of the contemporaneous values of the aforementioned explanatory variables.

$$\begin{aligned} inequality_{i,t} = \beta_0 &+ \beta_1 Growth_{i,t} + \beta_2 Manuf_{i,t} + \beta_3 Agri_{i,t} + \beta_4 FLPR_{i,t} \\ &+ \beta_5 Unempl_{i,t} + \beta_6 Inflation_{i,t} + \beta_7 Young_{i,t} \\ &+ \beta_8 Old_{i,t} + \beta_9 Social_{i,t} + \beta_{10} EMU_{i,t} \\ &+ \beta_{11} Maastricht_t + \beta_{12} SGP_t + EUtrade_{i,t} + u_{i,t} \end{aligned} \tag{5}$$

The error term, $u_{i,t}$, is defined as: $u_{i,t} = \gamma_i + \eta_t + \varepsilon_{i,t}$ where γ_i is time-invariant and denotes any country-specific effect not included in the regression, η_t is a year dummy variable, and

bilateral central rate for its currency against any other Member State's currency) on its own initiative during the same period.

- Long-term interest rates. In practice, the nominal long-term interest rate must not exceed by more than 2 percentage points that of, at most, the three best-performing Member States in terms of price stability.

$\varepsilon_{i,t}$ denotes the remainder disturbance. By assumption, $E(\varepsilon_{i,t}) = 0$ and $Var(\varepsilon_{i,t}) = \sigma^2$. The panel data is estimated with a fixed-effect model because country-specific effects, γ_i, may be correlated with the regressors.

The regression results are reported in Table 2. Inequality is first measured as the GE(1) index (columns 1 and 2) and is computed for each of the 13 countries included in the panel. The demographic factors tend to have a larger economic impact on inequality than macroeconomic stability considerations. Inequality is larger in countries with lower female labor force participation rates, and smaller manufacturing sectors. A one percentage-point increase in female labor force participation rate for instance is associated with a decrease in inequality measure by 0.0011, which represents 4.35% of the index' average. The manufacturing sector has an impact of the same economic significance. Inequality across regions also decreases with price stability. A one percentage point decrease in the inflation rate is associated with a 0.0003 decrease in inequality, which corresponds to 1.2% of the average GE(1) index. Unemployment and GDP growth do not have a significant impact on inequality. In terms of fiscal policy, social transfers do not affect inequality either. While there is no evidence that EMU has had any effect on inequality, deeper trade integration has been associated with larger inequality, corroborating the new economic geography predictions and the fears raised by Padoa-Schioppa (1987). A one percentage-point increase in intra-EU trade is associated with an increase in the GE(1) index by 0.0002 or 8%.

I investigate the sensitivity of the results to the inequality measure used as the dependent variable, and estimate Equation 5 with the GE(0) index and the Gini index. The results are reported in columns 3 and 4 of Table 2. Overall the effects of the manufacturing sector, female labor force participation rate and inflation are quite robust. The coefficients are also larger when the Gini index is used as the dependent variable. Moreover, with the Gini index, the coefficient on social transfers is negative and statistically significant. A one percentage-point increase in the share of social transfers in GDP is associated with a 3.16% decrease in inequality. When the two alternative inequality measures are used, the results suggest that countries that have joined the EMU have experienced lower levels of inequality, while deeper

trade integration has no longer any effect. On average, countries in EMU had inequality that was almost 20% lower than in non-EMU countries, everything else held constant. The effects of the monetary union on inequality was not felt prior to the launching of EMU, as indicated by the statistically insignificant coefficient on the *Maastricht* and *SGP* variables.

Table 2: The Determinants of Inequality in the EU

	(1)	(2)	(3)	(4)
	GE(1)	GE(1)	GE(0)	Gini
Growth rate of real GDP	0.0001	0.00004	0.0001	0.00004
	[0.0002]	[0.0002]	[0.0002]	[0.0004]
Share of employment in manufacturing sector	-0.0013***	-0.0014***	-0.0012***	-0.0032***
	[0.0003]	[0.0003]	[0.0003]	[0.0006]
Share of employment in agriculture	-0.0003	-0.0001	0.00002	-0.0001
	[0.0002]	[0.0002]	[0.0002]	[0.0006]
Female Labor Force Participation rate	-0.0011***	-0.0011***	-0.0011***	-0.0022***
	[0.0002]	[0.0002]	[0.0002]	[0.0003]
Unemployment rate	0.0003	0.0002	0.0003	0.0007*
	[0.0002]	[0.0002]	[0.0002]	[0.0004]
Inflation rate	0.0003***	0.0003***	0.0003*	0.0006*
	[0.0001]	[0.0001]	[0.0001]	[0.0003]
Share of population <15 year-old	-0.0004	-0.00002	0.0003	-0.0002
	[0.0004]	[0.0004]	[0.0005]	[0.0010]
Share of population >65 year-old	0.0006	0.0008	0.0011	0.0026
	[0.0006]	[0.0007]	[0.0008]	[0.0016]
Social Transfers other than in kind as a % of GDP	-0.0001	-0.0002	-0.0002	-0.0008**
	[0.0002]	[0.0002]	[0.0002]	[0.0004]
EMU	-0.0013	-0.0011	-0.0050**	-0.0064*
	[0.0014]	[0.0013]	[0.0021]	[0.0037]
Intra-EU trade		0.0002**	0.0001	0.0002
		[0.0001]	[0.0001]	[0.0003]
Maastricht		-0.00001	-0.0004	-0.0022
		[0.0014]	[0.0015]	[0.0030]
Stability and Growth Pact		0.0007	-0.00001	-0.0005
		[0.0017]	[0.0019]	[0.0039]
Constant	0.1199***	0.0902***	0.0856***	0.2598***
	[0.0212]	[0.0193]	[0.0235]	[0.0482]
Observations	282	281	281	281
Number of countries	13	13	13	13
R-squared	0.534	0.543	0.474	0.485

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Following the literature on the effect of EMU on interregional disparities[19] that generally emphasizes the effects of EMU on Cohesion countries, I run the same analysis on two sub-samples of countries. The first group includes the three Cohesion countries included in this

[19](Barry and Begg, 2003; Barry, 2003; Begg, 2003; Midelfart et al., 2003; Artis et al., 1997)

paper's sample: Greece, Spain and Portugal. The other sub-sample includes the other ten countries. Results are reported respectively in Tables 3 and 4. For the Cohesion countries, the smaller number of observations induces strong multicollinearity between the dummy variables used to capture the effects of the Stability and Growth Pact and of the Maastricht Treaty, and the year dummy variables. The latter are therefore dropped from the specification used for this group of countries. Interestingly, the determinants of inequality in the Cohesion countries are quite different from those obtained for the entire sample of countries. Large manufacturing sectors are still associated with less inequality, whereas large agricultural sectors and high unemployment rates are now associated with larger inequality. Inflation is still positively correlated with inequality. Regarding EU integration, EMU and the Stability and Growth Pact are now positively associated with inequality. Inequality measures were respectively 20% and 27% higher after countries joined the EMU and after the implementation of the convergence criteria. The transition to EMU has thus been more painful for these countries that were used to high levels of inflation. This finding corroborates Eichengreen and Leblang (2003)'s conclusions that when the monetary regime operates as an engine of deflation, it significantly slows down growth, and that this effect can be particularly disadvantageous in poorer countries. These last results also suggest that the gains in macroeconomic stability have not offset potential losses in cohesion induced by the lack of flexibility in the labor markets, further specialization and economic activity concentration (Midelfart et al., 2003). Trade integration and the Maastricht treaty do not have any significant effect on inequality in Cohesion countries.

Inequality in the other 10 countries is driven by a distinct set of factors. Larger manufacturing sector and higher female labor force participation rate are associated with less inequality. The coefficients on the age-related variables are now in line with my hypotheses: countries with larger shares of their populations less than 15 year-old or over 65 year-old experience more inequality. Macroeconomic instability does not have any significant impact, but larger social transfers are now associated with less inequality. This latter result could suggest that transfers affect inequality once they have reached a certain threshold. Between 1977 and

2003, Cohesion countries annually spent on average 13% of their GDP on social transfers (other than in kind), while this share was 18% among the other ten countries. Overall, EU integration has been associated with further reduction in inequality among this group of more developed countries. Joining EMU is associated with a decrease in inequality only when this one is estimated with the population-weighted index. This suggests that the effect of EMU is concentrated on the lower tail of the income distribution (i.e. on the least favored regions). The implementation of the Treaty of the European Union has been associated with a more robust decline in inequality, as indicated by the negative and statistically significant coefficient on the *Maastricht* variable. This effect ranges from a decrease of 8.73% (Gini index) to 16.4% (GE(0) index). Similarly, inequality was 2.7% (Gini index) to 10.4% (GE(0) index) lower after the implementation of the convergence criteria. The adjustments for joining EMU seem therefore to have been costly in terms of cohesion, but rewarded in the long-run by less inequality, once EMU was implemented. Trade integration has also contributed, albeit modestly, to decreasing inequality (a one percentage point increase in the share of intra-EU trade is associated with a decline in inequality by 0.13 to 1%).

Table 3: The Determinants of Inequality in Cohesion countries

	(1)	(2)	(3)	(4)
	GE(1)	GE(1)	GE(0)	Gini
Growth rate of real GDP	0.0001	0.00001	0.0001	0.00001
	[0.0002]	[0.0002]	[0.0002]	[0.0006]
Share of employment in manufacturing sector	-0.0009**	-0.0008**	-0.0008**	-0.0034***
	[0.0003]	[0.0003]	[0.0003]	[0.0011]
Share of employment in agriculture	0.0009***	0.0008***	0.0007**	0.0015*
	[0.0003]	[0.0003]	[0.0003]	[0.0009]
Female Labor Force Participation rate	-0.0004	-0.0004	-0.0005*	-0.0011
	[0.0003]	[0.0003]	[0.0003]	[0.0009]
Unemployment rate	0.0003	0.0004**	0.0004*	0.0013**
	[0.0002]	[0.0002]	[0.0002]	[0.0006]
Inflation rate	0.0003***	0.0004***	0.0004***	0.0012***
	[0.0001]	[0.0001]	[0.0001]	[0.0004]
Share of population < 15 year-old	-0.0005	0.0001	0.0003	0.0017
	[0.0007]	[0.0012]	[0.0012]	[0.0034]
Share of population >65 year-old	0.0012	0.0011	0.0016	0.0032
	[0.0016]	[0.0025]	[0.0024]	[0.0076]
Social Transfers other than in kind as a % of GDP	-0.0004	-0.0002	-0.0002	-0.0009
	[0.0004]	[0.0004]	[0.0004]	[0.0013]
EMU	0.0032**	0.0028*	0.0024*	0.0066
	[0.0015]	[0.0014]	[0.0013]	[0.0040]
Intra-EU trade		0.0002	0.0001	0.0005
		[0.0001]	[0.0001]	[0.0003]
Maastricht		0.0004	0.0007	0.004
		[0.0012]	[0.0012]	[0.0039]
Stability and Growth Pact		0.0033*	0.0031*	0.0096*
		[0.0017]	[0.0016]	[0.0054]
Constant	0.0363	0.0099	0.0078	0.0834
	[0.0394]	[0.0608]	[0.0591]	[0.1725]
Observations	68	68	68	68
Number of countries	3	3	3	3
R-squared	0.797	0.813	0.807	0.758

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Cohesion countries are Greece, Portugal and Spain.

Table 4: The Determinants of Inequality in non-Cohesion countries

	GE(1)	GE(1)	GE(0)	Gini
Growth rate of real GDP	-0.0002	-0.0003	-0.0003	-0.0009
	[0.0003]	[0.0003]	[0.0003]	[0.0006]
Share of employment in manufacturing sector	-0.0013***	-0.0013***	-0.0010***	-0.0021***
	[0.0003]	[0.0003]	[0.0003]	[0.0006]
Share of employment in agriculture	0.0001	-0.0001	0.0016**	0.0025*
	[0.0007]	[0.0007]	[0.0007]	[0.0014]
Female Labor Force Participation rate	-0.0016***	-0.0016***	-0.0018***	-0.0038***
	[0.0003]	[0.0003]	[0.0002]	[0.0004]
Unemployment rate	-0.0002	-0.0001	0.0001	-0.0002
	[0.0002]	[0.0002]	[0.0002]	[0.0005]
Inflation rate	0.0001	0.0001	0.0001	-0.0002
	[0.0002]	[0.0002]	[0.0003]	[0.0005]
Share of population < 15 year-old	0.0013***	0.0010**	0.0018***	0.0035***
	[0.0004]	[0.0004]	[0.0005]	[0.0011]
Share of population >65 year-old	0.0014	0.0013	0.0028***	0.0058***
	[0.0009]	[0.0009]	[0.0010]	[0.0017]
Social Transfers other than in kind as a % of GDP	-0.0006***	-0.0005***	-0.0006***	-0.0018***
	[0.0002]	[0.0002]	[0.0002]	[0.0004]
EMU	-0.0004	-0.0009	-0.0052***	-0.0056
	[0.0013]	[0.0013]	[0.0019]	[0.0035]
Intra-EU trade		-0.0004***	-0.0006***	-0.0013***
		[0.0001]	[0.0002]	[0.0003]
Maastricht		-0.0039**	-0.0044***	-0.0097***
		[0.0015]	[0.0017]	[0.0033]
Stability and Growth Pact		-0.0026**	-0.0028*	-0.0073**
		[0.0012]	[0.0015]	[0.0031]
Constant	0.1179***	0.1558***	0.1351***	0.3483***
	[0.0212]	[0.0250]	[0.0277]	[0.0549]
Observations	214	213	213	213
Number of countries	10	10	10	10
R-squared	0.621	0.632	0.609	0.628

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Non-Cohesion countries refer to Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Sweden and the UK

6 Conclusion

In this paper, I examine the evolution of per capita income inequality among and within EU countries, and the relative contributions of demographics, macroeconomic conditions and policy towards explaining this evolution. Overall, interregional inequality has significantly decreased between 1977 and 2003, but remains nonetheless high, at levels twice as high as those measured for US states. Furthermore, movements in interregional inequality have varied sig-

nificantly across countries. Inequality reduction has been quite sizable in Southern European countries, notably after their accession to the EU.

The breakdown of inequality into between-country and within-country components suggests that most of interregional inequality occurs within countries rather than between countries. Moreover, the importance of the within component has increased over time, notably since the mid-1990s. Between 1995 and 2003, the decrease in regional income inequality has been driven by a decreasing between-group component, while the within-group inequality was increasing. If the US are taken as a benchmark for predicting the evolution of inequality in an increasingly integrated Europe, one should expect overall inequality and the share of within inequality to rise.

In addition to distinguishing inequality between countries from inequality within countries, I check whether the inequality faced by a region depends on its ranking in the regional income distribution. Using an expanded rank-size function, I find that there is more inequality among regions with lower ranks (i.e. with lower per capita incomes) than among richer regions. This finding would support a reform of the current EU and national regional policies. While the increase in within-country inequality suggests that structural policies should be elaborated at the regional level, and not at the national level, higher inequality among poorer regions suggests that funds should be further concentrated onto these regions. López-Rodríguez and Faiña (2006)'s findings support this recommendation. The authors indeed find that the between objective 1 and non-objective 1 component of the Theil index has decreased since the end of the 1987, which suggests that objective 1 regions have been catching up.

I also examine which factors cause regional income inequality to vary over time, and whether EMU has had any significant impact. Per capita income distribution is influenced by several demographic, policy-related and macroeconomic factors. A large manufacturing sector and high female labor force participation rates are associated with less inequality, while higher price instability is positively correlated with inequality. For the entire sample of countries, the effect of EMU is not robust to a change in the inequality measure used as the dependent variable. EMU is associated with fewer regional disparities when the latter are captured with

the Gini index and the GE(0) index but not with the GE(1) index.

I also distinguish the effects of EMU on Cohesion countries from the effects on non-Cohesion countries, because the former faced deeper economic adjustments before they could adopt the common currency. While large employment in the manufacturing sector is consistently related with lower inequality, female labor force participation only affects inequality in non-Cohesion countries. In contrast, unemployment is positively related to inequality only in the Cohesion sample. As for EMU and other stages of the monetary union (implementation of convergence criteria and implementation of the Maastricht Treaty), adopting the common currency has led to higher inequality in Cohesion countries, but to lower inequality in the other countries. This last result provides some justification for the implementation of countervailing policies (such as the Cohesion Fund and Structural Funds), as argued in the Delors and Padoa-Schioppa Reports. Yet, the persistence of within-country inequality call for a reform of the existing EU regional policies, as there is not yet evidence that these policies has delivered the promised regional cohesion.

References

Aghion, P. and P. Howitt, *Endogenous Growth Theory*, Cambridge, Massachusetts: the MIT Press, 1998.

Ardy, B., I. Begg, W. Schelkle, and F. Torres, "How will EMU affect Cohesion?," *Intereconomics*, November/December 2002.

Artis, M.J., Z.G. Kontolemis, and D.R. Osborn, "Business Cycles for G7 and European Countries," *The Journal of Business*, April 1997, *70* (2), 249–279.

Atkinson, T., "Income inequality in OECD countries: Data and explanations," *CESifo Economic Studies*, 2003, *49* (4), 479–513.

Barro, R. and X. Sala-i-Martin, "Convergence across States and Regions," *Brooking Papers of Economic Activity*, 1991, *1*, 107–158.

_ **and** _ , "Convergence," *Journal of Political Economy*, 1992, *100* (2), 223–251.

_ **and** _ , *Economic Growth*, McGraw Hill, 1995.

Barry, F., "Economic integration and convergence processes in the EU Cohesion countries," *Journal of Common Market Studies*, 2003, *41* (5), 897–921.

_ **and I. Begg**, "EMU and cohesion: Introduction," *Journal of Common Market Studies*, 2003, *41* (5), 781–796.

Basile, R., S. de Nadis, and A. Girardi, "Regional Inequalities and Cohesion Policies in the European Union," *Working Paper, ISAE*, 2001.

Beblo, M. and T. Knaus, "Measuring income inequality in Euroland," *The Review of Income and Wealth*, September 2001, *47* (3), 301–333.

Begg, I., "Complementing EMU: Rethinking cohesion policy," *Oxford Review of Economic Policy*, 2003, *19* (1).

Blinder, A. and H. Y. Esaki, "Macroeconomic activity and income distribution in the postwar United States," *The Review of Economics and Statistics*, November 1978, *60*, 604–607.

Boldrin, Michele and Fabio Canova, "Europe's Regions: Income Disparities and Regional Policies," *Economic Policy*, April 2001.

Bouguignon, F., "Decomposable income inequality measures," *Econometrica*, 1979, *47*, 901–920.

Bourguignon, F. and C. Morrisson, "Inequality and development and: the role of dualism," *Journal of Development Economics*, 1998, *57*, 233–257.

Brakman, S., H. Garresten, and M. Van den Berg C. Van Marrewij and, "The Return of Zipf: Towards a further understanding of the rank-size distribution," *Journal of Regional Science*, 1999, *39* (1), 183–213.

Braunerhjelm, P., R. Faini, V. D. Norman, F.Ruane, and P. Seabright, "Integration and the Regions of Europe: How the Right Policies Can Prevent Polarization," in "Monitoring European Integration," Vol. 10, Centre for Economic Policy Research, 2000.

Breen, R. and C. Garcia-Peñalosa, "Income inequality and macroeconomic volatility: An empirical investigation," *Review of Development Empirics*, 2005, *9* (3), 380–398.

Brülhart, M. and J. Tortensson, "Regional Integration, Scale Economies, and Industry Location in the European Union," *CEPR Discussion Paper Series*, 1996, (1435).

Clementi, F. and M. Gallegati, "Power law tails in the Italian personal income distribution," *Physica A: Statistical Mechanics and its Applications*, 2005, pp. 427–438.

_ **and** _ , *Econophysics of Wealth Distributions*, Springer,

Cowell, F.A., *Measuring Inequality* LSE Economics Series, Oxford University Press, 2000.

Crespo-Cuaresma, J., M-A. Dimitiz, and D. Rizberger-Grünewald, "Growth convergence and EU membership," *Oesterreichische Nationalbank Working Papers*, 2002.

de la Fuente, A., "Convergence Across Countries and Regions: Theory and Empirics," *CEPR Discussion Paper*, May 2000, (2465).

Dunford, M., "Regional Disparities in the European Community: Evidence from Regio databank," *Regional Studies*, 1993, *27* (8), 727–743.

Duro, A., "Regional income inequalities in Europe: An updated measurement and some decomposition results," 2004. Working papers (Universitat Autnoma de Barcelona. Departament d'Economia Aplicada).

Eichengreen, B. and D. Leblang, "Exchange Rates and Cohesion: Historical Perspectives and Political-Economy Considerations," *Journal of Common Market Studies*, 2003, *41* (5), 797–822.

European Commission, *Unity, Solidarity, Diversity for Europe, its People and its Territory: Second Report on Economic and Social Cohesion*, Office for Official Publications of the European Communities, 2001.

Ezcurra, R. and M. Rapún, "Regional disparities and national development revisited: the case of Western Europe," *European Urban and Regional Studies*, 2006, *13* (4), 355–369.

Fan, C. C and E. Casetti, "The spatial and temporal dynamics of U.S. regional income inequality, 1950-1989," *The Annals of Regional Science*, 1994, *28*, 177–196.

Fayolle, J. and A. Lecuyer, "Croissance Régionale, Appartenance Nationale et Fonds Structurels Européens: Un Bilan d'étape," *Revue de l'OFCE*, Avril 2000, (73).

Felsenstein, D. and B. Portnov, "Understanding regional inequalities in small countries," *Regional studies*, July 2005, *39* (5), 647–658.

Fujita, M., P. Krugman, and A. J. Venables, *The Spatial Economy: Cities, Regions and International Trade*, the MIT Press, 1999.

Gabaix, X., "Zipf's Law for Cities: an Explanation," *The Quarterly Journal of Economics*, 1999, *114* (3), 739–767.

Gramlich, E.M., "The Distributional Effects of Higher Unemployment," *Brookings Papers on Economic Activity*, 1974, *2*, 293–342.

Grubb, R.H. Wilson W.N., "Sources of Increasing Inequality in Wages and Salaries, 1960-1980," *Monthly Labor Review*, 1989, *112.*

Guilmi, C. Di, E. Gaffeo, and M. Gallegati, "Power Law Scaling in the World Distribution of Income," *Economic Bulletin*, 2003, *15* (6), 1–7.

Gustafson, B. and M. Johansson, "In search of smoking guns: what makes income inequality vary over time in different countries," *American Sociological Review*, August 1999, *64* (4).

Halsag, J.H. and L.L. Taylor, "A look at long term development in the distribution of income," *Economic review, Federal Reserve Bank of Dallas*, First quarter 1993.

Heshmati, A., "Regional income inequality in selected large countries," *IZA Discussion Paper Series*, September 2004, (1307).

Kenen, P., *Monetary Problems of The International Economy*, University of Chicago Press, 1969.

Krugman, P., *Geography and Trade*, Cambridge MA, London: MIT Press, 1991.

_ , "Increasing Returns and Economic Geography," *Journal of Political Economy*, 1991, *9*, 483–499.

Krugman, P. R., *The Self-Organizing Economy*, Blackwell Publishers, 1996.

Litchfield, J.A., "Inequality: Methods and tools," text for the World Bank Povernet website March 1999.

López-Rodríguez, J. and J.A. Faiña, "Objective 1 regions versus non-objective 1 regions. What does the Theil index tell us?," *Applied Economics Letters*, 2006, *13* (12), 815–820.

Magrini, S., "The evolution of income dispersion among the regions of the European Union," *Regional Science and Urban Economics*, 1999, *29* (2), 257–281.

Manessiotis, V. and R. Reischauer, *Greece's Economic Performance and Prospects*, Brookings Institution and Bank of Greece, 2001.

Martin, P., "Public Policies and Economic Geography," *CEPR Discussion Paper Series*, 2002.

Martin, Ron, "EMU versus the regions? Regional convergence and divergence in Euroland," *Journal of Economic Geography*, 2001, *1*, 51–80.

McKinnon, R., "Optimum currency areas," *American Economic Review*, 1962, *53*, 717–725.

Midelfart, K.H., H.G. Overman, and A.J. Venables, "Monetary union and the economic geography of Europe," *Journal of Common Market Studies*, 2003, *41* (5), 847–868.

Mincer, J., *Aspects of Labor Economics*, National Bureau of Economic Research, Princeton University Press, 1962.

Mongeli, F.P., "New Views on the Optimum Currency Area Theory: What is EMU Telling Us?," Working Paper No. 138, European Central Bank April 2002.

Mundell, R., "A Theory of Optimum Currency Areas," *American Economic Review*, 1961, *51*, 657–665.

Neven, D. and C. Gouyette, "Regional Convergence in the European Community," *Journal of Common Market Studies*, March 1995, *33* (1).

Nitsche, V., "Zipf Zipped," *Journal of Urban Economics*, 2005, *57*, 86–100.

Padoa-Schioppa, T., *Efficiency, stability and equity: A strategy for the evolution of the economic system of the European Community*, Oxford University Press, 1987.

Partridge, M.D., D.S. Rickman, and W. Levernier, "Trends in US income inequality: evidence from a panel of states," *The Quarterly Review of Economics and Finance*, 1996, *36* (1), 17–37.

Petrakos, G. and Y. Saratis, "Regional inequalities in Greece," *Papers in Regional Science*, 2000, *79*, 57–74.

Puga, Diego, "The Rise and Fall of Regional Inequalities," *European Economic Review*, 1999, *43*, 303–334.

Quah, D., "Empirics for Economic Growth and Convergence," *European Economic Review*, 1996, *40*, 1353–75.

_ , "Empirics for Growth and Distribution Stratification, Polarization and Convergence Clubs," *Journal of Economic Growth*, 1997, *2*, 27–59.

Ram, R., "Interstate Income Inequality in the United States: Measurement, Modelling and Some Characteristics," *Review of Income & Wealth*, March 1992, *38* (1), 39–49.

Romer, P., "Endogenous technological change," *Journal of Political Economy*, 1990, *98*, 71–102.

Sala-i-Martin, X., "The World Distribution of Income: Falling Poverty and Convergence, Period," *Quarterly Journal of Economics*, May 2006, *CXXI* (2).

Thirlwall, T., "European Unity Could Flounder on Regional Neglect," *The Guardian*, January 2000.

Tsionas, E.G., "Regional growth and convergence: evidence from the United States," *Regional Studies*, 2000, *34*, 231–238.

A Inequality measures: formulas

- Gini index

$$Gini = \frac{1}{2n^2\bar{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j| \tag{6}$$

  where y_i = per capita income in region i; $\bar{y}$ = the average per capita income across all of the regions; n = the number of regions included in the sample.

  The Gini coefficient takes on values between zero and one, with zero interpreted as no inequality.

- Generalized Entropy index with parameter 1

$$GE(1) = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i \bar{y}}{\log} \frac{y_i}{\bar{y}} \tag{7}$$

- Generalized Entropy index with parameter 0 (or Mean Log Deviation)

$$GE(0) = \frac{1}{n}\sum_{i=1}^{n}\log\frac{\bar{y}}{y_i} \tag{8}$$

Generalized Entropy measures take values between zero and ∞, with zero representing perfect equality.

- Standard deviation of logs (SDL)

$$SDL = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[\log\left(\frac{y_i}{\bar{y}}\right)\right]^2} \tag{9}$$

- Coefficient of variation

$$COV = \frac{1}{\bar{y}}\left[\frac{1}{n}\sum_{i=1}^{n}(y_i-\bar{y})^2\right]^{\frac{1}{2}} \tag{10}$$

An increase in the coefficient of variation captures an increase in inequality.

- Gibrat index

The Gibrat index is obtained by fitting by Maximum Likelihood the the two parameters of lognormal distribution (the mean μ and the standard deviation σ) to the sample observations of income per capita. Using the regression standard deviation, the Gibrat index is calculated as:

$$Gibrat = \frac{1}{\sqrt{2\sigma^2}} \tag{11}$$

An increase in the Gibrat index indicates a more even distribution of income.

- Pareto index

The Pareto index is obtained by regressing the natural log of the cumulative distribution probability on logged per capita income. The coefficient on logged per capita income is the Pareto index. As the Pareto index falls, income gets more concentrated.

- Power law index

The Power Law Exponent is obtained by estimating a rank-size function for regional income per capita. I regress logged income per capita on logged rank:

$$\ln y = a + q\ln rank. \tag{12}$$

The absolute value of the slope (q) is referred as Power coefficient, and corresponds to a measure of inequality: the higher the magnitude of q the more unequal the income distribution across regions.

B Five axioms an inequality measure should meet

- the Pigou-Dalton transfer principle: income transfer from a poorer region to a richer region should register as an increase (or at least not a decrease) in inequality.
- Income scale independence: the inequality measure should not change if all regions' incomes change in the same proportion.
- Principle of population: inequality measure should be invariant to replications of the population: merging two identical income distributions should not change the inequality measure.
- Symmetry: inequality is independent of any other regional characteristics besides regional income.
- Decomposability: overall inequality should be related to inequality for subgroups, so that if inequality increases in all of the population subgroups, overall inequality should also increase.

For more details, see Cowell (2000); Bouguignon (1979); López-Rodríguez and Faiña (2006); Litchfield (1999).

C Decomposition of the GE(1) index

The GE(1) index can be decomposed in within and between-group inequalities. If the n regions are divided into G groups (here countries), k is the number of regions in each group (country) and s_g is the income share of group (country) g, T_g is the Theil index for that group, and $\bar{y}_g$ is the average income in group g, then the Theil index can be rewritten as

$$T = \sum_{g=1}^{G} s_g T_g + \sum_{g=1}^{G} s_g \ln \frac{\bar{y}_g}{\bar{y}} \tag{13}$$

where

G is the number of countries

n is the total number of regions

k is the number of regions in country g

$\bar{y}$ is the overall average per capita income

$\bar{y_g}$ is the average per capita income in country g

$s_g = \frac{\sum_{i=1}^{k} y_i}{\sum_{i=1}^{n} y_i}$

$T_g = \frac{1}{k} \sum_{i \epsilon g=1}^{k} \frac{y_{i \epsilon g}}{\bar{y_g}}$

The first term in Equation 13 measures within-country inequality, and the second term is a weighted sum of between-country inequality.

D Data definitions and sources

	definition	Source
Growth	Growth rate of real GDP (in percentage)	Cambridge Econometrics Database
Manuf	Share of employment in the manufacturing sector (in percentage)	Cambridge Econometrics Database
Agri	Share of employment in the agricultural sector (in percentage)	Cambridge Econometrics Database
FLFPR	Female Labor Force Participation Rate	OECD
Unemployment	Unemployment rate	AMECO, database of the European Commission's DG ECFIN
Inflation	Inflation rate	OECD Monthly Economic Indicators
Young	Percentage of the population younger than 15 year-old	AMECO, database of the European Commission's DG ECFIN
Old	Percentage of the population over 65 year-old	AMECO, database of the European Commission's DG ECFIN
Social	Social transfers transfers other than in-kind, as a percentage of GDP	AMECO, database of European Commission's DG ECFIN
EUtrade	Share of intra-EU trade in total trade	UNCTAD Handbook of Statistics, 2006