EMU and the dynamics of regional per capita income inequality in Europe

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This paper analyzes the evolution of per capita income inequality among 197 European regions between 1977 and 2003, and seeks evidence of the relationship between the European Economic and Monetary Union (EMU) and interregional income inequality. The conclusion is that overall interregional income inequality has decreased since 1977, owing to a decrease in between-country inequality. The panel analysis conducted in this paper suggests that the adoption of the common currency has, thus far, exacerbated regional inequality in poorer EU countries, while it has not significantly affected regional inequality within richer countries. Inequality in less advanced countries has also increased with the establishment of the convergence criteria and with the implementation of the Single Market.

- *Keywords*: income inequality, European Union, European Integration, 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[2]. Several factors can explain this widespread interest. First, the revival of growth theory (Romer, 1990; Aghion and Howitt, 1998) was contemporaneous with 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 slowed to almost a halt during the 1980s and early 1990s (Boldrin and Canova, 2001; Neven and Gouyette, 1995; Magrini, 1999), at a time when European economic integration was being further pursued. Second, reducing regional disparities has been one of the most explicit and resolute goals of the European Union (EU)[3], which has consequently devoted an increasing share of its budget to regional policy.

The establishment of the Single Market and the completion of the Economic and Monetary Union (EMU) have revived concerns about the impact of economic and monetary integration on interregional regional disparities. So far, most of the debate on the impact of the common market and currency has focused on national economic conditions. For instance, 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[4] are based on national macroeconomic variables. Meanwhile, the possible impact of EMU on European regions has received much less attention, even though the regional dimension is also critical to creation of the economic and social cohesion sought by the European Union (Martin, 2001; Thirlwall, 2000).

To assess the implication of EMU on regional income inequality, this paper first investigates the dynamics of interregional income inequality among 197 European regions between 1977 and 2003. The overall level of interregional inequality in per capita GDP is measured with General

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[2]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.

[3] 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".

[4] The Cohesion Fund was established in 1994 to contribute to the fulfillment of the conditions of economic convergence as set out in Article 104c of the Treaty establishing the European Community. Countries qualify for the Cohesion Fund when their per capita gross national products (GNP), measured in purchasing power parities, of less than 90 % of the Community average.

Entropy indices and the Gini Index (as in Dunford, 1993; Duro, 2004; Ezcurra and Rapún, 2006). Like Ezcurra and Rapún (2006), I find that European countries have not experienced the same level or the same trend in interregional inequality over the last three decades. In order to detect whether inequality is greater within or between countries, I decompose overall interregional inequality into its within- and between-country components. This decomposition confirms the findings of Duro (2004) that the overall decrease in interregional inequality is due to a decline in inequality among European countries.

To assess the role played by EMU in shaping interregional income inequality, I perform a panel data analysis that relates interregional income inequality to various facets of EU integration, notably the three phases of EMU and EU regional policy. While Ezcurra and Rapún (2006) control only for one instrument of EU regional policy (namely the Structural Funds allocated to objective-1 regions[5]), the analysis presented below accounts for all of the Structural Funds as well as for the Cohesion Fund allocated to regions of Greece, Portugal, and Spain. This panel data analysis suggests that EMU has been associated with higher inequality in Cohesion countries, while the establishment of the Single Market has led to lower inequality in richer countries.

The paper is organized as follows: Section 2 outlines some related theoretical and empirical literature useful to understand how EMU might affect interregional income inequality. Section 3 discusses the evolution of interregional inequality in Europe between 1977 and 2003. A panel-data analysis is carried out in section 4 to examine the empirical relationship between EMU and inequality. Section 5 presents the conclusions.

2 Related literature

The current literature offers various and often conflicting models to explain whether regional disparities will disappear with further economic and monetary integration. For proponents of neoclassical precepts (Barro and Sala-i-Martin, 1991, 1992), income disparities are bound to disappear because of diminishing returns to factors of production. Diminishing returns to factors of production imply that these returns are higher in poorer countries/regions where factor endowments are lower. Consequently, factor endowments and output should grow faster in poorer

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[5] To qualify for Objective 1 funds, a region must have a per capita GDP equal to less than 75% of EU average. Until 2007, the Structural Funds and the Cohesion Fund were allocated according to six objectives (Bouvet and Dall'erba, forthcoming).

countries/regions, leading to decreasing interregional income disparities. As explained in Magrini (2004), convergence in the open-economy version of the neoclassical model should be faster than in the closed-economy version because the traditional source of convergence, the internally-financed growth in capital per worker, is paralleled by interregional interactions that reduce the initial misallocation of resources. By promoting free movement of factors of production, further integration would lead to a more efficient resource allocation, factor price equalization and, thus, to lower wage and income inequality. Using cross-section data for 24 countries and US states from the 1950s and early 1960s, Williamson (1965), for instance, shows that regional income inequality follows Kuznet's inverted-U pattern, and that the initial rise in inequality is due to the concentration of income-generating factors in core regions. Over time, the diffusion of these income-generating factors leads to a progressive decline in interregional income inequality. Therefore, for neoclassical economists, persistent regional disparities are caused by factor market imperfections, such as low interregional labor mobility or other forms of labor and capital market rigidities.

In contrast to this approach, new economic geography (NEG) theory argues 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, factor accumulation, and thus in income (Krugman, 1991a, b; Fujita et al., 1999; Martin, 2002; Brühlart and Tortensson, 1996; Puga, 1999). According to the NEG theory, GDP in core regions should grow faster than in peripheral regions, hence causing inequality to rise. Moreover, by inducing deeper industrial specialization, EMU might increase the risk of asymmetric shocks and amplify income inequalities among countries and regions (Midelfart et al., 2003; Ardy et al., 2002).

Optimal Currency Area theory (Kenen, 1969; McKinnon, 1962; Mundell, 1961; Mongeli, 2002) suggests that monetary integration embodied in the adoption of a common currency, such as in EMU, brings both advantages and disadvantages. On the one hand, lower transaction costs provide more price transparency and less exchange rate uncertainty, which ultimately promotes economic growth in the monetary union. EMU could improve the economic performance of less competitive countries, and thus decrease inequality between countries, by inducing relative-price deflation in the former. While the case of Ireland validates this hypothesis, enhanced price transparency has not improved the competitiveness of Greece, Portugal and Spain (Ardy et al., 2002; Padoa-Schioppa, 1987). On the other hand, the absence of independent exchange rate and monetary policy would

make it harder to tackle national or regional asymmetric shocks, which could increase interregional inequalities. This is notably true for Southern European countries where labor market rigidities would make these countries more vulnerable to asymmetric shocks (Ardy et al., 2002; Barry and Begg, 2003; Barry, 2003; Begg, 2003). Barry and Begg (2003) conclude that the effects of EMU will be more pronounced in countries that have to change the most in order to participate in EMU.

On empirical grounds, the literature on the effects of economic integration on inequality has not reached a consensus either. Whether further integration has coincided with economic convergence depends on whether convergence is measured between countries or between regions. Most papers using country-level data (e.g. European Commission, 1997; Braunerhjelm et al., 2000) find evidence of economic convergence among European countries. Moreover, convergence tends to be faster if trade among these countries increases (Ben-David, 1993; Ben-David and Rahman, 1996; Braunerhjelm et al., 2000). At the regional level, the results vary significantly with the sample of regions, the period covered, and the approach used (see Magrini (2004) for a review of the literature on regional convergence in Europe). Overall, Magrini (2004) concludes that Europe is characterized by geographical clusters of regions with similar levels of per capita income, and that regional convergence has only occurred within these clusters.

3 Inequality dynamics: 1977-2003

3.1 Data and inequality measure

To measure interregional inequality in Europe, I consider the distribution of per capita GDP across EU regions over the period 1977 to 2003. The data set covers 197 NUTS 2[6] regions from the following 13 EU countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, Sweden, and the UK. Ireland and Luxembourg are not included in the panel because each one is 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

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[6]NUTS (Nomenclature of Territorial Units for Statistics) corresponds to Eurostat's classification of subnational spatial units where NUTS 0 refers to country level data and increasing numbers indicate increasing levels of subnational disaggregation.

mid-1980s creates an artificial jump in this country's inequality level[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 section 3.4.

The GDP data are compiled by Cambridge Econometrics which provides a balanced panel of European regional data. Details on the GDP data and their source are provided in the data appendix. The GDP variable is expressed in Purchasing Power Parity (PPP) because market exchange rates do not account for differences in relative prices across countries. Because regional price data are not available, the PPP indices account only for differences in the costs of living across countries, not across regions. As a result, the inequality measures presented below are likely to overstate within-country inequality, as poorer regions also tend to have lower costs of living (Brandolini, 2007). Each region's PPP per capita GDP is scaled relative to EU15 average PPP per capita GDP.

In this paper, the expression "income inequality" is used to refer to interregional inequality in per capita GDP. There is a great variety of inequality measures; the choice of a measure is always tricky because each measure has its merits and shortcomings (see Cowell, 2000). I use the General Entropy measure with parameter 1 (GE(1), also called the Theil index) to assess the level of inequality among EU regions. The analysis presented in the rest of the paper is robust to the use of different inequality measures, such as the GE(0) and Gini indices. Because the focus of this paper is the analysis of interregional inequality and not the analysis of personal income inequality, interregional inequality is not weighted by regional population. As explained in Milanovic (2005), the issue of regional convergence is better captured by unweighted inequality measures. Population-weighted inequality "deals neither only with nations nor individuals but falls somewhere in between". (Milanovic, 2005, page 10). Using unweighted inequality is, moreover, more relevant to the study of interregional inequality in Europe, because, as illustrated by Article 158 of the Treaty establishing the European Community and by EU cohesion policy, the aim of the EU is to reduce disparities among regions, not among EU citizens.

3.2 Trends in overall inequality

Figure 1 depicts the evolution of the GE(1) index, along with the GE(0) and Gini indices.

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[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.

All of the indices show a remarkably similar trend in EU-wide inequality. Because all of the inequality measures depict the same trend, the following comments and statistics are based only on the GE(1) index.

Overall, the GE(1) fell by 21% between 1977 and 2003. Time plots of the coefficient of variation (COV) and of the standard deviation of the logs (SDL) which are commonly used to measure σ-convergence[8] confirm this decline in income dispersion (figure 2). These results are very close to the findings of Duro (2004), despite slight differences in the number of regions included in the analysis, and in the period covered[9]. This general downward trend is in line with the prediction of the neoclassical model that regional disparities will disappear with further economic integration.

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. After a short fall between 1986 and 1989, inequality rose again in the early 1990s as European economies were heading towards the 1993 recession, and dramatically dropped between 1992 and 1993. This pattern suggests that inequality moves countercyclically[10]. Finally, it should be noted that the two most recent periods of falling inequality, 1993 to 1998 and 2000 to 2003, follow respectively the ratification of the Maastricht Treaty and the adoption of the euro.

-Insert figure 1 here-

-Insert figure 2 here-

To determine whether the level of inequality among EU regions has been high or low, it is useful to draw a comparison with the United States which has similar economic and population sizes. Interregional inequality in per capita GDP has been consistently wider among European regions than among U.S. states[11]. Fan and Casetti (1994) estimate that the Shannon entropy index (similar to the GE(1) index) computed for per capita income of US states reached 0.0238 in 1989, while the GE(1) index computed for EU regions was 0.0393 in the same year. Similarly, Boldrin and Canova (2001) find that European regional inequalities are twice those of the U.S. when

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[8] Sigma-convergence occurs if the dispersion of income, measured by the standard deviation of the logarithm of per capita income, declines over time.

[9] Duro (2004) covers the period from 1982 to 1995 and includes German Eastern Länder after 1991 and Austria, Finland and Sweden from 1995 to 1997.

[10] See Artis et al. (1997) for European business cycle peaks and troughs.

[11] However, personal income inequality tends to be larger in the US than in Europe (Atkinson, 1996; Brandolini, 2007).

measured either by the standard deviation of per capita income or the ratio of the top to bottom decile of regions. Can we then conclude that deeper economic integration is associated with lower inequality? The trend in US interstate inequality does not substantiate such a conclusion, because interstate inequality has been rising since 1975 (Fan and Casetti, 1994; Bouvet, 2009). The recent evolution of inequality among US states thus tends to support the predictions of the NEG.

3.3 Inequality decomposition

So far, the analysis has provided a general overview of inequality among EU regions but has not offered any insights into disparities that could exist among or within countries. This issue is addressed in this section by decomposing inequality into its between- and within-country components, while national trends in inequality are compared in the next section.

It is intuitively appealing to have an inequality measure that allows overall inequality to be expressed as the sum of inequality within and between groups, for instance within and between countries: $I_{total} = I_{between} + I_{within}$. This decomposition helps identify whether inequality is more prominent between or within countries and thus which component drives the overall trend in inequality described in section 3.2. Shorrocks (1980, 1984) shows that the only additively decomposable inequality measures which satisfy a set of desirable axioms[12] are the General Entropy (GE) indices. The decomposition of interregional inequality presented below is carried out using the GE(1) index.

Figure 3 represents the variation in the overall GE(1) index and its between- and within-country components over time. While within-country inequality was relatively constant between 1977 and 2003, the decrease in inequality between EU countries explains the decline in overall interregional inequality, hence corroborating the findings of the convergence literature summarized in Magrini (2004). It is clear from figure 3 that the increase in inequality in the early 1990s and its subsequent fall were driven by between-country inequality, while within-country inequality remained relatively stable. The aforementioned reduction in inequality between EU countries has been mostly driven by the success of Cohesion countries (Spain, Portugal, and to a lesser extent Greece) at converging with the rest of the EU (European Commission, 2001). The evolution of inequality between countries is therefore consistent with the neoclassical theory.

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[12] The Pigou-Dalton transfer principle, income scale independence, the principle of population, symmetry (see Cowell, 2000).

Even though between-country inequality shapes the dynamics of overall inequality, more than 60% of the inequality occurs within EU countries as opposed to between EU countries. The reader should keep in mind that, owing to the absence of regional price indices, within-country inequality might be overestimated. As indicated in figure 4, between 1977 and 2003, within-country inequality accounted on average for 61.5% of overall inequality[13]. Starting with a share of 58.4% of total inequality in 1977, within-country inequality remained stable around 58-60% between 1977 and 1990. It then fell to 55.8% in 1992, before increasing steadily until 2003, when within-country inequality accounted for 70% of overall inequality. Compared to the decomposition of household income inequality, the between-country component of interregional income inequality is quite substantial (30%) since between-country inequality in personal income accounts for less than 10% of total inequality[14].

<div align="center">-Insert figure 3 here-</div>
<div align="center">-Insert figure 4 here-</div>

3.4 National inequality trends

The evolution of national income inequality, measured by the GE(1) index in each country, is illustrated by figure 5. Not all countries experienced the decrease in inequality shown by the EU as a whole. Four countries experienced a significant decrease in inequality over the last three decades: Austria (60% decrease), Greece (65% decrease), Portugal (40% decrease), and Italy (15% decrease). Inequality fell most steeply in Austria and Italy in the 1980s. In Greece, the sharp drop in inequality occurred in the early 1980s, coinciding with its accession to the EU and with a major increase in government spending on welfare policies (Manessiotis and Reischauer, 2001). Inequality fell in Portugal at a relatively constant pace between 1977 and 1995, before slightly increasing between 1995 and 1998. With the exception of Austria, countries that experienced declines in inequality have also been among the main beneficiaries of EU regional (Structural Funds and Cohesion Fund) policy. Regional disparities in Germany, Sweden, and the United Kingdom have widened. The

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[13]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 I perform the decomposition without Sweden, the increase in the late 1990s persists.

[14] Papatheodorou and Pavlopoulos (2007) find that, in 1999, between-EU country inequality accounted for 7.7% of household income inequality.

GE(1) index grew by 22% in Germany (with and without the Eastern Länder[15]), by 34% in the UK, and by 561% in Sweden. This dramatic surge in Swedish inequality happened mostly after 1995. Inequality displayed a non-linear trend in three other countries. In France, it showed an inverted U-shaped trend, leveling off at a level higher than at the beginning of the period. 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 regions peaked in 1981-1983, before sharply falling between 1985 and 1995; it has since slightly increased. Regional disparities have remained high and stable in Belgium.

No clear relationship between EMU and interregional inequality emerges from the description of the national inequality trends. The next section provides a more careful analysis of the statistical relationship between regional inequality and EMU. Since inequality decreased mainly in countries that received most of EU Structural Funds and Cohesion Fund, the analysis of the statistical relationship between EMU and interregional income inequality needs to control for the role of EU regional policy.

-Insert figure 5 here—

4 EMU and inequality: A panel analysis

4.1 Specifications

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[15] It is important to keep in mind that the 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. He finds that, one year after the 1990 reunification, the GE(1) index had increased by 36.6%. 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'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.

In this section, I examine the role of EMU and EU regional policy in shaping interregional income inequality. The panel analysis is conducted at the country-level, and uses data on within-country inequality as the dependent variable. To be consistent with the analysis of inequality dynamics presented in section 3, I measure interregional income inequality with the GE(1) index. The explanatory variables considered fall into four broad categories: demographics, macroeconomic stability, institutions/policies, and EMU. 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; Bourguignon and Morrisson, 1998; Breen and García-Peñalosa, 2005).

The demographic variables are the female labor force participation rate, the unemployment rate, the share of employment in agriculture, and the share of employment in the manufacturing sector. There is no consensus on the effect of female labor force participation rate on regional income inequality. Given that women are more likely to experience breaks in their professional careers, and to occupy part-time positions, a higher female economic activity rate would result in lower average wage (Thurow, 1987). Checchi and García-Peñalosa (2008) also find that female share in employment is positively correlated with income inequality in developed countries. Yet, some authors argue that income inequality might fall with higher female participation as women's earnings may increase the number of middle-income households (Cancian and Danziger, 1993). The unemployment rate is utilized because higher unemployment rates usually affect more people in the lower tail of personal income distribution, thus lowering average per capita income (Levernier et al., 1995). Checchi and García-Peñalosa (2008) argue that this positive correlation between unemployment and inequality only holds as long as the unemployment rate is not too high. When a very high unemployment rate is combined with generous unemployment benefits, more and more individuals share the same income level. Consequently, an increase in unemployment might cause a decrease in inequality. Manufacturing sectors are usually associated with better salaries and more job security than service jobs (Gustafson and Johansson, 1999; Grubb, 1989). On the other hand, the agricultural sector is usually characterized by lower productivity and lower wages. Thus, higher shares of employment in manufacturing and agriculture should be associated with lower inequality and higher inequality, respectively.

In section 3, plots of inequality measures suggest that inequality usually rises during economic downturns, and that it tends to decrease during economic expansions (Sala-i-Martin, 2006;

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Gramlich, 1974). Thus, following Blinder and Esaki (1978), and Breen and Garcia-Peñalosa (2005), I include some controls for macroeconomic stability, namely the deviation of growth rate of real per capita GDP from its average value[16] computed over the 1977-2003 period and the inflation rate. I use social transfers as a percentage of GDP (Gustafson and Johansson, 1999; Beblo and Knaus, 2001; Checchi and García-Peñalosa, 2008) and union density (Freeman, 2000; Rueda and Pontusson, 2000) as policy variables. Generous social transfers are associated with lower inequality as they increase the income of poorer households. Regarding unions, if strong union membership results in wages set above workers' marginal product of labor, it might increase unemployment and thus inequality. As noted in Checchi and García-Peñalosa (2008), the effect of unions on wage dispersion also depends on who is unionized. If unionization is stronger for wages in the middle of the wage distribution, stronger unions tend to lower inequality.

To include the influence of EU integration, I control for the three phases of EMU that culminated in the introduction of a common currency (Stage Three). Stage One corresponds to the economic phase of EMU with the ratification of the Treaty of the European Union (also called the Maastricht Treaty) which entered into force in 1993 and started the negotiations for a monetary union. Stage Two saw the adoption of the Stability and Growth Pact[17] designed to guarantee budgetary discipline after creation of the euro[18]. The effect of EMU on inequality is captured by three dummy variables. The dummy variable *Euro* is equal to 1 after a country has adopted the common currency and zero otherwise. Austria, Belgium, Finland, France, Germany, Italy, the

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[16] I obtain similar results when I measure output stability with the output gap (measured as the difference between real GDP and potential GDP, which is computed by detrending real GDP with the Hodrick-Prescott filter.

[17] While Stage Two of EMU started in 1994, the SGP framework was only adopted in 1997.

[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 1.5 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 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.

Netherlands, Portugal, and Spain adopted the euro in 1999, while Greece joined the eurozone in 2001. *Maastricht* is a dummy variable that takes a value of 1 from 1993 to 2003, and 0 otherwise, to capture the effects of the completion of the Single Market and the Treaty of the European Union. I also add a dummy variable, *SGP*, to capture the effect of the Stability and Growth Pact, adopted in 1997 to ensure that countries would attain the convergence criteria before and maintain them after adopting the common currency. This variable takes a value equal to 1 for 1997 and the subsequent years, and 0 prior to 1997. The coefficients of the three EMU variables need to be interpreted with caution. The *Euro* variable, for instance, might capture how other events contemporaneous to the introduction of the common currency, such as changes in the global business cycle, have affected the eurozone countries differently from countries that have not adopted the euro (Denmark, Sweden, and the UK).

Following the literature on the effect of EMU on interregional disparities[19] and because the signature of the Maastricht Treaty coincided with the creation of the Cohesion Fund, I distinguish the effect of EMU on Cohesion countries by interacting the three EMU variables with a dummy variable, *Cohesion,* which is equal to one for the three countries receiving some Cohesion Fund included in this study, Greece, Portugal and Spain[20]. For EU regional policy impacts, I measure the annual national allocations of Structural Funds and of Cohesion Fund as percentages of national GDP, using data on the Structural Funds and on the Cohesion Fund from Doménech (2000). Structural Funds are allocated among all EU member states, while the Cohesion Fund is allocated only among four countries (Greece, Ireland, Portugal, and Spain). The data appendix provides details on the data and their sources. Table 1 reports the summary statistics for all the variables used in the panel.

I estimate the following equation:

$$inequality_{i,t} = \mathbf{x}_{i,t}\boldsymbol{\beta} + \mathbf{z}_{i,t}\boldsymbol{\gamma} + \mathbf{w}_{i,t}\boldsymbol{\delta} + \alpha t_t + u_{i,t} \qquad (1)$$

where $i=$ *country* and $t=$ *year, 1977-2003* and $x_{i,t}$ is a matrix of the demographic variables described above, $z_{i,t}$ is a matrix of the national macroeconomic and policy related variables; t_t is a time trend; $w_{i,t}$ is a matrix of one of the EMU variables (*Euro, Maastricht, or SGP*) and its

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[19] Barry and Begg (2003); Barry (2003); Begg (2003); Midelfart et al. (2003); Artis et al. (1997).
[20] Ireland also received monies through the Cohesion Fund, but is not included in the study.

interaction terms with the Cohesion dummy variable. The error term, $u_{i,t}$, is defined as: $u_{i,t} = \gamma_i + \varepsilon_{i,t}$ where γ_i is time-invariant and denotes any country-specific effect not included in the regression and $\varepsilon_{i,t}$ denotes the remainder disturbance. By assumption, $E(\varepsilon_{i,t}) = 0$ and $Var(\varepsilon_{i,t}) = \sigma^2$. Equation 1 is estimated with country fixed effects.

-Insert table 2 here –

4.2 Results

Tables 2 and 3 report the OLS estimates for equation 1. Fixed effects are preferred to random effects because the Hausman tests also reported in tables 2 and 3 reject the hypothesis that country-specific effects γ_i are uncorrelated with the regressors (with the exception of the first three columns of table 2). For ease of presentation in both tables, the GE(1) index used as dependent variable is multiplied by 100. The regression results reported in columns 1 to 3 of table 2 initially exclude the interaction terms with the Cohesion dummy variable (added in columns 4 to 6). The Structural Funds and Cohesion Fund variables are added to the specification in table 3.

Starting with table 2, more employment in the manufacturing sector and a higher female labor force participation rate are associated with lower income inequality. A larger share of national employment in agriculture is also associated with lower inequality, but this effect is smaller than the one observed for the manufacturing sector. I find no robust evidence that macroeconomic instability, proxied by the volatility on the growth rate of per capita GDP and the inflation rate, is associated with higher levels of inequality. As in Bertola (2008), unemployment is negatively related to income inequality. In his article, Bertola argues that this negative correlation could be due to features of the labor markets that keep wages above their market-clearing levels, notably for low-productivity workers. I also find evidence, although somewhat weaker than in Bertola (this issue), that higher social transfers are associated with less inequality: a one percentage-point increase in the share of social transfers in national GDP is correlated with a 1.05% decrease in inequality (decrease by 0.024 percentage points, column 2). Union density is positively related to interregional inequality: a one percentage-point increase in union membership is associated with a one percent increase in inequality.

As for the overall effects of EMU (columns 1 to 3 of table 2), the introduction of the euro

and the implementation of the SGP are associated with an increase in inequality of 9.12% and 11.7% respectively, whereas the establishment of the Single Market coincides with a reduction in inequality of 6.6%. Bertola (this issue) also finds a positive correlation between the introduction of the euro and inequality. To explain this positive correlation, Bertola argues that economic integration enhances market competition, which forces countries to adopt less generous social policies. Once I interact the three EMU variables with the Cohesion dummy variable, I find that EMU has affected Cohesion countries differently from richer countries. As shown in column 4 of table 2, the adoption of the common currency has coincided with an increase in inequality in Cohesion countries but not in the richer countries. In Cohesion countries, the GE(1) index was 0.521 percentage points higher after 1999, which represents a 24.8% increase in inequality[21]. Likewise, earlier stages of EMU have been associated with an increase in inequality in Cohesion countries: on average, 12.4% after the creation of the Single Market, and 23.5% after the implementation of the SGP. While the introduction of the euro and the SGP have not significantly affected inequality in non-Cohesion countries, the creation of the Single Market is correlated with a decrease in inequality by 13.4% in these countries[22]. The positive coefficient on the interaction term between the euro variable and the Cohesion dummy variable, and the opposite effects of the Single Market on both groups of countries seem to corroborate Padoa-Schioppa's (1987) expectations that increased competition and improved price transparency could increase inequality in the less developed and less competitive member states, since only the richest regions can withstand international competition.

As the ratification of the Maastricht Treaty coincided with the creation of the Cohesion Fund, the *Cohesion-Maastricht* interaction term might also capture the effect of this instrument of EU regional policy. Because the completion of the Single Market and the introduction of the common currency meant stronger competition for Cohesion countries, these countries negotiated larger Structural Funds allocations and the creation of the Cohesion Fund before agreeing to move the economic integration process forward (Molle, 2007). To disentangle the two effects, I introduce the Structural Funds and Cohesion Fund variables in the specification. Table 3 presents these results.

Once I control for EU regional policy, the coefficients on the agricultural employment variable decrease in magnitude but remain statistically significant. The results for the other demographic and macroeconomic variables are robust to the introduction of these two policy

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[21] For Cohesion countries, the GE(1) index averaged 2.10 percentage points between 1977 and 2003.
[22] For non-Cohesion countries, the GE(1) index averaged 2.33 percentage points between 1977 and 2003.

variables.

The two main instruments of EU regional policy turn out to have opposite effects on inequality. The economic impact of both of them is limited. On the one hand, the Cohesion Fund is associated with more inequality. Using results from column 1, a back-of-the-envelope calculation suggests that doubling the average Cohesion Fund allocation (from 0.02% to 0.04% of GDP) would be associated with a 0.7% increase in GE(1). This positive correlation does not necessarily imply that the Cohesion Fund induces an increase in inequality, and could be due to reverse causality. Southern European countries might indeed have received more Cohesion Fund because inequality kept rising, which is the case in Portugal and Spain after 1995 (see figure 5). On the other hand, the Structural Funds are weakly associated with lower inequality. Using the results from column 2, doubling their size relative to GDP (0.415%[23] to 0.830% of EU GDP) would be associated with a decrease in inequality of 2.6% (0.059 out of 2.28 percentage points GE(1) average).

Several factors can explain the contrasting effects of the Structural Funds and Cohesion Fund on interregional inequality. First, their allocation procedures and their objectives are different. On the one hand, the Structural Funds are allocated at the regional level, based on regional economic and social criteria. They aim at promoting regional convergence, regional competitiveness, and employment (see Bouvet and Dall'erba (forthcoming) for a review of the Structural Funds policy). On the other hand, the Cohesion Fund is allocated to countries with per capita gross national products of less than 90% of the Community average, and is mostly devoted to transport projects (notably trans-European networks) which are likely to strengthen agglomeration forces, especially if these infrastructures link richer regions. As a result, the Cohesion Fund is less likely to promote interregional convergence than the Structural Funds. Second, as noted by Ederveen et al. (2006), both instruments of EU regional policy are at best conditionally effective at reducing interregional disparities because they finance projects which have to be co-funded by the recipient regions and/or countries. Since poor regions have the most difficulty augmenting European spending, it is rare that co-financing in low-income regions can double the amount allocated by the EU, while, in richer regions, co-financing more than triples the initial amount set by the EU Commission (Bouvet and Dall'erba, forthcoming). Finally, the effectiveness of EU regional policy depends on the quality of projects that regions and countries choose to co-fund with EU monies. This project selection is affected by the quality of the local bureaucracies which tends to be lower in Southern Europe. To

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[23] When the average is calculated over 1986-2003, when Structural Funds were actually distributed.

test this hypothesis, I have run the specifications presented in table 3 on two samples of countries[24]: one including the three Cohesion countries, and one including the ten non-Cohesion countries. I find that for the Cohesion countries, the Structural Funds have no effect on interregional inequality while they are associated with lower inequality in non-Cohesion countries.

Once I control for EU regional policy, the effects of the EMU variables remain identical in terms of their signs, but are smaller in magnitude. The persistent statistical significance of the coefficients on the *Maastricht* dummy and its interaction term with the Cohesion dummy confirms that the interaction term *Cohesion*Maastricht* dummy in column 5 was not just capturing the effect of the Cohesion Fund and the Structural Funds.

5 Conclusion

This paper analyzes the evolution of per capita regional income inequality between and within EU countries, and assesses the relative contributions of demographics, macroeconomic conditions, and policies towards explaining this evolution. Overall, interregional inequality has significantly decreased between 1977 and 2003. It remains, nonetheless, twice as high as inequality levels measured for U.S. states. Furthermore, movements in interregional inequality have varied significantly across countries. Within-country inequality reduction has been quite sizable in Southern European countries, notably after their accession to the EU (then called European Economic Community).

The breakdown of inequality into between-country and within-country components suggests that more than half of overall interregional income inequality, between 56% and 70%, occurs within countries rather than between countries. Moreover, the relative importance of the within component has increased over time, notably since the mid-1990s. Between 1995 and 2003, the decrease in interregional income inequality has been driven by a decreasing between-country component, while the within-country inequality was stable.

In examining the determinants of within-country regional inequality, I find that inflation and volatility in per capita GDP growth, which are presumed to fall with EMU, have no direct effect in inequality once I control for EMU, while generous social transfers are associated with lower interregional inequality. I 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

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[24] These results are available upon request.

adopt the common currency. These more radical adjustments and the enhanced price transparency and international competition probably explain why EMU, notably with the implementation of the convergence criteria and the adoption of the euro, has been associated with higher regional inequality within Southern European countries. EMU has had a more limited impact in non-Cohesion countries. While the creation of the Single Market has led to lower interregional inequality in these countries, the adoption of the euro and the implementation of the convergence criteria have had no significant impact. Using NEG theory, one could argue that EMU has led to more inequality in poorer countries such as Spain and Portugal but not in richer countries such as France and Germany because the latter have already fully exploited potential economies of scale, while, in the former, agglomeration forces are still at play, resulting in greater interregional inequality. Controlling for the development of EU regional policy contemporary with the establishment of the Single Market indicates that the positive correlation found earlier between the Maastricht Treaty and inequality in Cohesion countries does not simply capture the effect of the Cohesion Fund. The Cohesion Fund is indeed associated with more interregional inequality, while the Structural Funds are associated with lower inequality.

The overall decrease in inequality seems to provide some empirical substance to the neoclassical theory that predicts a decrease in disparities once there is free mobility of the factors of production. Yet, how could the neoclassical theory be reconciled with the persistence of interregional inequality within countries? Predictions of the neoclassical model are based on the assumptions of perfect competition and free factor mobility. Thus, inequality between countries might have decreased because EU integration has facilitated factor mobility between countries and increased international competition, but might not have affected competition and mobility within EU countries, notably within Southern European countries which are still characterized by rigid labor markets. Delivering economic growth and cohesion to EU regions, therefore, entails the completion of the labor market reforms launched with the Lisbon Strategy. Furthermore, the agglomeration of economic activity triggered by economic integration is also likely to have allowed only the richest regions of a country to converge with higher-income economies, thus deepening interregional income disparities within EU countries.

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Figures and tables

figure 1: Yearly Gini, GE(0) and GE(1) indices for the 197 EU regions included in the study, using PPP per capita GDP data, 1977-2003. *Source: elaboration on data from Cambridge Econometrics.*
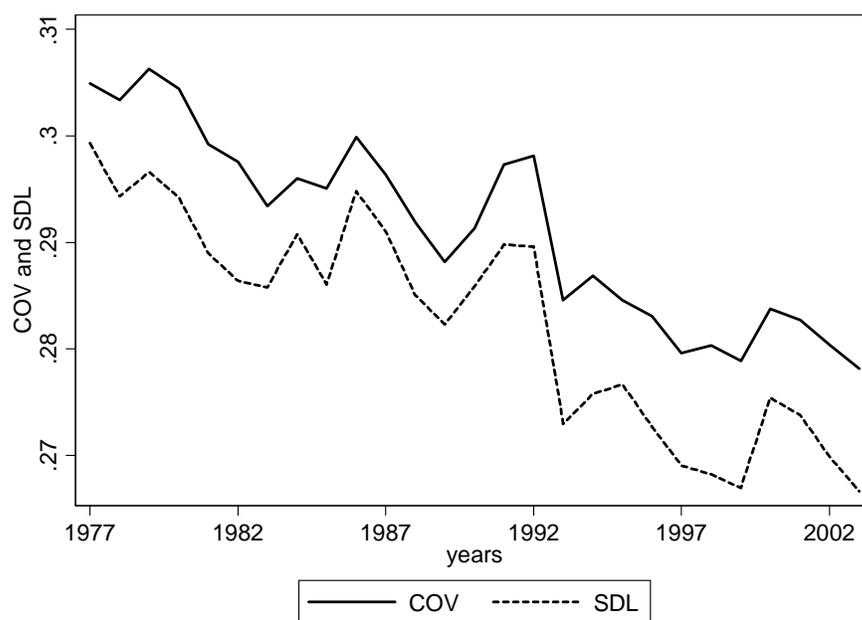
figure 2: σ-convergence across the 197 EU regions included in the study, using PPP per capita GDP data, 1977-2003. *Source: elaboration on data from Cambridge Econometrics.*

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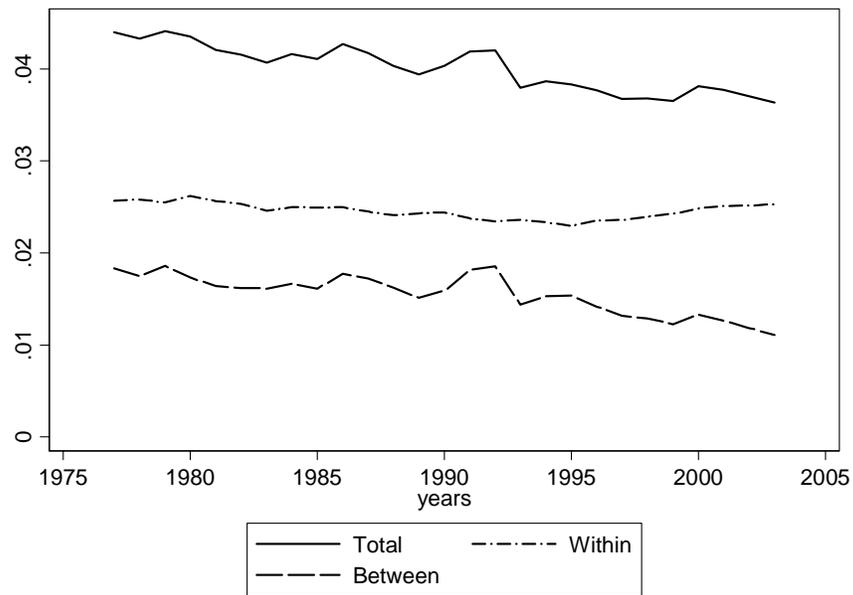
figure 3: Decomposition of the GE(1) index in its within- and between-country components, using PPP per capita GDP data, 1977-2003.
Source: elaboration on data from Cambridge Econometrics.

figure 4: Shares of between- and within-country inequality in the GE(1) index, using PPP per capita GDP data, 1977-2003. *Source: elaboration on data from Cambridge Econometrics.*

figure 5: Interregional inequality within 13 EU countries, using PPP per capita GDP data, 1977-2003. *Source: elaboration on data from Cambridge Econometrics.*

table 1: Summary Statistics
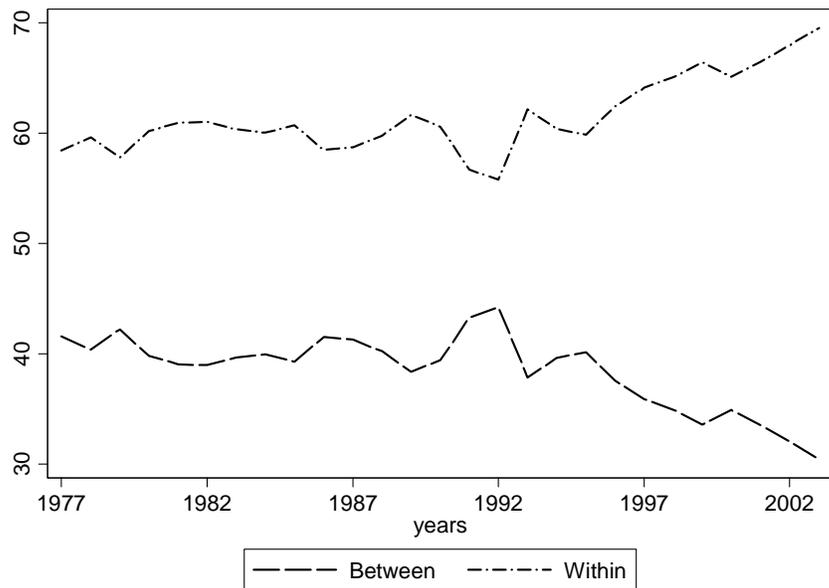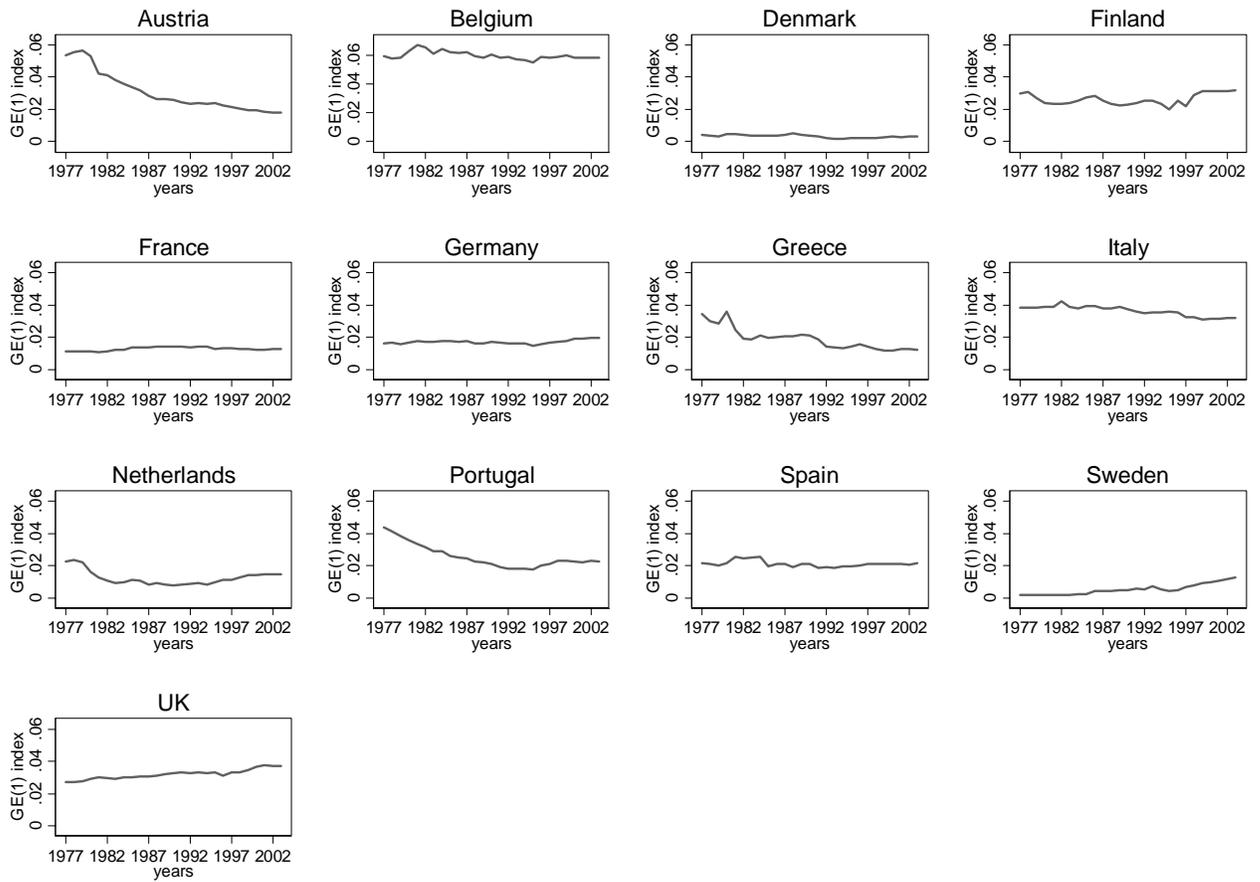
Variable	Obs	Mean	Std. Dev.	Min	Max	time span
PPP per capita GDP	300	97.24	18.55	54.00	157.00	1977–2003
GE(1) index (%)	300	2.28	1.48	0.16	6.43	1977–2003
Volatility of the growth rate of real per capita GDP	300	0.04	1.82	-9.00	4.52	1977–2003
Inflation rate (%)	300	5.46	5.19	-0.69	28.88	1977–2003
Share of employment in manufacturing (%)	300	21.93	4.21	12.93	35.07	1977–2003
Share of employment in agriculture (%)	300	7.57	6.45	0.76	30.18	1977–2003
Female Labor Force Participation rate (%)	300	58.83	12.85	32.76	83.33	1977–2003
Unemployment rate (%)	300	7.81	3.39	1.60	19.80	1977–2003
Social Transfers as % of GDP	300	17.38	4.13	8.90	28.50	1977–2003
Labor union membership (%)	300	42.89	23.20	7.38	87.42	1977–2003
Structural Funds as % of GDP	300	0.31	0.64	0	3.29	1977–2003

Note: the number of observations is limited to 300 because female labor force participation rate data are missing for Austria prior to 1995, for Belgium, Denmark, and Greece prior to 1982 and because 9 observations are missing in the union membership series (1977 to 1979 for Spain, 1978-1979 and 2002-2003 for Greece, and 1977-1979 and 2002-2003 for Portugal)

table 2: The Determinants of Inequality in the EU

	Dependant variable: within-country inequality					
	1	2	3	4	5	6
Volatility in the growth rate of	-0.008	-0.01	-0.015	-0.01	-0.005	-0.016
PPP per capita GDP	[0.014]	[0.015]	[0.014]	[0.014]	[0.015]	[0.014]
Inflation rate	0.007	0.01	0.008	0.01	0.019*	0.015
	[0.009]	[0.010]	[0.010]	[0.009]	[0.010]	[0.010]
Share of employment in	-0.142***	-0.150***	-0.142***	-0.142***	-0.148***	-0.139***
manufacturing sector	[0.021]	[0.022]	[0.021]	[0.021]	[0.022]	[0.021]
Share of employment in	-0.060***	-0.071***	-0.061***	-0.047**	-0.027	-0.038**
agriculture	[0.018]	[0.019]	[0.018]	[0.019]	[0.022]	[0.019]
Female Labor Force	-0.111***	-0.113***	-0.103***	-0.115***	-0.123***	-0.114***
Participation Rate	[0.012]	[0.012]	[0.012]	[0.012]	[0.013]	[0.013]
Unemployment rate	-0.035**	-0.033**	-0.033**	-0.023	-0.029*	-0.028*
	[0.015]	[0.016]	[0.015]	[0.015]	[0.015]	[0.015]
Social Transfers as a %	-0.013	-0.024*	-0.006	-0.021	-0.023*	-0.015
of GDP	[0.013]	[0.012]	[0.013]	[0.013]	[0.012]	[0.013]
Labor Union Membership	0.029***	0.030***	0.030***	0.025***	0.026***	0.026***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.005]
Euro	0.208***			0.087		
	[0.074]			[0.068]		
Euro*Cohesion Dummy variable				0.521***		
				[0.174]		
Maastricht		-0.151*			-0.313***	
		[0.088]			[0.111]	
Maastricht*Cohesion Dummy					0.574***	
variable					[0.190]	
SGP			0.260***			0.09
			[0.075]			[0.081]
SGP*Cohesion Dummy variable						0.493***
						[0.139]
Trend	-0.022**	-0.011	-0.032***	-0.017*	0.012	-0.015
	[0.009]	[0.009]	[0.010]	[0.009]	[0.012]	[0.011]
Constant	11.918***	12.360***	11.356***	12.135***	12.261***	11.793***
	[1.293]	[1.320]	[1.306]	[1.280]	[1.311]	[1.308]
Observations	300	300	300	300	300	300
Number of countries	13	13	13	13	13	13
R-squared	0.518	0.514	0.522	0.53	0.529	0.535
F-statistic that country fixed						
effects=0	140.99	140.21	143.41	139.34	139.68	141.4
(p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Hausman test	2.07	0.75	0.89	246.34	246.42	246.85
(p-value)	0.996	1.000	0.999	0.000	0.000	0.000

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

table 3: The Impact of EU regional policy on inequality

Dependant variable: within-country inequality

	1	2	3
Volatility in the growth rate of	-0.011	-0.007	-0.016
PPP per capita GDP	[0.014]	[0.015]	[0.014]
Inflation rate	0.011	0.018*	0.014
	[0.010]	[0.010]	[0.010]
Share of employment in	-0.137***	-0.139***	-0.138***
manufacturing sector	[0.021]	[0.022]	[0.021]
Share of employment in	-0.036*	-0.036	-0.042**
agriculture	[0.020]	[0.022]	[0.021]
Female Labor Force	-0.116***	-0.122***	-0.114***
Participation Rate	[0.012]	[0.013]	[0.013]
Unemployment rate	-0.025	-0.028*	-0.028*
	[0.015]	[0.015]	[0.015]
Social Transfers as a %	-0.018	-0.022*	-0.015
of GDP	[0.013]	[0.013]	[0.013]
Labor Union Membership	0.025***	0.024***	0.025***
	[0.006]	[0.006]	[0.006]
Structural Funds	-0.049	-0.142**	-0.026
	[0.053]	[0.059]	[0.063]
Cohesion Fund	0.722**	0.512	-0.043
	[0.316]	[0.365]	[0.384]
Euro	0.094		
	[0.069]		
Euro*Cohesion Dummy variable	0.453***		
	[0.174]		
Maastricht		-0.299***	
		[0.110]	
Maastricht*Cohesion Dummy variable		0.485**	
		[0.209]	
SGP			0.088
			[0.082]
SGP*Cohesion Dummy variable			0.484***
			[0.161]
Trend	-0.012	0.012	-0.015
	[0.009]	[0.012]	[0.011]
Constant	11.888***	12.229***	11.842***
	[1.280]	[1.325]	[1.322]
Observations	300	300	300
Number of countries	13	13	13
R-squared	0.534	0.535	0.535
F-statistic that country fixed effects=0	136.26	134.48	138.46
(p-value)	0.000	0.000	0.000
Hausman test	244.1	243.63	244.65
(p-value)	0.000	0.000	0.000

Robust standard errors in brackets

* significant at 10%; ** significant at 5%; *** significant at 1%

Data Appendix

Variable definitions:

Within-country inequality: measured with GE(1) index as inequality between regions of a same country.

Volatility in the growth rate of PPP per capita GDP: measured as the difference between the yearly growth rate of real per capita GDP and the average yearly growth rate of real per capita GDP (average computed over 1977-2003).

Inflation rate: computed as annual percentage change in Consumer Price Index, in percentage points.

Share of employment in the manufacturing sector: share of employed workers in the manufacturing sector, in percentage points.

Share of employment in the agricultural sector: share of employed workers in the agricultural sector, in percentage points.

Female labor force participation rate: in percentage points.

Unemployment rate: harmonized unemployment rates, >25 year-old, in percentage points.

Social transfers: Social transfers other than in kind paid by general government, as a percentage of GDP.

Labor union membership: percentage of the employed workers that are members of labor unions, in percentage points.

Structural Funds: annual actual payments of EU Structural Funds to a country expressed as a percentage of this country's GDP, in percentage points. The 1986 Single European Act laid the bases for a genuine EU regional policy and led to the creation of the Structural Funds in the same year. Variable is equal to 0 for all countries prior to 1986.

Cohesion Fund: annual actual payments of EU Cohesion Fund to a country expressed as a percentage of this country's GDP, in percentage points. The Cohesion Fund was created in 1993. Variable is equal to 0 for all countries prior to 1993.

Euro: dummy equal to 1 after a country has adopted the common currency and zero otherwise. Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal and Spain adopted the euro in 1999, while Greece joined the eurozone in 2001.

Maastricht: dummy equal to one from 1993 to 2003

SGP: dummy equal to one from 1997 to 2003

Cohesion Dummy variable: dummy equal to one for Greece, Portugal and Spain

Sample:

1977 -2003 annual data for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain, Sweden, and the UK

Sources:

Volatility in the growth rate of PPP per capita GDP: Cambridge Econometrics Database
Inflation rate: OECD Monthly Economic Indicators
Share of employment in the manufacturing sector: Cambridge Econometrics Database
Share of employment in the agricultural sector: Cambridge Econometrics Database
Female labor force participation rate: OECD
Unemployment rate: AMECO, database of European Commission's DG ECFIN
Social transfers: AMECO, database of European Commission's DG ECFIN

Labor union membership: OECD
Structural Funds: Doménech et al. (2000)
Cohesion Fund: Doménech et al. (2000)

Cambridge Econometrics data set is mainly based on information provided by Eurostat. Because Eurostat regional dataset is incomplete for the 1970s and early 1980s, Cambridge Econometrics completes these data with European national statistics sources.