

WHAT DOES GREATER ECONOMIC INTEGRATION MEAN FOR INTERREGIONAL INCOME INEQUALITY? AN ANALYSIS OF OECD COUNTRIES AND REGIONS

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***Abstract** - This paper provides an overview of the evolution of interregional income disparities among 304 regions from 27 OECD countries between 1995 and 2005. This sample of regions allows to compare interregional income inequality in different economic integration systems: the USA (used as an example of a political union), the European Economic and Monetary Union (EMU), the European Union (EU), and the North-American Free Trade Agreement (NAFTA). Overall, interregional income inequality is lower among US states and EMU regions than among EU regions and NAFTA regions. Thus, interregional income inequality seems to be negatively related to economic integration. However, income inequality has risen among US states, while it has been stable among OECD regions, and has even decreased among European regions. Moreover, rank-size scatterplots suggest that inequality is higher among low-income regions than among richer regions.*

Key-words: REGIONAL INEQUALITY, ECONOMIC INTEGRATION, EUROPEAN UNION, EMU, NAFTA, ZIPF LAW.

JEL Classification : R11, O52, E65.

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INTRODUCTION

This paper aims at a better understanding of the impact of economic and monetary integration on regional income inequality. 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, 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 countries/regions, leading to decreasing inter-regional income disparities. 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. Overtime, 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, labor market rigidities. Until the 1970s, the neoclassical view seemed to be corroborated by the experience of most developed countries. However, the recent upsurge in inequality among many of these same countries (such as the US) has thrown into question conventional economic theory and sent scholars searching for explanation.

To contrast with this approach, contributions to the new economic geography (NEG) theory argue that, by promoting trade and factor mobility, deeper economic integration (captured by reduction in trade barriers) 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). Moreover, by inducing deeper industrial specialization within the economic system, economic integration might increase the risk of asymmetric shocks (Midelfart et al., 2003; Ardy et al., 2002).

Optimal Currency Area theory (Kenen, 1969 ; Mundell, 1961; McKinnon, 1962 ; Mongeli, 2002) considers that monetary integration embodied in 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 national or regional asymmetric shocks, which could increase interregional inequalities.

The empirical literature has not yet eliminated these theoretical doubts about the effects of economic integration. Among the studies using microdata to construct inequality indices, Mahler et al. (1999) find that economic globalization (measured as exports, imports, and investment) is not an important factor in explaining the recent trends in personal income inequality in developed countries. Yet, using macroeconomic data, Ben-David (1993) concludes that convergence among European countries belonging to the European Economic Community coincided with the introduction of trade reforms (deeper economic integration). Thus, the debate on the relationship between economic integration and income inequality is far from being closed.

To assess the impact of economic and monetary integration on regional disparities, this paper investigates the evolution of interregional income inequality among 304 OECD regions between 1995 and 2005. The experiences of the United States, the European Economic and Monetary Union (EMU), the European Union (EU), and the North-American Free Trade Agreement (NAFTA) provide a very useful arena for examining the link between economic and monetary integration and interregional income inequality. The most integrated system of a political union is illustrated with the case of the United States, while NAFTA corresponds to the lowest level of economic integration, and EMU and the EU correspond to intermediate levels of integration. Understanding whether deeper economic integration amplifies or reduces interregional inequality is especially critical for the EU which devotes a large fraction of its budget (36% of its 2007-2013 budget) to its cohesion policy. International relations scholars indeed argue that EU cohesion policy has been used to compensate member states for the “widening” and the “deepening” of European integration (Allen, 2005; Molle, 2007).

First, the overall level of interregional income inequality is measured with indices commonly used to study personal income disparities (Atkinson, 2003; Partridge et al., 1996; Beblo and Knaus, 2001; Heshmati, 2004). Overall inequality evaluates inequality within a system such as a set of regions. A low level of overall inequality is associated with regional convergence, even though the former does not provide any information about the regional dynamics behind the convergence process. A decline in interregional inequality, especially within the most integrated economic systems, would provide empirical support to the neoclassical theory, while an increase in inequality would highlight the relevance of the NEG model. Furthermore, because the neoclassical model assumes free mobility of factors of production, persistence in inequality within a system might not invalidate the neoclassical theory but merely indicates that the underlying assumptions of the theory are not satisfied. Insofar as the analysis conducted in this paper offers only stylized facts about interregional inequality within different economic systems and does not control for other factors that could affect inequality (such as regional redistributive policies, asymmetric economic shocks, etc...), it does not allow us to draw strong conclusions on the impact of economic integration on interregional inequality. Instead, this paper presents some stylized facts that would need to be explained by further research relying on more rigorous econometrical analysis.

Furthermore, as pointed out by Rey (2001), overall inequality measures can mask important development within the distribution. To address this issue, I check whether within or between-country inequalities drive inequality among OECD regions. I also expand the rank-size function to estimate whether inequality varies with a region's rank within the income distribution.

The remainder of the paper is organized as follows. Section 1 presents the data set and the methodology used to measure interregional inequality among OECD regions. Section 2 presents the evolution of interregional income inequality among OECD regions and within the economic systems these regions belong to. Section 3 looks at the variation in inequality between and within countries members of these economic systems. Finally, the conclusion summarizes the main findings and discusses further research agenda.

1. DATA AND METHODOLOGY

The primary purpose of this paper is to provide a descriptive account of the evolution of regional income inequality within the four aforementioned economic systems, and of the possible relationship between economic integration and interregional income inequality. Regional income is measured as GDP per capita in USD constant prices, constant PPPs, OECD base year 2000. These data are obtained from the OECD Regional Statistics. The series are calculated by the OECD Secretariat based on the GDP at current prices divided by the Gross Domestic Product Annual Deflator (base 2000 = 100) and by the 2000 PPP rate. The results are GDPs per capita expressed in US\$ comparable across countries and over time. Because price data are based on GDP deflators, they 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.

The OECD data set covers the 1990-2006 period, but the number of observations varies by country: data are available for US states only from 1997 to 2005, from 1997 to 2004 for Mexican states, and from 1995 to 2005 for most European countries. The analysis presented below includes 27 OECD countries¹ and their 304 regions (a list of these countries and their disaggregation in regions is presented in appendix A). Regions in OECD Member Countries have been classified according to two territorial levels (TL). The higher level (Territorial Level 2) consists of about 335 macro-regions while the lower level (Territorial Level 3) is composed of 1681 micro-regions. The analysis presented in this paper is based on regions defined as Territorial Level 2. This classification – which, for European countries, is largely consistent with the Eurostat classification – facilitates greater comparability of regions at the same territorial level. The differences with the Eurostat NUTS classification concern Belgium, Germany, Greece, and the Netherlands for which the analysis is based on NUTS 1 regions.

¹Turkey, Iceland, and New Zealand are excluded from the analysis because their data availability was too limited.

Before using the per capita income data to compute inequality measures, one can get a sense of the extent of income disparities among OECD countries and regions by considering the summary statistics presented in table 1. At the regional level, Oslo in Norway was the richest region of the sample in 1997, and had a per capita income 16.4 times higher than the income of Oaxaco in Mexico, which was the poorest region in 1997. The discrepancy between the richest and poorest regions was even larger in 2004, as the per capita income in Brussels (Belgium) amounted to 18.6 times the income of Chiapas, Mexico. At the country level, the income ratios between the richest country (Luxembourg) and the poorest one (Mexico) were smaller than those observed among regions, and were equal to 5.67 and 6.70 in 1997 and 2004 respectively.

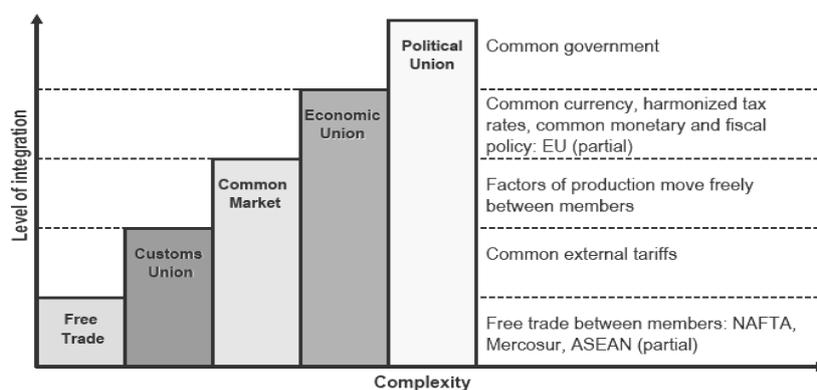
Table 1: Summary Statistics

	Highest per capita income (in real PPP \$)	Lowest per capita income (in real PPP \$)	Mean (in real PPP \$)	Standard deviation (in real PPP \$)
Regions				
1997	Oslo (Norway): \$50,419	Oaxaco (Mexico): \$3,068	\$20,950	\$9,031
2004	Brussels (Belgium): \$63,879	Chiapas (Mexico): \$3,429	\$26,759	\$11,526
Countries				
1997	Luxembourg: \$41,987	Mexico: \$7,400	\$22,172	\$7,870
2004	Luxembourg: \$56,122	Mexico: \$8,371	\$26,054	\$9,658

Source: elaboration on data from OECD Regional Statistics.

To analyze the implication of economic integration for interregional income inequality among OECD countries and regions, we first need to classify the economic systems made of OECD countries according to their levels of economic integration. The five levels of integration are illustrated in figure 1, and can be described as follows :

- Free trade area
 - All barriers to trade of goods/services are removed
 - Each country allowed to determine non-member policy
- Customs Union
 - Eliminates trade barriers between member countries
 - Adopts common external trade policy
- Common Market
 - No barriers to trade among member countries
 - Common external trade policy
 - Allows factors of production to mover freely among members
- Economic Union
 - Free flow of products and factors of production
 - Adoption of common external trade policy
 - Requires common currency, harmonization of tax rates, common monetary and fiscal policy
- Political Union
 - Central political apparatus coordinates economic, social and foreign policy of members.

Figure 1: Levels of economic integration

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Source: Rodrigue (2006).

Among OECD countries and economic systems, I use the US states to illustrate the case of a complete political union². While the other OECD countries can be categorized as political unions, I chose to use the USA because its demographic and economic sizes are comparable to those of the European Union. Despite these similarities, the USA and the EU should be compared with caution, as they differ in their origin, age, institutional design, and their economic and social culture. EMU and to a lesser extent the EU represent economic unions, while NAFTA (USA, Canada, and Mexico) can be categorized as a free trade area. Given the years covered in this study, the analysis for the EU is based on data for the EU15 countries, while the analysis for EMU includes the countries which had adopted the euro by 2001³. These different levels of economic integration reached by OECD countries allow us to compare interregional inequality in different economic integration systems. These economic systems differ in many aspects: the depth of the integration, but also their duration, and whether these systems involve countries/states with somewhat similar levels of development (like the US states, the EU or EMU) or very different development levels (like NAFTA).

2. INTERREGIONAL INCOME INEQUALITY IN OECD COUNTRIES

There is a great variety of measures available to inequality scholars, and the choice of a measure is always tricky because each measure has its merits and shortcomings. Scholars (Cowell, 2000; Bouguignon, 1979; López-Rodríguez and Faiña, 2006; Litchfield, 1999) yet agree on a set of axioms that an inequality measure should fulfill: the Pigou-Dalton transfer principle, income scale dependence, the principle of population, and the symmetry principle (see

²The analysis presented below is based on the 50 states, and excludes the District of Columbia.

³The euro was adopted in 1999 by Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, Portugal, Spain, and in 2001 by Greece.

appendix B for more details.) The Gini Index, the General Entropy measure with parameter 1 (GE(1), also referred as Theil index) satisfy these four axioms, and are therefore used in this paper to assess the level of inequality among OECD regions. The formulas used to compute these measures are reported in appendix C.

Since 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, 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 Community⁴ and by EU cohesion policy, the aim of the EU is to reduce disparities among regions, not among EU citizens.

Figure 2 illustrates the temporal patterns of the Gini and GE(1) indices. Before discussing the evolution of income inequality within the different economic systems, I first compare their inequality levels. Inequality among OECD countries (figure 2(a)) has been lower than inequality among OECD regions (figure 2(b)). Income inequality among OECD regions was indeed 150%⁵ higher than among OECD countries in 2004. This first observation is not surprising since national average per capita GDP smoothes out regional disparities. Comparing the different economic systems, inequality has been higher among NAFTA regions (figure 2(c)) than among EU and EMU regions (figures 2(d) and 2(e)) and US states (figure 2(f)). In 2004, inequality among EU regions was 450% higher than among US states, whereas inequality among NAFTA regions was 1,158% larger than inequality within the USA. This last result is not surprising either given that US states are among the richest OECD regions and Mexico has some of the poorest OECD regions. Inequality levels differ also between EMU and the EU. In 2004, inequality in per capita GDP was 253% higher among EU regions than among EMU regions. Overall, there seems to exist a negative correlation between inequality in per capita GDP and deeper economic integration, which would support the neoclassical theory.

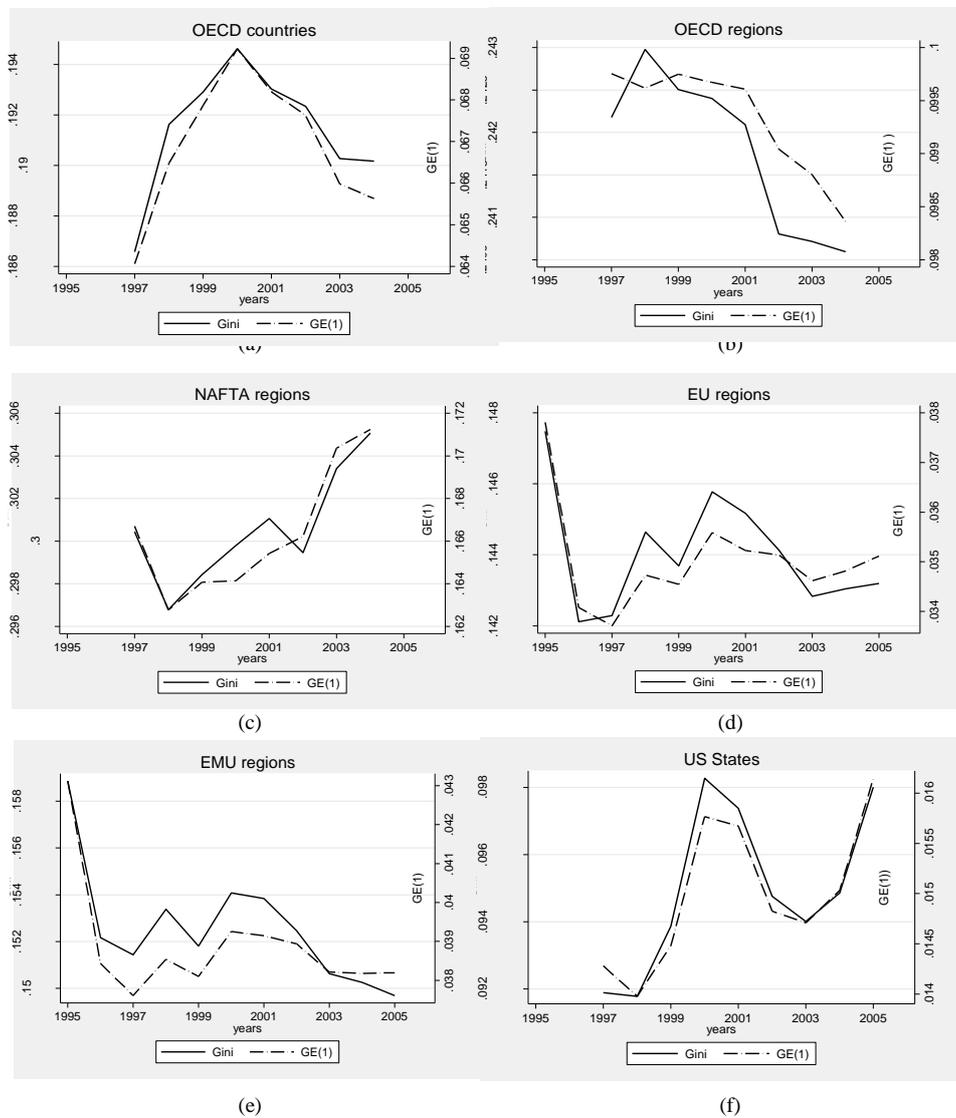
Regarding the evolution of inequality between 1997 and 2004, the GE(1) and Gini indices show remarkably similar trends. While inequality has been relatively stable among OECD regions (decrease by 1.40% between 1997 and 2004), cross-country inequality first increased between 1997 and 2000 and then decreased until 2004. Inequality among NAFTA regions has increased between 1997 and 2004 by 2.7%. This finding corroborates Madariaga et al. (2004)'s analysis of sigma-convergence between the USA and Mexico which concludes that income levels have diverged between the two NAFTA partners. Inequality

⁴Article 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”.

⁵The statistics provided in this section are based on the GE(1) index.

has also risen among US states (+5.27% between 1997 and 2004). According to Fan and Casetti (1994), it has actually been increasing since 1975. Further research would be necessary to verify whether the implementation of NAFTA is partly responsible for the aforementioned increase in interstate inequality. If economic integration is indeed responsible for the recent evolution of inequality among US states and within NAFTA, then this trend in inequality would not support Kuznet's inverted-U hypothesis nor the neoclassical theory, but instead would support the predictions of the new economic geography theory.

Figure 2: Overall Inequality



Source: elaboration on data from OECD Regional Statistics.

As for European regions, there has been no significant differences in inequality within the EU and within EMU. Between 1997 and 2004, inequality among EMU regions decreased by 1.5%, while inequality among EU regions dropped by 7.20%. Using comparable data, Bouvet (2010) finds that interregional income inequality has been decreasing among EU regions at least since 1977.

How can we reconcile the opposite inequality trends in America and Europe? Because the construction of the United States as a political union is far much older than the period covered in this paper, the observed increasing inequality has probably not been caused by further integration within the USA, but may have been caused by other factors, such as the participation of the USA into another economic block (i.e. NAFTA), sectoral shifts, or the geographic concentration of certain industries (such as high-tech industry in the Silicon Valley, and long Route 128 in Boston.) Another possible solution is to consider the extent of the US and EU regional redistributive policies. A substantial regional redistributive policy should indeed help limit interregional income disparities. Thus, interregional income inequality might be lower in Europe owing to a more extensive regional policy than in the USA. While in Europe, cohesion policy will account for 35.7% of the total EU budget or 347.41 billion euros in 2007-2013 (which represents almost 50 billion euros each year), the US federal government spent an annual average of 9 billion dollars on regional economic development programs (Drabenstott, 2006). When comparing the regional economic development policies of these two economic blocks, one should keep in mind that the design and the size of these policies are very likely influenced by differences in the blocks' age, origin, institution designs, and economic and social culture. Thus, one could argue that the US policy is more limited than its European counterpart because interstate inequality has been relatively low, whereas the EU uses its regional policy to compensate member states for the “widening” and the “deepening” of European integration (Allen, 2005; Molle, 2007). A more rigorous econometric analysis would be necessary to identify the effects of regional policies on interregional inequality and the causality direction between these two variables.

3. INEQUALITY VARIATIONS

3.1. Decomposition of inequality between and within countries

The conventional inequality measures used in section 2 capture the overall spread of regional income distribution. In addition to variation across economic systems and over time, inequality among OECD regions can be further analyzed by distinguishing inequality within and between-countries belonging to the same economic system. From this exercise, we can infer whether the relative importance of the within and between components of regional income inequality varies with the level of economic integration. Inequality decompositions is also helpful to analyze changes in income inequality over time.

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: $I_{total} = I_{between} + I_{within}$ (see appendix D). Not all inequality indices are additively decomposable. Shorrocks (1980, 1984) shows that the only additively decomposable inequality measures that also satisfy a set of desirable axioms (mentioned in section 2) are General Entropy (GE) indices. The decomposition of inequality is carried out using the GE(1) index⁶.

For the USA, this inequality decomposition can only be done if the country's states partitioned into subgroups. I use the Bureau of Economic Analysis (BEA)'s 9 regions (see appendix E) to decompose interstate income inequality. Because the shares of within and between inequality have not significantly changed over the period covered in the study, their average values for each economic system are presented in table 2. At this stage of the paper, it is important to keep in mind that the use of national price data to compute regional PPP GDP might result in underestimating PPP GDP in poorer regions (where prices tend to be lower), and thus in overestimating within-country inequality.

Table 2: GE(1) index decomposition

		average value	share in GE(1) index
OECD regions	Within	0.0323	29.49
	Between	0.0771	70.51
	Total GE(1)	0.1094	100.00
NAFTA regions	Within	0.0476	24.84
	Between	0.1439	75.16
	Total GE(1)	0.1915	100.00
European Union regions	Within	0.0234	66.82
	Between	0.0116	33.18
	Total GE(1)	0.0350	100.00
EMU regions	Within	0.0252	64.86
	Between	0.0137	35.14
	Total GE(1)	0.0388	100.00
USA states	Within	0.0970	64.67
	Between	0.0053	35.33
	Total GE(1)	0.0150	100.00

Source: elaboration on data from OECD Regional Statistics.

The decomposition yields different results for lower levels of economic integration than for economic systems with deeper economic and political integration. Among OECD regions and NAFTA regions, 3/4 of inequality exists between countries instead of within countries. In more integrated economic systems (EU, EMU, and the USA), 65% of inequality stem from inequality

⁶I 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 and therefore are not reported.

within countries/BEA regions⁷. Why is inequality within countries relatively so large? Predictions of the neoclassical model are based on the assumptions of perfect competition and free factor mobility. Thus, deeper economic integration might have facilitated factor mobility between countries and increased international competition, but might not have affected competition and factor mobility within countries. This would be especially true for European countries which are still characterized by rigid labor markets, and low interregional labor mobilities. Using a simple NEG model, Martin (2005) argues that economic integration causes a reduction of international trade cost but no change in trade cost between regions of the same country. Due to the combination of national institutional features (such as a national minimum wage law which prevents labor costs to be even smaller in poorer regions) with this reduction of international trade cost, “poor regions cannot exploit their comparative advantage relative to rich regions as well as poor countries can exploit their comparative advantage relative to rich countries” (Martin, 2005; page 2).

3.2. Rank-size function: Zipf's law applied to regional income distribution

The decomposition performed in section 3.1 suggests that inequality between countries is much lower than among regions from the same country for the EU and US states, but not for NAFTA regions. Besides changing with the size of the geographic units (countries or regions) considered, inequality can also vary among groups of regions depending on these regions' positions in the income distribution. The rank-size function describes the relationship between the size and rank of observations arranged in a descending order according to size (Zipf, 1949). In the context of this paper, a region's size is captured by its real PPP per capita income, so that the wealthiest region in the sample has a rank equal to one and the poorest region has a rank equal to 304. While the rank-size function is rarely used to study income inequality (with the exception of Fan and Casetti, 1994, Gallegati and Clementi, 2005, 2006), this technique is usually applied in urban economics where cities are ranked according to their populations in order to assess the level of urban concentration (Gabaix, 1999; Brakman et al., 1999; Midelfart et al., 2003; Krugman, 1996; Nitsche, 2005). The inequality measure derived from the rank-size function, the power law exponent, is the coefficient b obtained by regressing logged regional per capita income, $y_{i,t}$ on logged rank, $r_{i,t}$:

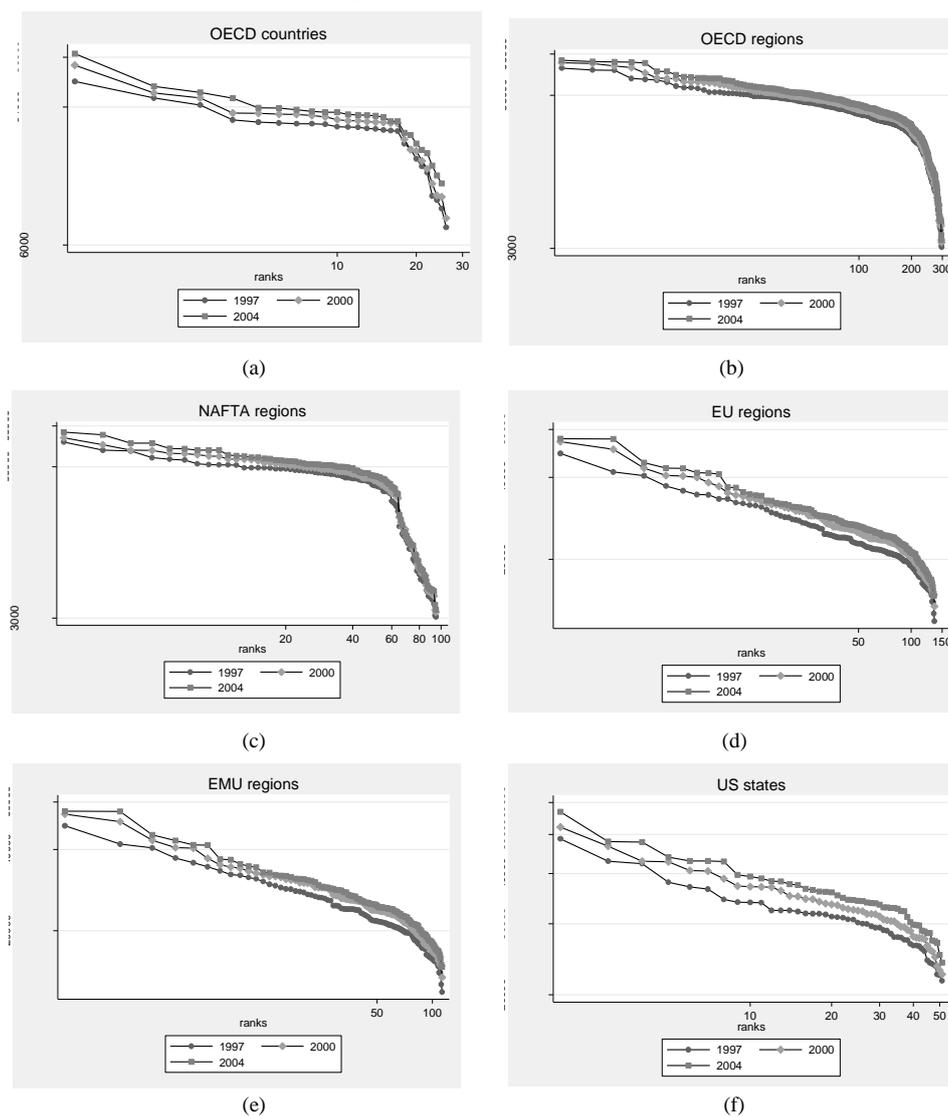
$$\ln y_{i,t} = a + b \ln r_{i,t} \quad (1)$$

The power law exponent evaluates the degree of income concentration in a system of regions, and corresponds graphically to the slope of the rank-size curve. This rank-size function provides only a measure of the overall inequality, because it assumes that inequality between all of the regions follows the same law. A more negative value of the exponent indicates greater overall inequality

⁷As noted in Rey (2001), the results of the decomposition of US inequality in its between and within components vary with the chosen partitioning scheme: the within-region component tend to be smaller when the decomposition is calculated with BEA regions (65% of total inequality) than with Census regions (90% of total inequality) or divisions.

across regions. The average values of the power law exponent presented in table 3 confirm that inequality tends to be lower in more integrated economic systems (such as the US and the EU).

Figure 3: Rank-size Plots



Source: elaboration on data from OECD Regional Statistics.

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 3), the slope (i.e. the power-law exponent) tends to be lar-

ger for lower ranks (for poorer regions). This implies that, like for U.S. states (Fan and Casetti, 1994), inequality is higher among low-income regions. This is especially true for the system including all of the OECD regions (figure 3(b)) and NAFTA regions (figure 3(c)) because Mexican regions are among the poorest regions in the sample (2/3 of Mexican regions consistently rank in the bottom 10% of the distribution of OECD regions, and all of Mexico's regions are poorer than their Canadian and US counterparts in NAFTA).

Table 3: Power Law Exponent

Economic System	Power Law Exponent averaged over 1997-2004
NAFTA	-0.680
OECD regions	-0.454
OECD countries	-0.405
EMU	-0.273
EU	-0.257
USA	-0.207

Source: elaboration on data from OECD Regional Statistics.

3.3. Expansions of the rank-size function

This non-linear relationship between a region's rank and per capita income can be further studied by expanding the rank-size equation. (Fan and Casetti, 1994) suggest making the slope of the rank-size function a function of the rank and the time trend, so that the rank-size specification can be rewritten as:

$$\ln \tilde{y}_{i,t} = a + b_{00} \ln r_{i,t} + b_{01} t \ln r_{i,t} + b_{02} t^2 \ln r_{i,t} + b_{03} t^3 \ln r_{i,t} + b_{10} r_{i,t}^2 \ln r_{i,t} + b_{11} r_{i,t}^2 t \ln r_{i,t} + b_{12} r_{i,t}^2 t^2 \ln r_{i,t} + b_{13} r_{i,t}^2 t^3 \ln r_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $\tilde{y}_{i,t}$ is the regional income expressed as a fraction of the income of the richest region in each economic system in the corresponding year⁸, t is the time trend, and $r_{i,t}$ is the regional rank. The original power-law exponent b from equation 1 can be reconstructed as:

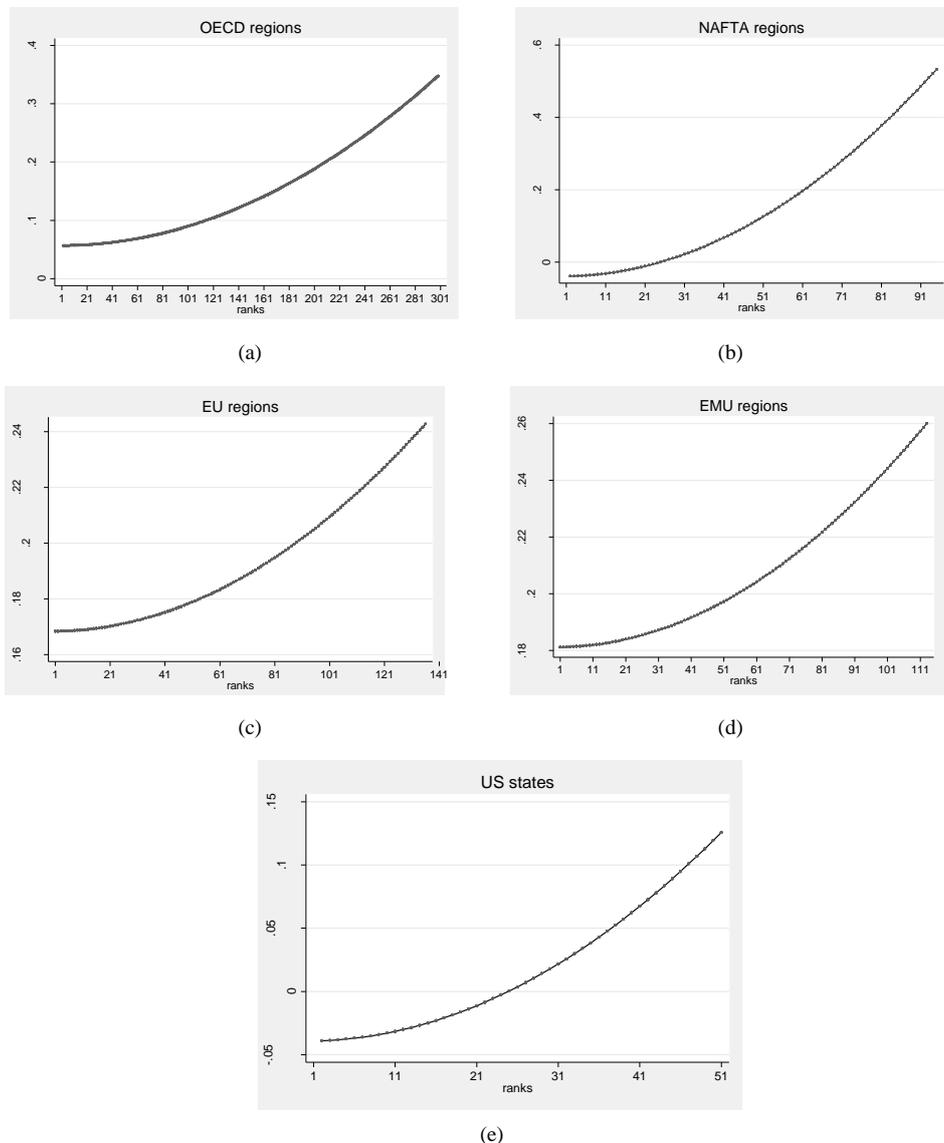
$$b = b_{00} + b_{01} t + b_{02} t^2 + b_{03} t^3 + b_{10} r_{i,t}^2 + b_{11} r_{i,t}^2 t + b_{12} r_{i,t}^2 t^2 + b_{13} r_{i,t}^2 t^3 \quad (3)$$

Substituting for t in equation 3 each year and taking the average of the power law exponent (\bar{b}) between 1997 and 2004, I illustrate variation in inequality by rank in figure 4. To ease the interpretation, I represent inequality measured as $-\bar{b}$ since a more negative value implies higher inequality across regions. For all of the economic systems, inequality is higher among the poorest regions (with a lower rank), as already noted in figure 3. This finding can be interpreted as cross-section evidence of Kuznet's inverted U relationship between economic development (measured by the level of per capita income) and regional income inequality, especially for NAFTA since Mexican regions

⁸As explained in Fan and Casetti (1994), this transformation helps reducing the complexity of the model and to focus the analysis on changes in inequality rather than on changes in income.

have per capita incomes significantly lower than those of their US or Canadian counterparts. It also provides some evidence for Martin (2005)'s argument that poorer regions are falling further behind because they cannot exploit their comparative advantage relative to richer regions, owing to some national institutional features (notably labor market institutions) that prevent these poor regions to improve their national cost advantage relative to richer regions from the same country.

Figure 4: Changes in inequality with rank



Source: elaboration on data from OECD Regional Statistics.

CONCLUSION

To examine the relation between economic integration and regional income inequality, I compare the levels and trends of inequality in four economic systems which have reached different integration levels: the US states, EMU, the EU, and NAFTA. Overall, inequality tends to be lower among regions that belong to a deeper integration process, such as the political union formed by US states or EMU. This stylized fact thus provides empirical substance to the neoclassical theory. The analysis of interregional income inequality based on the rank-size function suggests that inequality tends to be larger among low-income regions than among their richer counterparts, which provides some cross-section evidence of Kuznet's inverted U relationship between economic development (measured by the level of per capita income) and regional income inequality.

The increase in inequality within the USA and the decomposition of inequality in its between and within-country components yet cast some doubts on the neoclassical predictions. Indeed, in more integrated economic systems (the USA and the EU), most of the inequality among European regions and US states exists within European countries and BEA regions respectively, where potential forces of convergence (such as labor and capital mobility) are likely to be stronger. How could the neoclassical theory then 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, deeper economic integration might have facilitated factor mobility between countries and increased international competition by lowering international trade cost, but might not have affected competition/trade cost and factor mobility within countries. This would be especially true for European countries which are still characterized by rigid labor markets, and low interregional labor mobilities. As a result, deeper economic integration might have helped decrease inequality among countries but not within countries.

Insofar as the analysis conducted in this paper offers only stylized facts about interregional inequality within different economic systems and does not control for other factors that could affect inequality (such as regional redistributive policies, asymmetric economic shocks, sectoral shifts...), it does not allow us to draw strong conclusions on the impact of economic integration on interregional inequality. In the case of the USA for instance, because the construction of the United States as a political union is far much older than the period studied in this paper, the observed increasing inequality may have been caused by other factors, such as the participation of the USA into another economic block (i.e. NAFTA), sectoral shifts, or the geographic concentration of certain industries (such as high-tech industry in the Silicon Valley, and long Route 128 in Boston). As the current theoretical debate continues, much more empirical work needs to be carried out before we can truly grasp the relationship between economic integration and interregional income inequality. Further research should therefore aim at disentangling all the possible factors that could affect interregional income disparities, to better assess the impact of economic integration.

APPENDIX

A. Countries and Regions List

Country	number of regions	Country	number of regions
AUS: Australia	8	LUX: Luxembourg	1
AUT: Austria	9	MEX: Mexico	32
BEL: Belgium	3	NLD: Netherlands	4
CAN: Canada	12	NOR: Norway	7
CZE: Czech Republic	8	POL: Poland	16
DNK: Denmark	3	PRT: Portugal	7
FIN: Finland	5	SVK: Slovak Republic	4
FRA: France	22	KOR: Korea	7
DEU: Germany	16	ESP: Spain	19
GRC: Greece	4	SWE: Sweden	8
HUN: Hungary	7	CHE: Switzerland	7
IRL: Ireland	2	GBR: United Kingdom	12
ITA: Italy	21	USA: United States	50
JPN: Japan	10		

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.

C. Inequality Measures: Formulas

- Gini index

$$Gini = \frac{1}{2n^2 \bar{y}} \sum_{i=1}^n \sum_{j=1}^n |y_i - y_j| \quad (4)$$

where y_i = real wage in region i ; \bar{y} = the average wage 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

$$GE(1) = \frac{1}{n} \sum_{i=1}^n \frac{y_i}{\bar{y}} \log \frac{y_i}{\bar{y}} \tag{5}$$

where y_i = real wage in region i ; \bar{y} = the average wage across all of the regions; n = the number of regions included in the sample.

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

D. 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 wage share of group (country) g , T_g is the GE(1) index for that group, and \bar{y}_g is the average wage in group g , then the Theil index can be rewritten as

$$T = \sum_{g=1}^G s_g T_g + \sum_{g=1}^G s_g \ln \frac{\bar{y}_g}{\bar{y}} \tag{6}$$

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 real wage; \bar{y}_g is the average real wage in country g ,

$$s_g = \frac{\sum_{i=1}^k y_i}{\sum_{i=1}^n y_i} \quad T_g = \frac{1}{k} \sum_{i \in g=1}^k \frac{y_{i \in g}}{\bar{y}_g}$$

The first term in Equation 6 measures within-country inequality, and the second term is a weighted sum of between-country inequality.

E. BEA Regions

REGION	STATES
New England Region	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Mideast Region	Delaware, Maryland, New Jersey, New York, Pennsylvania
Great Lakes Region	Illinois, Indiana, Michigan, Ohio, Wisconsin
Plains Region	Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, South Dakota
Southeast Region	Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia
Southwest Region	Arizona, New Mexico, Oklahoma, Texas
Rocky Mountain Region	Colorado, Idaho, Montana, Utah, Wyoming
Far West Region	Alaska, California, Hawaii, Nevada, Oregon, Washington

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**LES IMPLICATIONS D'UNE PLUS GRANDE INTÉGRATION
ÉCONOMIQUE SUR LES INÉGALITÉS RÉGIONALES DE REVENUS :
UNE ANALYSE DES RÉGIONS ET DES PAYS DE L'OCDE**

Résumé - Cet article propose de comparer l'évolution des disparités régionales de revenu au sein de différentes zones d'intégration économique en considérant 304 régions des 27 pays de l'OCDE entre 1995 et 2005. De façon générale, les inégalités régionales de revenu sont plus faibles aux États-Unis et dans les régions de l'Union monétaire et économique européenne que dans les régions de l'Union européenne ou dans les régions de l'ALENA. Les inégalités régionales de revenu semblent, donc, être négativement liées à l'intégration économique. Cependant, ces inégalités ont augmenté aux États-Unis, tandis qu'elles sont restées stables dans les régions de l'OCDE et ont diminué dans les régions européennes. La relation rang-taille suggère que ces inégalités sont plus fortes entre les régions à faible revenu qu'entre les régions à revenu élevé.