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**An European Distribution of Income
Perspective on Portugal-EU
Convergence**

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An European Distribution of Income Perspective on Portugal-EU convergence

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Abstract

Growth and real convergence in Portugal are usually analyzed after EU accession on January 1st 1986 based on real GDP per capita. There is however a lack of literature approaching the subject from an European distribution of income perspective and for a longer time period. We fill this gap by using all available time series information on real GDP per capita and population covering a longer period from 1950 until 2009 in order to get a broader picture of the convergence process. The analysis is based on the income distribution for the countries that compose the EU-14 group computed using each country's mean income weighted by the respective population so that we have a distribution of income by individual. This cross-section distribution of income approach allows us to determine the shape of the distribution at each point in time and to study its evolution, and in this way to search for different convergence patterns, and thus analyze within a broader framework the Portuguese-EU convergence process. The results point to a bimodal EU-14 income distribution in 1950 and again in 2009, thus to two convergence clubs, and to two distinct convergence patterns over the whole period. From 1950 to 1974 convergence takes place, while from 1975 onwards it comes to a halt when considering the whole group. However, the same does not apply to Portugal from the 1980s until 2006, a country with a mean income lower than the EU-14 median income that continued to converge, although not necessarily due to European integration.

Keywords: real convergence, income distribution, σ -convergence, concentration and inequality measures

1. Introduction

Is the convergence process in the EU from the 1950s onwards marked by different trends pointing to different environments for the Portuguese real convergence process within the EU? Growth and real convergence in Portugal are usually analyzed after EU accession, on January 1st 1986 based on the behavior of real GDP per capita, see e.g. Duarte and Simões (2002) and Mateus (2006). However, there is a lack of literature approaching the subject from an European distribution of income perspective and a longer time frame. We fill this gap by using all available time series information on real GDP per capita covering the period from 1950 until 2009. The analysis is based on the cross-section distribution of income of the EU-14 that allows us to determine the shape of the distribution at each point in time and to study its evolution, and in this way to search for different convergence patterns in order to produce a broader framework to interpret the Portuguese-EU convergence process after accession. We compute the EU-14 income distribution based on information on mean income for each country weighted by the respective population.

This approach to real convergence has its roots on concepts like σ -convergence usually proxied by dispersion measures such as the coefficient of variation. The former evolved to a vast literature, known as the world income distribution literature that makes use of a greater number of inequality measures and is theoretically based on the well-known and largely recognized literature on economic inequality. Moreover, it has an important advantage relative to the σ -convergence literature: it explores the information relative to the evolution of the income distribution.

The paper is organized in four sections. After the Introduction, section 2 contains a bird's eye view on the real convergence process in the EU-14 after Portugal's accession based on a more traditional convergence analysis. The evolution of the EU-14 income distribution over the period 1950-2009 is analyzed in section 3. Section 4 presents some final remarks.

2. Growth and convergence in Portugal after EU accession: some descriptive insights

Table 1 contains information on real GDP per capita levels (2005 international USD) and average growth rates for the period 1986-2009. Over the whole period, Portugal grew faster than the EU-14 average. However, the Portuguese convergence and growth experience after EU membership was not uniform. In fact it can be divided into two periods: 1986-1998, a convergence period during which growth in the Portuguese economy accelerated and Portugal grew faster than the EU-14 average, 3.74% and 2.16%, respectively; and a stagnation/divergence period from 1999 onwards when its growth rate slowed down to figures lower than the reference group average, 0.65% and 1.23 %, respectively.

Table 1: Real GDP per capita levels and growth rates 1986-2009

	Real GDP per capita 1986 (2005 int. USD)	Real GDP per capita 1999 (2005 int. USD)	Av. Growth 1986-2009 (%)	Av. Growth 1986-1998 (%)	Av. Growth 1999-2009 (%)
Portugal	10795.22	18646.13	2.66	3.74	0.65
EU-14	20446.88	28199.84	1.93	2.16	1.23

Source: authors' computations based on data from the PWT 7.0

Figure 1 shows that during the period 1986–2009 absolute or unconditional β -convergence among the EU-14 took place, with the initially poorer countries growing on average faster than the richer ones, and thus converging in terms of levels of income per capita, although not necessarily to the same equilibrium situations. Performing the same analysis for the two sub-periods (Figures 2-3) shows however that the convergence rhythm changed dramatically from the first to the second sub-period, slowing considerably and possibly coming to a halt in the near future.

Figure 1:

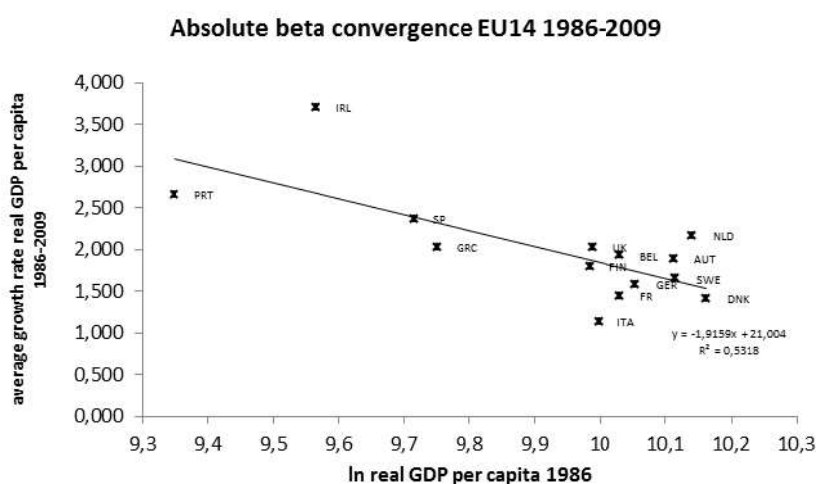


Figure 2:

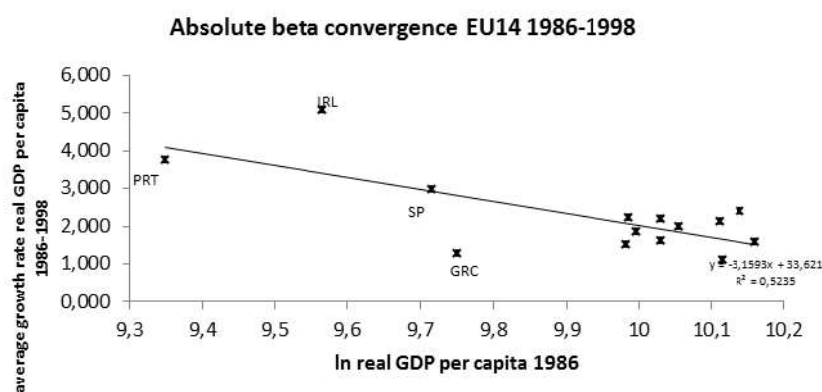


Figure 3:

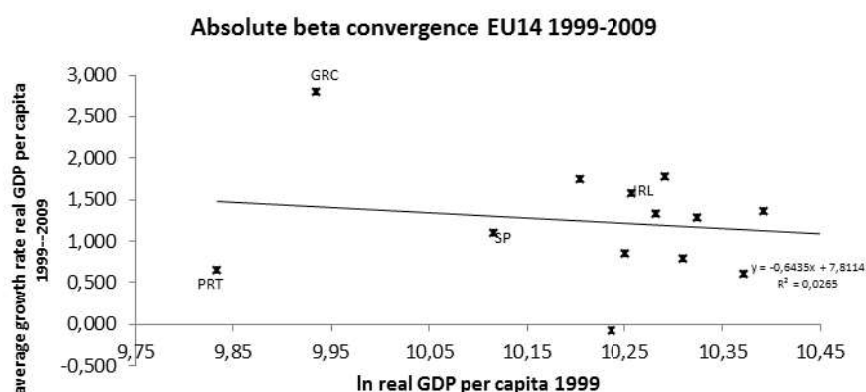
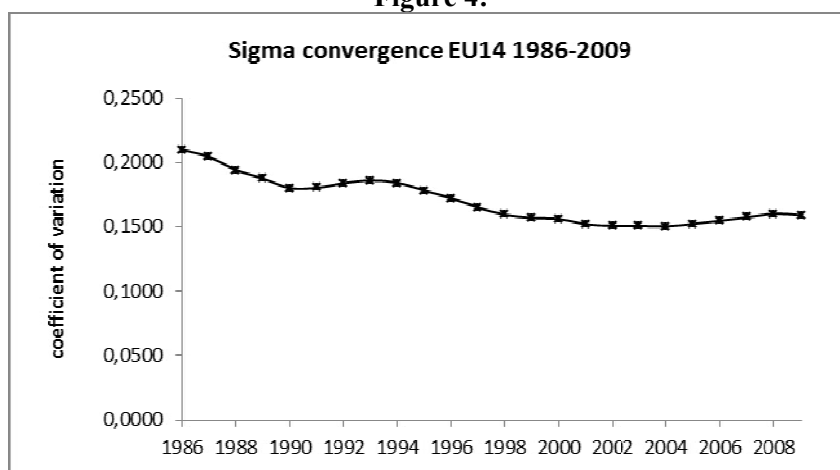


Figure 4 presents evidence on σ -convergence¹ that is on the evolution of disparities in terms of real GDP per capita among EU-14 countries over the period 1986-2009 based on the coefficient of variation. From the inspection of Figure 4 it is possible to conclude that there was considerable convergence between EU-14 countries until the early 2000s, but since around 2004 it has slowed down. From 1986 until 2004, the evolution of income disparities among EU14 countries indeed shows a clear downward trend, with the coefficient of variation decreasing from 0.21 to 0.1503. Since 2004 it has increased slightly up to 0.1603 in 2008 and then declined to 0.1592 in 2009.

Figure 4:



¹ The concepts of β and σ -convergence are closely related, with β -convergence as a necessary but not sufficient condition for the existence of σ -convergence.

3. The evolution of the EU-14 income distribution over the period 1950-2009

In this section, we first describe the methodology used to examine the convergence process among the EU-14 countries by looking at the characteristics and dynamics of the distribution of real GDP per capita. We then proceed to a visual inspection of density functions and afterwards analyze the evolution of some measures that characterize the different distributions.

3.1 The distributional approach to convergence

Our approach to the analysis of the process of real convergence in the EU-14² is developed in the framework of income distribution analysis by exploiting what Milanovic (2005; 2012) identifies as the *concept 2* of inequality and considers as the most suitable to address the issue of the evolution of the cross-country income distribution from the perspective of individuals. Economic research on world inequality has been carried out based on three different concepts of world inequality that although related are distinct since they reflect different phenomena. The issue of world inequality is studied either from the point of view of countries or from that of individuals. In the former case, the so-called *concept 1* of world inequality is used and in the latter one the so-called *concepts 2* and *3*. Economic growth analysis usually considers the first approach, analyzing convergence between countries in terms of income or real GDP per capita and thus makes use of *concept 1* which corresponds to unweighted international inequality. It follows that each country counts the same (through its mean income) irrespective of its population in the density function of the world income distribution. In the second approach weighted international inequality is taken into account. In the case of *concept 2* the mean country income is weighted by the population size in order to build the density function and to measure world income inequality. Under *concept 3* the individuals from each country included in the world income distribution are representative of the distribution of income of their own countries. From a theoretical point of view the last concept is the most appropriate to conduct world inequality analysis from the perspective of individuals. However, world income density functions and inequality measures are harder to compute in this last case. *Concept 2* lies between the other two and it presents two main advantages: it is simpler to compute than *concept 3* and it is a good predictor of the latter (Milanovic (2005)).

We thus compute the distribution of income in the EU-14 using information on each country's mean income weighted by its respective population. The variables used are population and real GDP per capita (*rgdpch*) from PWT 7.0 (Heston *et al.* (2011)). As the total number of countries considered in 1950 and 2009, and in other points in time, is not the same (in 1950, 12

² Countries considered: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

countries; 1951-69, 13, and afterwards 14 countries) we created samples of 1,000,000 values with replacements in every year. Several tools were used to conduct our analysis³.

First, we compute density functions to determine the shape of the EU-14 income distribution in 1950 and 2009 and we analyze its evolution in terms of divergence using polarization indexes, see e.g. Handcock and Morris (1999), and in terms of convergence using Lorenz dominance analysis, see e.g. Lorenz (1905) and Abdelkrim and Duclos (2007). The literature on the evolution of the income distribution, see e.g. Durlauf *et al.* (2005) and Quah (1996), makes use of a wide number of inequality measures theoretically supported by the well-known and accepted literature on economic inequality, see e.g. Silber (1999), Bourguignon (2000) and Haughton and Khandker (2009).

Afterwards, we use a wide range of measures, from concentration measures (Hirschman (1964) and Rosenbluth (1955)) and the coefficient of variation to inequality measures, in order to characterize in more detail the distribution at each point in time and analyze its dynamics. We were able to identify two sub-periods, characterized by two different patterns of income distribution convergence for the whole group of EU-14 countries. We conducted a Lorenz dominance analysis, this time for the sub-period starting in 1975 and ending in 2009 and found that the two Lorenz curves were not significantly different. Furthermore, by using inequality measures such as the quantiles ratios (Q_10_50, Q_25_50, Q_75_50 and Q_90_50) we were able to disentangle different processes of income convergence for some countries of the EU-14 by analyzing specific parts of the EU-14 distributions and their evolution. Special attention was paid to Portugal.

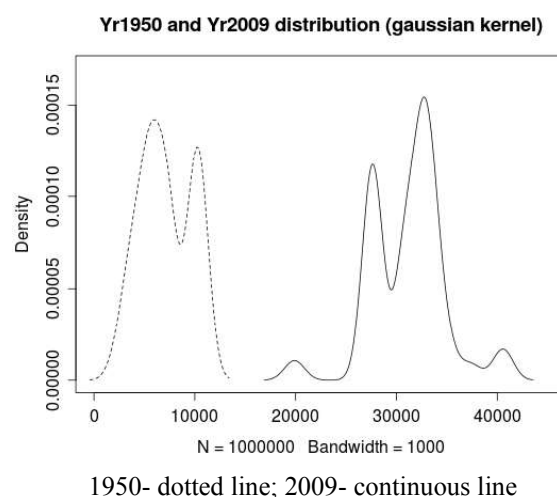
3.2 Evolution of the EU-14 income distribution

Figure 5 contains the distributions of real GDP per capita in 1950 and 2009⁴ for the countries belonging to the EU-14. The evolution of the distribution between 1950 and 2009 reveals the maintenance of a bimodal distribution from the 1950s through to the end of the first decade of the new millennium. However, while for the 1950 distribution the principal mode is the left one, in 2009 it stands at the right.

³ Computations were done using Zeileis (2012), Handcock (2012), and also Abdelkrim and Duclos (2007).

⁴ We do not highlight the 1986 distribution since it is a part of a longer-term evolution that started in the 1950s. As we will see, there was a reduction in inequality in the distribution between 1950 and 2009, although from 1975 onwards this pattern becomes less clear.

Figure 5: Income distribution in 1950 and 2009, EU-14



Source: authors' computations based on data from the PWT 7.0

Figure 5 also points to the absence of polarization⁵, which can be confirmed by the inspection of Table 2 that contains the results of the polarization test where the null of no-polarization, at the median, lower and upper, cannot be rejected (Handcock and Morris (1999)). The evolution of the EU-14 real GDP per capita distribution between 1950 and 2009 is thus compatible with the absence of polarization, i.e. the existence of a “club” of poor countries converging towards a low steady-state and another club of richer countries converging towards a higher income steady-state, and indicates that a convergence process is taking place.

Table 2: Polarization test results

Index	LCI	Value	UCI	Signif. level
Median Polarization	-0.677	-0.173	0.332	0.251
Lower Polarization	-1.332	-0.324	0.684	0.265
Upper Polarization	-1.332	-0.324	0.684	0.265

Notes: LCI – lower confidence interval; UCI – upper confidence interval;
Signif level – significance level for the estimated value.

The visual inspection of the distribution is interesting for uncovering patterns and evolutions in the distribution of real GDP per capita, but does not provide specific measures for characterizing the distributions and their dynamics. To analyze what has happened in terms of inequality we will use some appropriate inequality and concentration measures. From 1950 until 2009 it is irrefutable the occurrence of a reduction of inequality in Europe (see Figure 6; Lorenz (1905)).

⁵ Median Polarization – includes Lower Polarization and Upper Polarization.

Figure 6: Lorenz curves for 1950 and 2009, EU-14

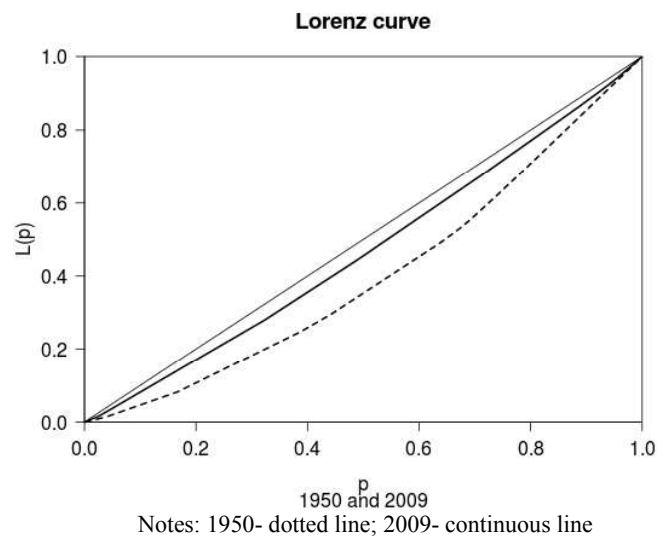


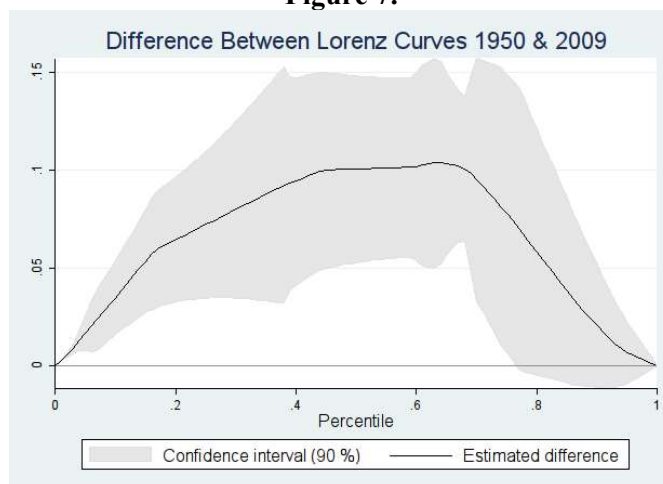
Table 3 shows that the values of the Gini index (Fields (2001) and Haughton and Khandker (2009)) confirm the difference between the two Lorenz curves patent in Figure 6, since the 90% confidence intervals for each of the indexes do not intercept.

Table 3: Gini index difference test, 1950 and 2009

Index	Estimate	Signif. Level	[90% CI]	
Gini_1950	.1962569	0.0002	.1324382	.2600756
Gini_2009	.0653189	0.0031	.0341449	.0964929
Diference	-.130938	0.0010	-.1836149	-.0782611

Figure 7 shows the difference between the 1950 and the 2009 Lorenz curves (and the associated 90% confidence intervals; Abdelkrim and Duclos (2007)), revealing what happened for all the values of the distribution, and not only for the mean values. Nevertheless, it can be observed that at the right part of the distribution, near quantile 0.8, the null of the difference between the two curves cannot be rejected.

Figure 7:



The previous analysis lead us to conclude for a reduction in inequality between 1950 and 2009, corresponding to a process of convergence not only in terms of mean real GDP per capita but also along the real GDP per capita distribution, among the EU-14. In order to have a more detailed picture of what happened in all the years over the period 1950-2009, and thus to try to identify sub-periods exhibiting different inequality trends, a panoply of indicators, from concentration to inequality measures was used. Figures 8 to 19 show the respective evolution throughout the period under analysis.

Figure 8

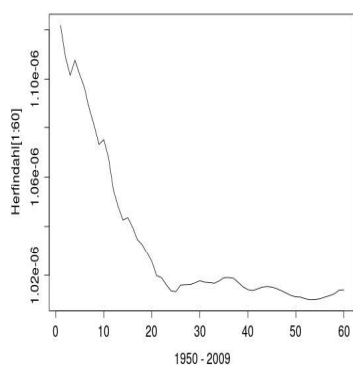


Figure 9

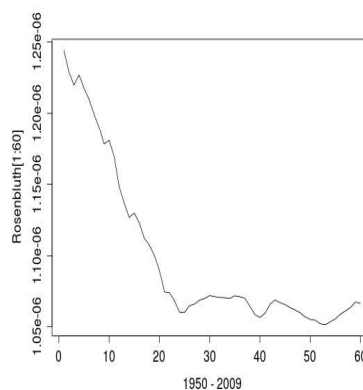


Figure 10

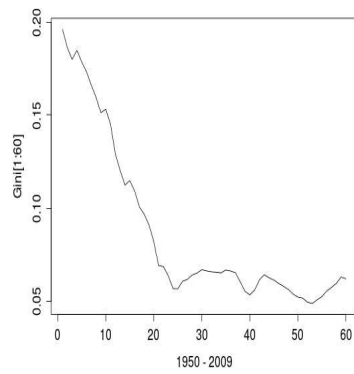


Figure 11

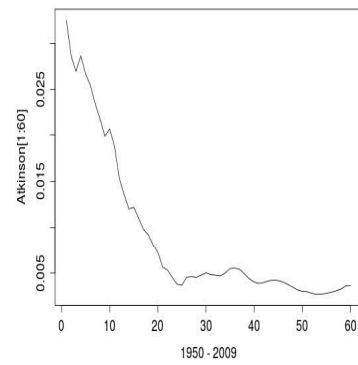


Figure 12

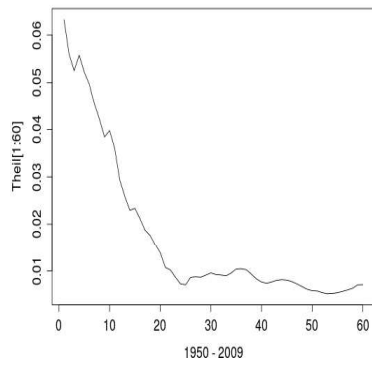


Figure 13

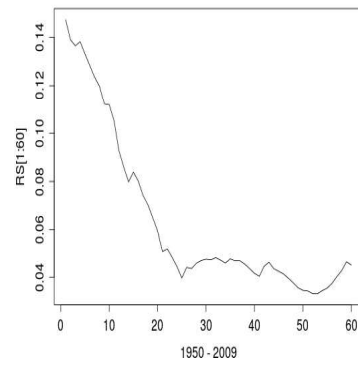


Figure 14

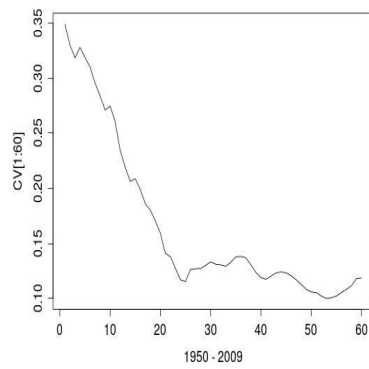
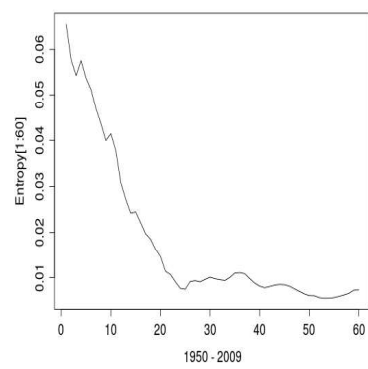
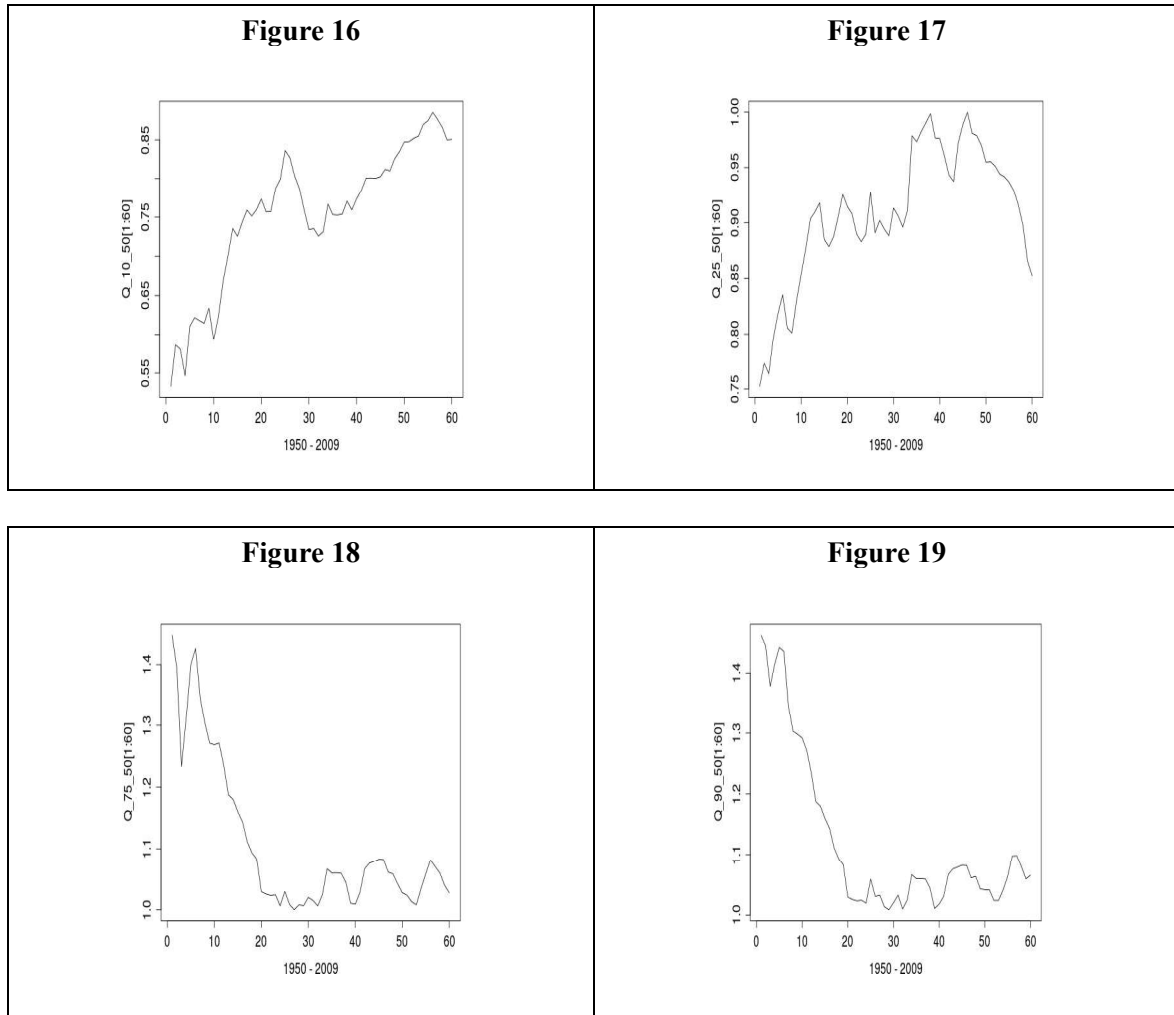


Figure 15





Figures 8 to 15 show that the concentration measures known as Herfindahl, and Rosenbluth, Figures 8 and 9 (Hirschman (1964) and Rosenbluth (1955)), and all the inequality indexes (Gini, Atkinson, Theil, Ricci-Schutz, Coefficient of Variation and Entropy, Figures 10 to 15) share a common pattern characterized by a negative slope for the sub-period from 1950 until 1974 (25th observation in the horizontal axis) and by another sub-period from 1975 onwards where a precise evolution cannot be determined and where at most a slightly positive trend can be observed at end of this sub-period.

There are however some differences in what concerns the evolution of the quantiles ratios. Q_{10_50} increases from 1950 until 1974 and from 1975 until 1981 it decreases quickly, again increasing from 1982 until the beginning of the current economic crisis. Q_{25_50} increases from 1950 until 1995 and afterwards decreases reaching values similar to the 1960 values. Concerning Q_{75_50} and Q_{90_50} the threshold year observed for the change in their behavior is not 1974 but in 1973.

Since the Portuguese real GDP per capita levels are situated in quantile 10th, the quantile ratio Q_{10_50} is probably a good proxy to analyze the process of convergence of the Portuguese (mean) income towards the EU-14 median income. That ratio increased from 1950 until 1974,

then decreases quickly from 1975 until 1981, and again increases from 1982 until the beginning of the current crisis. We thus conclude that Portugal does not follow the (no) convergence pattern of the EU-14 entire group in the second sub-period under analysis from 1975 to 2009. This last result is confirmed also by the dominance Lorenz curve analysis between 1975 and 2009 carried out below.

Table 4: Gini index difference test, 1975 and 2009

Index	Estimate	Signif Level	[90% CI]	
Difference	.0014917	0.8547	-.0126504	.0156338

The indefinite evolution from 1975 until 2009 can be illustrated by looking at the values of the Gini index, 0.0608 and 0.0622, respectively. The difference between them indicates that for the most part the two confidence intervals coincide. In terms of their difference, Table 4 indicates that the null of no difference cannot be rejected. This result is informative in terms of a mean result only and so we have to check the difference for all the distribution of the two Lorenz curves.

Figure 20:

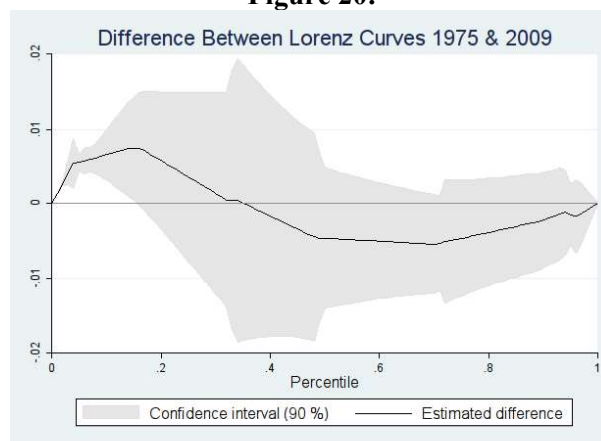


Figure 20 shows the difference between the Lorenz curves (Abdelkrim and Duclos (2007)) for the years 1975 and 2009. We can see that at the 90% confidence interval there are no differences between the two curves after quantile 0.15, and up to that quantile inequality decreases. This means that in general, i.e. for the majority of countries in the sample, we can say that the convergence process came to a halt in 1975. This result emphasizes the richness of the analysis in terms of relative convergence along the quantiles of the real GDP per capita distribution of output and not only at the mean level.

4. Concluding remarks

In this paper we found that the evolution of the income distribution for the EU-14 from the perspective of the individuals between 1950 and 2009 reveals the maintenance of a bimodal distribution from the 1950s through to the end of the first decade of the new millennium. However, while in 1950 the principal mode of the distribution is the left one, in 2009 it stands at the right. This evolution is thus compatible with the absence of polarization, i.e. a “club” of poor countries converging towards a low steady-state and another club of richer countries converging towards a higher steady-state, and indicates that a convergence process has been taking place for a long time among EU-14 countries from the perspective of the individuals, and is thus not necessarily a consequence of EU accession, also pointing out to the existence of growth nonlinearities shaping the growth process.

A more detailed temporal analysis reveals however that the EU-14 income distribution presents two different patterns of convergence over time. From 1950 to 1974 there is convergence in terms of income distribution in the EU-14 but from 1975 onwards that same process cannot be identified for the whole group. It can even be said that the process came to a halt based on the inspection of the difference between the 1975 and the 2009 Lorenz curves.

The evolution of the overall income distribution for the period and sub-periods under analysis might mask different patterns of the convergence process for some parts of the distributions that is for some countries of the EU-14. In order to uncover that possibility we calculated the quantile ratios for the EU-14 income distribution and we were able to trace the evolution of those inequality measures over the whole period under analysis. Since the Portuguese income levels are associated with quantile 10th, the quantile ratio Q_{10_50} is probably a good proxy to analyze the process of convergence of the Portuguese (mean) income towards the EU-14 median income. That ratio increased from 1950 until 1974, then decreased quickly from 1975 until 1981, and again increased from 1982 until the beginning of the current crisis. We thus conclude that Portugal does not follow the convergence pattern of the EU-14 entire group in the second sub-period of the analysis, from 1975 to 2009. This last result is also confirmed by the dominance Lorenz curve analysis between 1975 and 2009. This indicates that the convergence process undergone by the Portuguese economy after EU accession is probably part of a more general convergence path and not a direct consequence of European integration.

The results obtained in this empirical study challenge some traditional views on the benefits of the European integration process and call for further detailed and rigorous analysis in the near future on the benefits of the internal market (1990) and of the monetary union (1999). This will enable us to gain a better understanding of the benefits of European integration and make a contribution to its deepening.

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