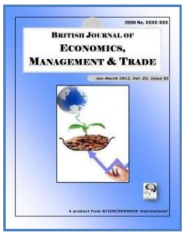

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Growth and Income Convergence: Do Worldwide Economic Groups Make Any Difference?

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The aim of this paper is to study the income convergence process according to economic growth in the world. In addition of the income countries analysis, the paper introduce a deeper analytical framework involving groups of countries in the word.
The study concerns 135 countries using data covering the period from 1980 to 2013. The methodological framework develop a cross-country analysis in the world, which integrate a decomposition approach for unconditional β-convergence, σ-convergence and conditional β-convergence of economic growth and income dynamics. Furthermore, based on the generalized Gini coefficient, the decomposition framework split the change in income inequality into progressivity/pro-poor growth and re-ranking components.
The results are consistent with earlier studies that have examined inequality across countries. The main findings underline - even if cross-sectional and longitudinal analysis of the income distribution provide different complementary pictures over time - that except for few countries, all the results show a very weak evidence of β-convergence, σ-convergence and conditional β-convergence in the world, and that there is still a lot of work to do in order to reach some accepted levels of convergence as far as the income disparities and economic growth are concerned. Furthermore, even in the case of groups of countries with common economic interests, the convergence process is even more complicated and very hard to achieve in the majority of cases if a relative homogeneity could not be ensured about the growth's key indicators.

Keywords: Growth; income convergence; inequality; redistribution; progressivity.

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1. INTRODUCTION

For a long time, the convergence (the catching-up hypothesis) challenge within an economic area was depending on the need to combine economic growth with social and institutional development at both national and regional level. Consequently, there is an increasing interest for measuring disparities as a first necessary condition to talk about the establishment of an economic and monetary union.

Since the moment that research on national and regional income convergence has become popular, studies on national and regional convergence in the world is still relatively scarce. Because of data availability, there is a few empirical research on convergence in countries' groups [1] over the world. Therefore, this paper aims to provide more distinct information on groups' convergence in the world. We will try to establish the close links that exist between the alternative measures of convergence used in the public economics literature. We exploit this framework to put more light on the income distribution and convergence possibilities between groups of countries.

Furthermore, special attention is paid to differences in the national convergence process between poor and non-poor countries in the world. The main research questions in this paper are focused on the study of the potential convergence processes that may exist between countries and groups of countries. Hence, we will try to give an answer to the main following questions: will relatively poor economies remain poor for many years in the future? Are the non-poor countries in the 80's the same countries that are relatively non-poor today? Is the degree of income inequality across economies increasing or falling over time?

Therefore, it is important to measure the convergence between worldwide economies, in terms of per capita GDP, especially for the late period where an important number of these countries have known some deep changes in political and social structures. The results of this study will help policy makers to derive some important conclusions about the future of the regional convergence between countries.

Our results go beyond those based on regression analysis or correlation between the considered variables because we simultaneously measure three distinct convergence cases of income dynamics, namely the β-convergence, σ-convergence and leapfrogging.

Additionally, by measuring income dispersion, the results incorporate varying degrees of inequality aversion when decomposing the Generalize Gini coefficient into progressivity/pro-poor growth and re-ranking components, which permits a robust analysis of income convergence across a range of variability measures.

The structure of the paper is organized as follows. The next section introduces the definitions of convergence approaches, their similarities and differences and highlights the decomposition framework. Section 3 analyses some empirical evidence on convergence in the world using a sample of 135 countries over the period 1980-2013 and the sub-periods 1980-1989, 1990-1999 and 2000-2013. The last section concludes.

2. BRIEF LITERATURE REVIEW

The relationship between income inequality and growth is still a debated issue, which can be summarized by the Shakespearian-like dilemma "is inequality good or not good for growth". Therefore, there are still no clear theoretical explanations or overall accepted empirical evidence about this relationship that allow us to predict what the consequences of increasing or declining income inequality may be.

From one hand, in the literature, there is some works that support the existence of a convergence process whatever its speed or level. For instance, according to the World Bank Report (2003), globalization has mostly reduced inequality between countries. Sperlich and Sperlich (2012) [1] have found that trade and some approximation point in economic geography promote growth and beta convergence in South-South integration areas. Hence, income dispersion does not generally decrease although they find some indications of sigma convergence.

From another hand, and at the same time, there are plenty of empirical studies emphasizing that

[1]*The considered groups in this study are: UM (Union for the Mediterranean), EFTA (European Free Trade Association), EU (European Union), EZ (Euro zone), MENA (Middle East & North Africa), NA (North Africa), GCC (Gulf Cooperation Council), OICS (Organization of Islamic Cooperation), FTAA (Free Trade Area of the Americas), OECD (Organization for Economic Co-operation and Development), OPEC (Organization Of Petroleum Exporting Countries), NIC (Newly Industrialized Countries.*

inequality within countries is increasing (e.g. Kanbur and Venables [2], Chen [3]). Bittencourt [4] suggested that income and structural convergence were associated in the post-second World War period in Latin America countries that exhibited a different ability to reshape their institutions with a view to encouraging more economic integration and less income divergence. According to Paas and Schlitte [5], the speed of convergence among regions in the European Union is painfully slow. Furthermore, there is a distinct difference between convergence processes at the regional and at the national level. Especially in the European Union, the catching-up at the national scale seems to be driven by some growth centers, mainly capital regions. Jayanthakumaran and Lee [6] found that the relative per capita income series of ASEAN-5 countries were consistent with stochastic convergence and beta-convergence, and the structural breaks associated with the world oil crisis and the Asian crisis impacted heavily on the convergence/divergence process. Sala-i-Martin [7] estimates nine indexes of income inequality implied by world distribution of income. All of them show substantial reductions in global income inequality during the 1980s and 1990s but not during 2000 and 2010. Artelaris et al. [8] confirmed the existence of regional convergence clubs in most developed European Countries, but when considering the whole European Union, there is a heterogeneous spatial impact of the European Union economic integration process.

Because of this divergence, this paper aims to offer some empirical insights in the debated issues described above, providing more distinct information on regional disparities, economic growth and income convergence in the World. According to Derviş, this research area is becoming more common because the future of the world economy will depend largely on the interaction between the rise of many large emerging and developing economies, the increasing interdependence across countries, and the widening gap between the top and bottom tails of the distribution of income, both within countries and for the world population as a whole. These trends have political, social, and geostrategic implications that will shape future policy debate [9].

3. THE DECOMPOSING OF INEQUALITY CHANGE

The income convergence subject across countries over time was initially suggested based on a test of the neo-classical growth model with the main following idea: convergence implies that poor countries (or regions) grow faster than rich ones in terms of their per capita income. Fundamental works that are more recent were subsequently realized by Sala-i-Martin [10], Barro and Sala-I-Martin [11] and Mankiw et al. [12], to examine the nature of the convergence process by focusing on the traditional beta-convergence analysis.

According to several works, income inequality dynamics must distinguish between different forms of convergence. The β-convergence is defined as situations where *poor economies tend to grow faster than rich ones*, while σ-convergence is defined as situation where *countries in a group are converging if the dispersion of their real per capita GDP levels tends to decrease over time*. While Friedman [13] has defined the convergence case as the consistent diminution of variance among countries of the real GDP per capita, O'Neil & Van Kerm [14] measure the σ-convergence as *the change in the Gini coefficient over time*. They use the exact additive decomposition suggested by to express this change as the net effect of β-convergence when offset by leapfrogging among countries.

3.1 Convergence Concepts

In what follows, we will discuss the main convergence concepts usually used in examining the convergence dynamics, namely β-convergence, σ-convergence, Progressivity, Re-ranking and Leapfrogging.

3.1.1 β-convergence

The main used methodology in the previous works when measuring β-convergence was the regression of income growth rates on initial income to test if poor countries grow faster than rich countries:

$$log\left(\frac{y_{i,t+1}}{y_{i,t}}\right) = \alpha + \beta \log(y_{i,t}) + \varepsilon_{i,t}$$

However, several authors like Mankiw [12] and Friedman [13] have argued that these regressions detect *mobility* within an income distribution but did not give any idea whether income *dispersion* across countries has fallen. This mean that poor countries can grow faster than rich countries and yet for income to diverge. According to O'Neill & Van Kerm [14], for this to

happen it must be the case that the initially poorer countries overtake/leapfrog the richer countries, so that the rankings of countries change [15].

β-convergence is defined as a negative relationship between the initial income level and subsequent income growth rate. In other words, if there is a negative correlation between the initial income level and the growth rate, then poorer economies grow faster than richer ones and there should be a β-convergence.

3.1.2 σ-convergence

The sigma-convergence approach was mainly developed in the work of Quah [16]. In his paper, he showed that the traditional β-convergence regression does not give a clear answer about convergence, as the relationship tends to be negative even if the income differences have not decreased. As suggested by Quah, σ-convergence pertains to the decline in the cross-sectional dispersion of per capita income over time. Quah puts forward that σ-convergence should tell us if there is an increasing trend in income inequality or income are equitably distributed.

Based on the several convergence works, it can be concluded that the β-convergence is a necessary but not sufficient condition for sigma-convergence to occur [10,11]. A significant negative β-convergence regression does not necessarily imply a reduction in variation of regional income or growth rates over time.

3.1.3 Progressivity, re-ranking and leapfrogging

According to Jenkins and Van Kerm [17], the change in income inequality over time can be additively decomposed into terms representing the *progressivity* of income growth and the extent of *re-ranking* (mobility). The used measurement is the Generalized Gini index [18-21].

The Generalized Gini index for a given year can be expressed as a covariance:

$$Gini = \frac{-\upsilon}{\bar{Y}} Cov(Y, (1-p)^{\upsilon-1})$$

Where Y is a random variable of interest (usually the income distribution) with mean $\bar{Y}$, p is the *rank* order of individuals/countries with income y, υ is a parameter tuning the degree of aversion to inequality. The standard Gini corresponds to $\upsilon = 2$, [22].

In parallel, when considering the bivariate distribution of income at *t* and *t+1* an analogous concept can be defined as the *Concentration coefficient* expressed as the share of total *t+1* income held by the poorest $100*p_t$ percent of the population at time *t* against p_t. The Concentration coefficient measures the association between two random variables. It is computed as [14]:

$$Conc = \frac{-\upsilon}{\bar{Y}_{t+1}} Cov(Y_{t+1}, (1-p_t)^{\upsilon-1})$$

Overall, Gini coefficients are popular measures of inequality by themselves. Similarly, Concentration coefficients are often used to measure income-related inequalities in other socially important variables [10].

The explicit dependence of the Gini coefficient on each country's rank in the income distribution allows to decompose the change in the Gini coefficient over time. If we consider the change in the Generalized Gini coefficient between a base year t_0 and a final year t_1 for a fixed population of individuals, the change in the Generalized Gini coefficient $\Delta G(\upsilon)$ can be written as:

$$\Delta G(\upsilon) = Gini_1(\upsilon) - Gini_0(\upsilon) = R(\upsilon) - P(\upsilon)$$

Where:

$$P(\upsilon) = Gini(Y^0; \upsilon) - Conc(Y^0, Y^1; \upsilon)$$
$$R(\upsilon) = Gini(Y^1; \upsilon) - Conc(X^0, X^1; \upsilon)$$

$P(\upsilon)$, the progressivity component, can be interpreted as an indicator of how much growth has benefited disproportionately to individuals at the bottom of the distribution in the initial time period. $R(\upsilon)$, the re-ranking (or mobility) component, captures how much a progressiveincome growth has led to re-ranking between countries/individuals, so that the net reduction in inequality is the difference between $P(\upsilon)$ and $R(\upsilon)$. $R(\upsilon)$ can also be interpreted as a measure of mobility (in the form of re-ranking) in its own right [23].

Viewing the change in inequality in this way allows to identify the relative contribution of both re-ranking and progressive growth to the overall change in the Gini coefficient. When analyzing income inequality, we can get positive or negative change in Gini coefficient. If $\Delta G \geq 0$, this mean that there is a rising trend in inequality, and in parallel, $\Delta G < 0$ reflects a falling trend in income inequality. In an analysis of cross-country convergence in GDP, O'Neill and Van Kerm [14] have interpreted $\Delta G(\upsilon)$ as the change in income dispersion over time. There will be a σ-

convergence if there is a decrease in the change in the Gini coefficient (positive changes are the expression of a σ-divergence).

From one hand, the growth rate is proportional if $P = 0$. When the growth process is progressive, then $P > 0$. In this case, there is a lower inequality income level over time. If the growth process is regressive, then $P < 0$, meaning that there is an increasing inequality. The more progressive is the growth process, the greater the value of *P* and hence the larger the reduction in inequality [14]. Therefore, the progressivity component (-P) measures the reduction (or increase) in income dispersion arising from the progressivity (or regressivity) [2] of the growth schedule. It is calculated by holding rankings fixed at their period 1 values.

From another hand, the inequality dynamics can be affected by the second component *R* that is supposed to be a mitigation of the progressivity according to O'Neil and Van Kerm [14]. *R* measures this offsetting effect where only income from the final distribution of income are used. However, a country's rank in this distribution is allowed to change.

Furthermore, in the case of higher income growth rates among lower income countries, the progressivity component is used to express the level to which income inequality can be reduced over time. It is a distributive measure of *pro-poor income growth*. O'Neill & Van Kerm [14] argues that in this case, the progressivity component becomes the absolute expression of β-convergence in income growth and its contribution to the overall reduction in income inequality. The last component, *R*, the re-ranking component in this decomposition approach, is commonly used to measure the offsetting effect of positional mobility on income inequality. This captures the fact β-convergence need not necessarily translate into lower inequality if poor countries leapfrog the richer countries.

As noted by O'Neill and Van Kerm [14], β-convergence measure is calculated using only the ranks from the initial income distribution. As a result, growth among poor countries is evaluated at a fixed (and relatively high) weight. The leapfrogging component, in turn, captures the contribution of changing weights (re-ranking) to overall inequality.

3.2 Conditional β-Convergence

As noted by Sala-i-Martin [10], it is important to distinguish between absolute (unconditional) convergence and relative (conditional) convergence. When considering the conditional convergence hypothesis, then the per capita income of countries or regions converge with others in the long-term if their macroeconomic indicators and social structures (investment, government policy, technologies, human capital, employment, institutions, population growth rates, preferences, demographic situation, infant mortality rates, etc.) are identical. The conditional convergence framework can be argued by the fact that some economic growth models such as the Solow model do not necessarily predict absolute β-convergence; instead, it predicts that countries that are further away from their steady states will grow faster than countries closer to their steady state.

The conditional β-convergence assumes that there is a negative relation only if the structural variables are identical in the economies under consideration. There exists a negative correlation between the growth rate and the distance that the income level is away from its steady state equilibrium. Therefore, poorer countries do not necessarily grow faster than richer ones because the latter may be even further away from their steady state equilibriums. The conditional β-convergence can be calculated by the following regression formula, which integrate a set of explanatory variables that proxy for the steady state [10]:

$$log\left(\frac{y_{i,t+1}}{y_{i,t}}\right) = \alpha + \beta \log(y_{i,t}) + \phi X + \varepsilon_{i,t}$$

Where *X* is a matrix of variables, maintaining constant the steady state of each economy. All the other terms are defined in the previous sections. There is conditional β-convergence if the estimate of β is significantly negative once *X* is held constant. The speed of convergence and the half-life can then be recovered using this estimate.

The speed of convergence is then $b = -ln(1 + T\beta)T$. Where *T* is the length of the time between the two periods. The time necessary for the economies to fill half of the variation, which separates them from their steady state, is called the half-life:

[2] *A progressive growth process is expressed by a decreasing growth rate with income, and a regressive growth process is expressed with an increasing growth rate with income. If the growth rate is constant across income levels, then we have a proportional growth process.*

$$\tau = -ln(2)/ln(1+\beta).$$

According to O'Neill & Van Kerm [14], the distinction between unconditional and conditional convergence may not be important among groups of countries that are relatively homogenous (OECD, Euro Area, USA) contrary to more heterogeneous sets of countries. In other words, the conditional convergence and the absolute convergence hypotheses coincide, only if all the economies have the same steady state [10].

In general, the choice of the proxy variables remain a subjective matter. Nevertheless, there is a large consensus about some important variables like technology level and saving rate (the strict version of the Solow-Swan model), the primary and secondary school enrolments, the saving rate, and some political variable [10], the average share of real investment in real GDP, the average rate of growth of the working age population, the savings rate and the population growth rate [14]. Other authors, like Levine and Renelt [24], have proposed a different approach based on a special type of regression in order to calculate the conditional convergence with an important set of proxy variables.

4. DATA AND RESULTS

4.1 Data

We have analyzed national income disparities and convergence in 135 countries in the world (see Table 3) during the years 1980-2013. These years cover different special events (political transition, economic restructuration, etc.) for many countries, in addition to the worldwide economic and financial crisis. The used decomposition approach in this paper requires information about the joint distribution of income at two points in time.

In order to capture the effect of time, the whole period is spilled to three sub-periods 1980-1989, 1990-1999 and 2000-2013. The income convergence within world countries is focused on empirical testing of the different convergence hypothesis using GDP per capita data at current US dollar obtained from the World Bank 2013 annual report [3] and the IMF World Economic Outlook Database[4].

[3]*World Development Indicators (2013) : http://data.worldbank.org/data-catalog/world-development-indicators*

[4]*World Economic Outlook Database: http://www.imf.org/external/pubs/ft/weo/2013/01/weodata/index.aspx*

4.2 σ-convergence, β-convergence and Leapfrogging

Table 1 reports the Generalized Gini coefficient for six values of the inequality aversion parameter equal to 1.5, 2, 2.5, 3, 3.5 and 4. The first value places relatively more weight on income at the top of the distribution. When this value is equal to 2, this correspond to the standard Gini coefficient. Values greater than 1, are supposed to give relatively more weight to inequality at the low end of the distribution. In the eighth column, we calculate the standard deviation of natural logarithm of GDP per capita, as an additional measure of inequality.

Overall, all the measures show an increasing trend of income inequality over the period 1980-2013. For each measure, the majority of this rise in inequality took place in the second decade between 1990 and 2000 where the convergence speed up significantly in this period.

The interpretation of the obtained results in Table 1 depends on the relative assigned weight to inequality. When we assign more weight on inequality at the top end of the income distribution, we can evaluate the contribution of non-poor countries in influencing the inequality change. In contrast when we assign more weight on inequality at the low end of the income distribution, this allow to us to examine the contribution of poor countries in increasing or decreasing inequality. As we can see, in both situation, for the completely world countries, income diverged substantially over all the considered periods especially in the second decade from 1990 to 1999.

The results in Table 2 decompose these changes in income inequality using the progressivity and re-ranking component discussed in the previous section. This approach allows us to determine the redistributive impact of income growth. The results are provided for the standard Gini coefficient with a value of inequality aversion equal to 2. As we can see, there is various components of the convergence process: the change in the Gini coefficient, the σ-convergence, the progressive income growth (β-convergence) and re-ranking (leapfrogging) to the change in overall inequality. The final column reports the average growth rate of the standard Gini coefficient between the initial and the final years.

Looking at the results, one can see that β-convergence plays a minor role in the cross-country income dynamics. The major part of redistributive effect is rather presented by the re-ranking component (leapfrogging). In addition, it is obviously clear that some groups of countries, often considered as potential groups of common economic interests, does not actually represent any income's convergence opportunities, thereby they are far away from the creation of a common currency area. This is the case of the GCC countries and OPEC, with *both* a rising σ-convergence (0.009 and 0.004 respectively) and an increasing progressivity (-0.002 and -0.001 respectively).

Furthermore, when looking only to the σ-convergence results, we can conclude that on the whole, when σ-convergence decrease, β-convergence increase but very slowly. Since for all groups of countries the progressive income growth had not a significant redistributive effect, income inequality rise substantially. Furthermore, our decomposition shows that neither σ-divergence nor β-convergence was important over the considered period. The effective β-convergence (the impact of pro-poor income growth on inequality) fell substantially in the case of the worldwide countries' groups.

For almost all groups of countries, there is a regressive process of income growth. The observed leapfrogging combined to increase income dispersion is considered as the dominant situation. In this case, if $P(\upsilon) > 0$ income growth is concentrated more among poorer individuals than richer individuals, a factor leading to lower inequality over time, other things being equal. Jenkins and Van Kerm call this the *pro-poor growth*. By contrast, when $P(\upsilon) < 0$ income gains over time are more than proportionally concentrated among richer individuals than poorer ones, a factor tending to increase inequality over time, other things being equal [17].

When the full 33-year period is considered, we see that leapfrogging was the dominant force driving income dynamics jointly with a regressive redistributive effect of growth. Again, the results are, for the most part, consistent with the traditional Barro-regression convergence process. The lack of convergence across groups of countries is an interesting finding on various grounds. In other words, in the world the degree of cross-country income inequality not only fails to disappear, but rather tends to increase over time (σ-divergence). The results suggest also that groups of countries which are predicted to be richer a few decades from now are the same countries that are rich today (β-divergence). These findings may be used by economists or politicians to devise international institutions which may work to overturn this tendency.

To illustrate graphically the decomposition framework presented in this paper, we refer once again to the work of O'Neill and Van Kerm [14] and Sala-i-Martin [10] where all the convergence cases are presented with a very interesting analysis of income dynamics. We reproduce these situations in Fig. 1.

According to our results and when considering Figs. 1 and 4, we can easily compare our analysis with the different cases. Our results seem to be closer to case number 6 where there is a lack of β-convergence (the initially rich or non-poor economy grows faster than poor economies) associated with the lack of σ-divergence (the distance between economies increases over time) and non-leapfrogging (poor economies cannot catch up non-poor countries). Hence, initially poor worldwide countries' groups could not grow faster than initially rich ones, and there is a rising cross-sectional income dispersion over time.

Table 1. Relative trends in income inequality for world countries with alternative degrees of inequality aversion

Time period	G(1.5)	G(2)	G(2.5)	G(3)	G(3.5)	G(4)	SD_ln(GDP)
1980 - 1989	0.5024	0.8225	1.046	1.2117	1.3403	1.4436	1.434344
1990 - 1999	0.5544	0.9128	1.1653	1.354	1.5012	1.6198	1.588015
Δ inequality	0.052	0.0903	0.1193	0.1423	0.1609	0.1762	0.153671
2000 - 2013	0.5575	0.9287	1.1983	1.4051	1.5699	1.7049	1.616489
Δ inequality	0.0031	0.0159	0.033	0.0511	0.0687	0.0851	0.028474
1980 - 2013	0.5637	0.9282	1.1867	1.3809	1.5331	1.656	1.613999

Calculations are based on the Generalized Gini coefficient;
Source: authors' calculations

Table 2. Income convergence dynamics 1980-2013

	Initial	Final	∆Gini(2)	Re-ranking	Progressivity P(2)	GDPPC average
	Gini(2)	Gini(2)	(σ-convergence)	R(2)	(β-convergence)	growth rate
World*	0.69500	0.69500	0.00000	0.00200	0.00200	0.05100
			(0.000519)	(0.000238)	(0.000534)	
UM	0.60600	0.60500	-0.00100	0.00200	0.00400	0.05100
			(0.000845)	(0.000468)	(0.000868)	
EFTA	0.35000	0.35000	0.00000	0.00400	0.00400	0.05400
			(0.002619)	(0.000956)	(0.002457)	
EU	0.47600	0.47400	-0.00200	0.00400	0.00600	0.05200
			(0.001274)	(0.000567)	(0.001222)	
EZ	0.41600	0.41300	-0.00300	0.00300	0.00600	0.05400
			(0.001239)	(0.000449)	(0.001406)	
MENA	0.62500	0.62700	0.00200	0.00300	0.00100	0.04200
			(0.003105)	(0.000658)	(0.002818)	
NA	0.51000	0.50700	-0.00300	0.00300	0.00600	0.03300
			(0.004275)	(0.000863)	(0.003990)	
GCC	0.40000	0.40900	0.00900	0.00600	-0.00200	0.04000
			(0.005437)	(0.001437)	(0.004883)	
OICS	0.74700	0.74700	0.00100	0.00200	0.00100	0.04300
			(0.001780)	(0.000303)	(0.001712)	
FTAA	0.55800	0.55800	-0.00100	0.00200	0.00300	0.05100
			(0.001555)	(0.000823)	(0.001238)	
OECD	0.43100	0.42900	-0.00100	0.00300	0.00500	0.05300
			(0.001258)	(0.000414)	(0.001347)	
OPEC	0.63500	0.64000	0.00400	0.00300	-0.00100	0.03800
			(0.003803)	(0.001032)	(0.003609)	
NIC	0.47000	0.47400	0.00400	0.00500	0.00200	0.06700
			(0.002219)	(0.001231)	(0.001980)	

** 135 country; Bootstrap standard errors are shown in parentheses*
Calculations are based on s-gini with aversion parameter υ = 2
Source: authors' calculations

Furthermore, Figs. 2 and 3 show a more advanced graphical analysis based on the visualization of the convergence process by countries and by groups of countries respectively. As we can, income' convergence of world countries taken one by one does not actually gives a fairly clear idea about the income disparities. Ultimately, Fig. 2 gives only some information about the outline's cases (countries that belong to a group without sharing the same characteristics of income's distribution with the rest of the group).

Fig. 3 shows a more significant positioning as far as income convergence is concerned. Overall in the world, we can identify three major sets of countries' groups. First, a set of countries' groups characterized by high levels of income and reduced inequalities (OECD, EFTA, EZ, EU, UM and FTAF). Second, a set of countries' groups with relatively medium income levels and high levels of income inequalities (mainly σ-divergence). This is the case of MENA, OICS and OPEC. Third, the set of countries' groups composed of GCC and NIC. These two groups are characterized by a very high level of income' inequalities and an increasing level of growth in terms of GDP per capita. As a special case, North Africa group contains countries with low levels of income but also with reduced income' inequalities over time.

In a last stage of the analysis, we will talk about the classification of the in-sample countries into poor economies and non-poor economies. We have used the principal of the poverty line to distinguish these two classes, measured as 2/3 of median value. Table 3 represents the evolution over time of the two countries classes in the world. The results are further confirmation of the analysis above. Since the moment where we see that there is no form of convergence between groups of countries in the world, we can expect an unchangeable situation of status of each

country over time. In other words, poor countries remain poor and non-poor countries remain non-poor. This is the dominant situation in the majority of countries except some cases presented in bold character in Table 3. Some countries have moved from the poor countries class to the non-poor class (EST, KAZ, LBN, MDV, MNE, PER, ROM and SUR). Conversely, other ones are considered as poor countries after being ranked among non-poor ones. This is notably the case of DZA, ECU, IRN, IRQ, JOR, PRY, SYR, THA and TUN).

Further analysis can be developed by looking at Fig. 4, which plot the evolution of GDP per capita over time. As we can see, there is a strong link between Fig. 4 and the above analysis. Countries in the world tend to diverge over time. Thinks could be worse when we notice that there is a decreasing growth tendency against an increasing trend in population growth rates.

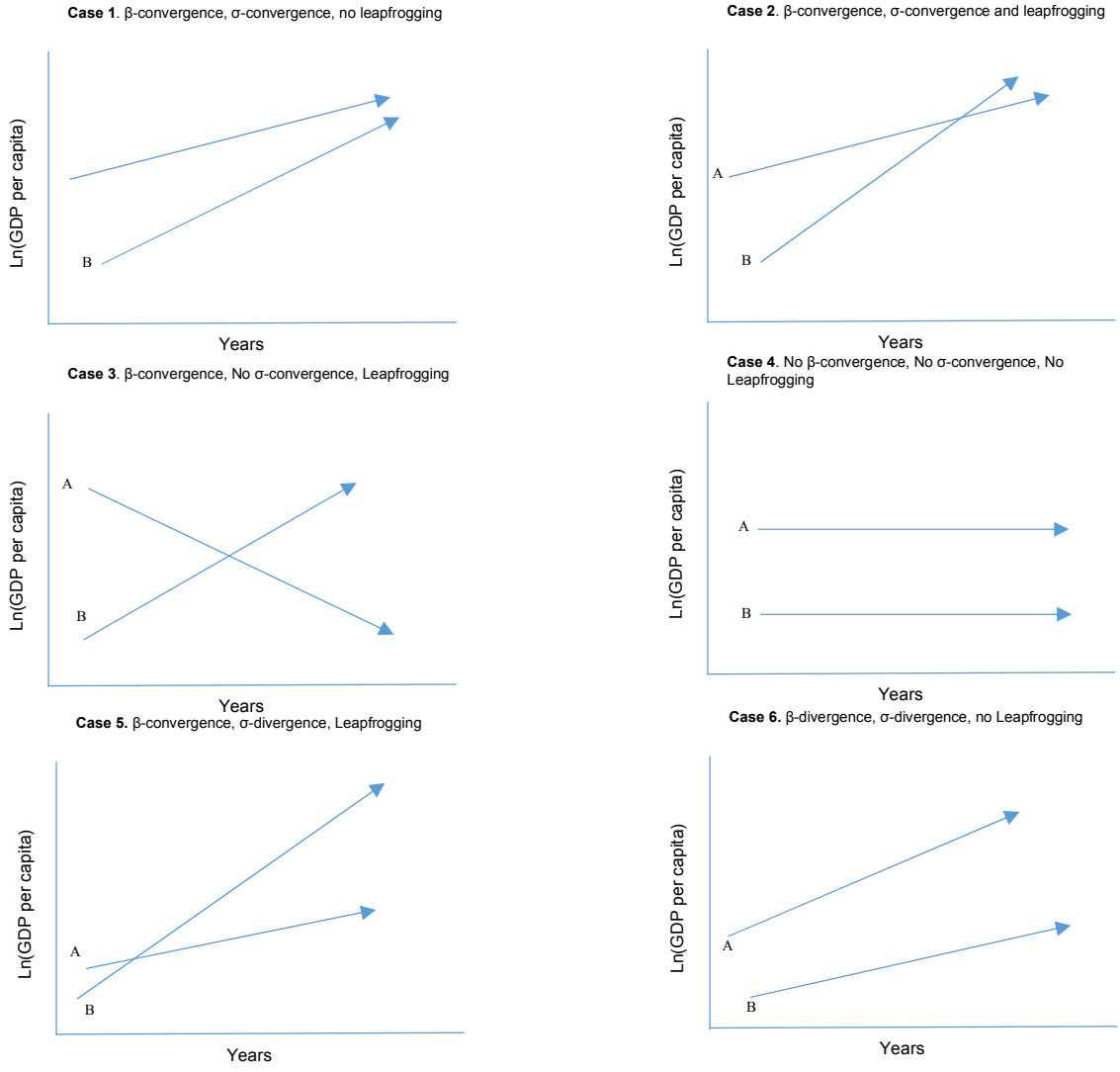

Fig. 1. Income convergence dynamics [35]

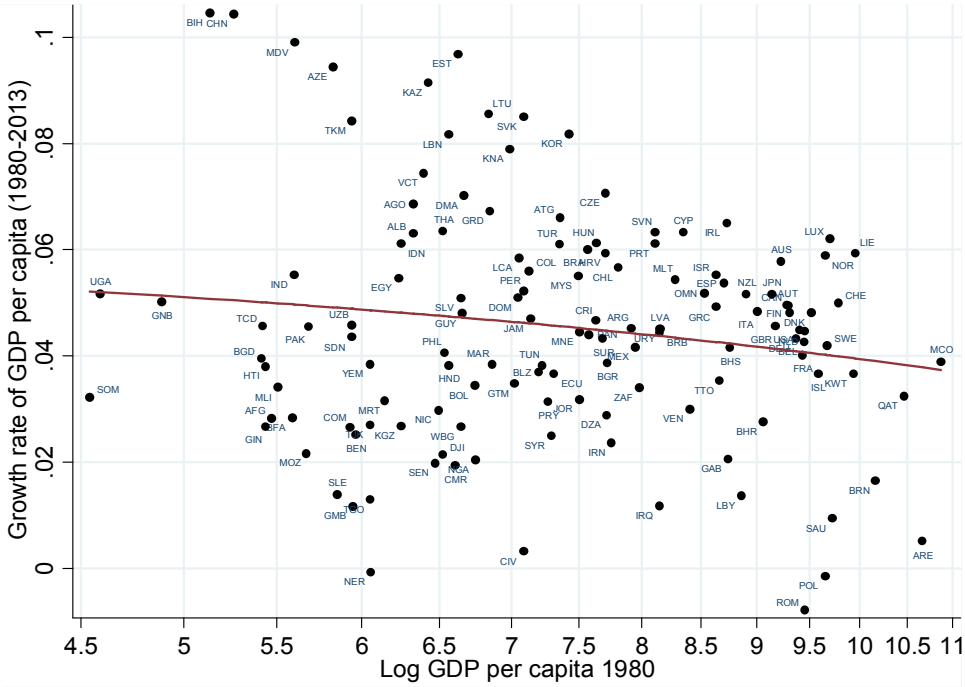

Fig. 2. Convergence across countries (1980-2013)
World countries' groups
Data source: author's calculations according to World Bank WDI.

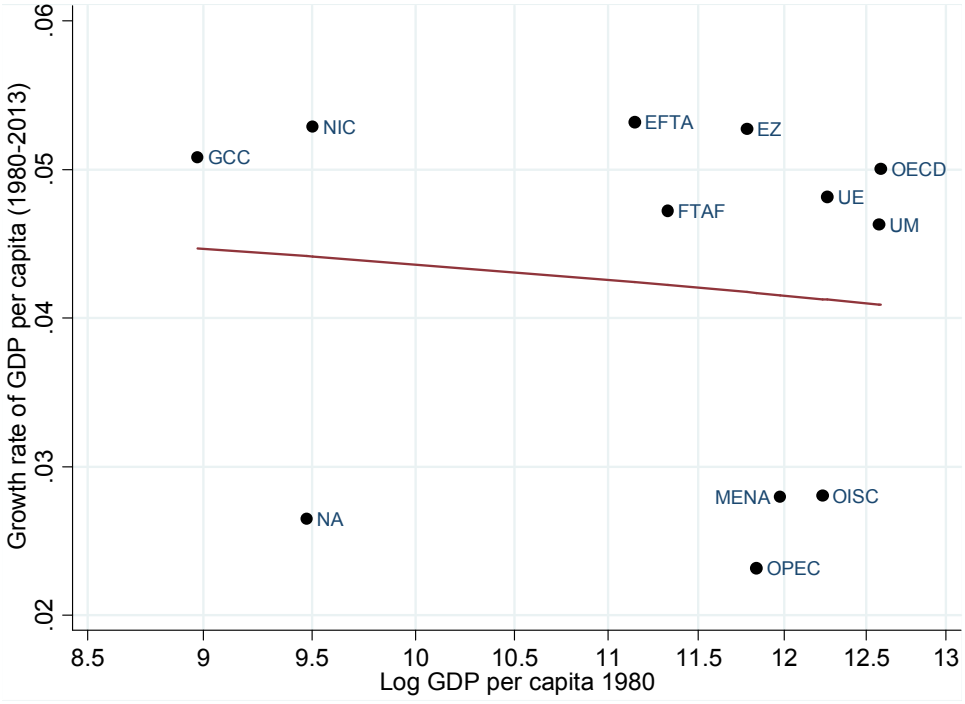

Fig. 3. Convergence across groups of countries (1980-2013)
World countries' groups
Data source: author's calculations according to World Bank WDI, 2013

Table 3. The in-sample poor and Non-poor World countries

Rank	Poverty line (GDPPC) (Thousands dollars)	1980-1989 1119.1820 USD	1990-1999 1572.7701 USD	2000-2013 3452.9493 USD	Rank	Poverty line (GDPPC) (Thousands dollars)	1980-1989 1119.1820 USD	1990-1999 1572.7701 USD	2000-2013 3452.9493 USD
1	AFG	1	1	1	68	JOR	0	1	1
2	AGO	1	1	1	69	JPN	0	0	0
3	ALB	1	1	1	70	KAZ	1	1	0
4	ARE	0	0	0	71	KGZ	1	1	1
5	ARG	0	0	0	72	KNA	0	0	0
6	ATG	0	0	0	73	KOR	0	0	0
7	AUS	0	0	0	74	KWT	0	0	0
8	AUT	0	0	0	75	LBN	1	0	0
9	AZE	1	1	1	76	LBY	0	0	0
10	BEL	0	0	0	77	LCA	0	0	0
11	BEN	1	1	1	78	LIE	0	0	0
12	BFA	1	1	1	79	LTU	0	0	0
13	BGD	1	1	1	80	LUX	0	0	0
14	BGR	0	1	0	81	LVA	0	0	0
15	BHR	0	0	0	82	MAR	1	1	1
16	BHS	0	0	0	83	MCO	0	0	0
17	BIH	1	1	1	84	MDV	1	1	0
18	BLZ	0	0	0	85	MEX	0	0	0
19	BOL	1	1	1	86	MLI	1	1	1
20	BRA	0	0	0	87	MLT	0	0	0
21	BRB	0	0	0	88	MNE	0	1	0
22	BRN	0	0	0	89	MOZ	1	1	1
23	CAN	0	0	0	90	MRT	1	1	1
24	CHE	0	0	0	91	MYS	0	0	0
25	CHL	0	0	0	92	NER	1	1	1
26	CHN	1	1	1	93	NGA	1	1	1
27	CIV	1	1	1	94	NIC	1	1	1
28	CMR	1	1	1	95	NLD	0	0	0
29	COL	0	0	0	96	NOR	0	0	0
30	COM	1	1	1	97	NZL	0	0	0
31	CRI	0	0	0	98	OMN	0	0	0
32	CYP	0	0	0	99	PAK	1	1	1
33	CZE	0	0	0	100	PAN	0	0	0
34	DEU	0	0	0	101	PER	1	0	0

Table 3 continued…….

35	DJI	1	1	1	102	PHL	1	1	1
36	DMA	0	0	0	103	POL	0	0	0
37	DNK	0	0	0	104	PRT	0	0	0
38	DOM	0	0	0	105	PRY	0	1	1
39	DZA	0	0	1	106	QAT	0	0	0
40	ECU	0	1	1	107	ROM	0	1	0
41	EGY	1	1	1	108	SAU	0	0	0
42	ESP	0	0	0	109	SDN	1	1	1
43	EST	1	0	0	110	SEN	1	1	1
44	FIN	0	0	0	111	SLE	1	1	1
45	FRA	0	0	0	112	SLV	1	1	1
46	GAB	0	0	0	113	SOM	1	1	1
47	GBR	0	0	0	114	SUR	0	1	0
48	GIN	1	1	1	115	SVK	0	0	0
49	GMB	1	1	1	116	SVN	0	0	0
50	GNB	1	1	1	117	SWE	0	0	0
51	GRC	0	0	0	118	SYR	0	1	1
52	GRD	0	0	0	119	TCD	1	1	1
53	GTM	1	1	1	120	TGO	1	1	1
54	GUY	1	1	1	121	THA	1	0	1
55	HND	1	1	1	122	TJK	1	1	1
56	HRV	0	0	0	123	TKM	1	1	1
57	HTI	1	1	1	124	TTO	0	0	0
58	HUN	0	0	0	125	TUN	0	0	1
59	IDN	1	1	1	126	TUR	0	0	0
60	IND	1	1	1	127	UGA	1	1	1
61	IRL	0	0	0	128	URY	0	0	0
62	IRN	0	1	1	129	USA	0	0	0
63	IRQ	0	1	1	130	UZB	1	1	1
64	ISL	0	0	0	131	VCT	0	0	0
65	ISR	0	0	0	132	VEN	0	0	0
66	ITA	0	0	0	133	WBG	1	1	1
67	JAM	0	0	0	134	YEM	1	1	1
					135	ZAF	0	0	0

Note. The poverty line is set at 2/3 of median value
Countries with a value of 1 are identified as poor and countries with a value of 0 are identified as non-poor.
Source: author's calculations

4.3 Conditional β-Convergence

The results of conditional convergence in income dynamics are presented in Table 4. As the principal of the Extreme Bound Analysis is based on a bivariate regression before introducing the other proxy variables, the conditional convergence is widely shaped by the behavior of the proxy variables. As we can see, results does not change much when we move from absolute to conditional convergence since the moment that all the estimates are non-significant. For all the considered periods, the regression could not estimate the upper and the lower of the regression parameters when we regress the initial income and the other proxy variables on the annualized income growth rate. Hence, even if we consider the conditional convergence hypothesis, countries' groups in the world are not close to a convergence process.

Table 4. Income conditional convergence dynamics in the world countries' groups

Time period	Estim.	Bounds	Coeff.β	Std. Error.	t	P-val
	Bivar Reg.	-	3.57E-06	7.59E-06	0.4700	0.6390
1980 to 1989	EB Min	0.0000	0.0000	0.0000	-1.1029	0.4689
	EB Max	0.0000	0.0000	0.0000	-0.9449	0.5180
	Bivar Reg.	-	-2.22E-06	3.67E-06	-0.6100	0.5440
1980 to 1989	EB Min	0.0000	0.0000	0.0000	-2.6494	0.2298
	EB Max	0.0000	0.0000	0.0000	-1.6400	0.3486
	Bivar Reg.	-	3.52E-06	3.32E-06	-1.0600	0.2900
1980 to 1989	EB Min	0.0000	0.0000	0.0000	-4.2597	0.1468
	EB Max	0.0000	0.0000	0.0000	-2.7767	0.2201
	Bivar Reg.	-	9.83E-07	2.88E-06	0.3400	0.7330
1980 to 1989	EB Min	0.0000	0.0000	0.0000	-4.6172	0.1358
	EB Max	0.0000	0.0000	0.0000	-4.2150	0.1483

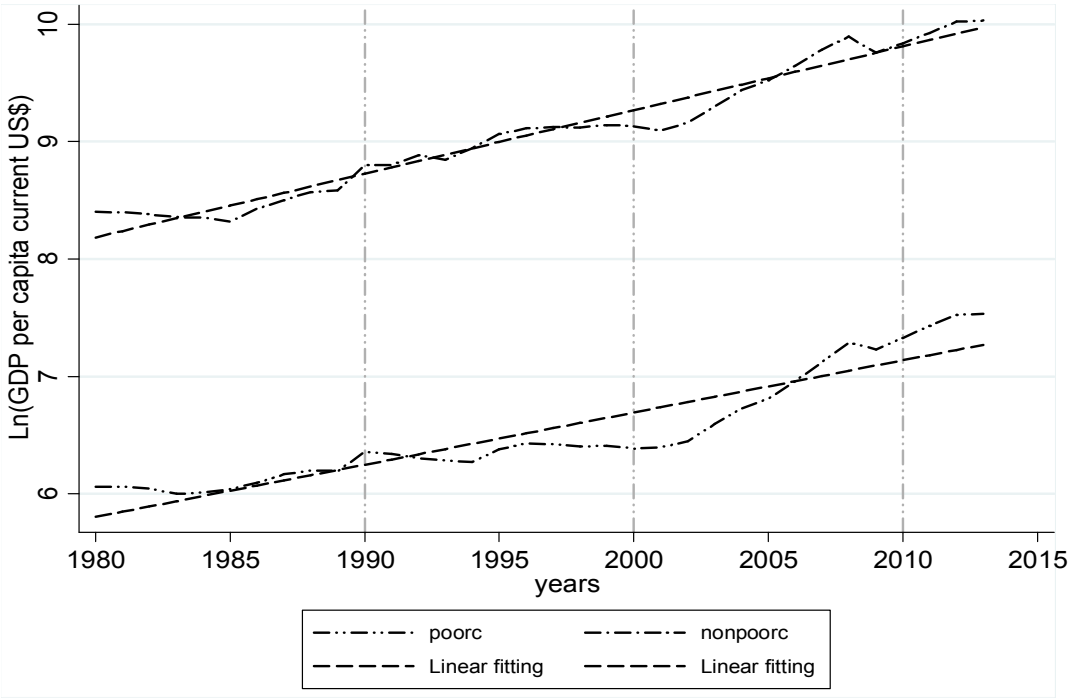

Fig. 4. World income' convergence tendency (1980-2013)
World countries; Data source: author's calculations according to World Bank WDI, 2013

5. CONCLUSION

The adopted approach in this study represents a useful development in the analysis of cross-country income convergence because it has the advantage to illustrate the difference between the cases which consider the simple coefficient from the classical linear regression to capture β-convergence and the situation which encompass more relevant convergence process that may hide important differences in income dynamics not revealed by the classical approach. Therefore, this study can be viewed as an integrated framework, which combine a set of convergence processes usually seen as competitive approaches in the analysis of income dynamics. By doing so, we can easily evaluate and understand the possible connections between the various works on convergence discussed in the literature.

In this paper, we have proposed a decomposition framework of the Generalized Gini coefficient that analyze the changes in inequality over time in relation with the progressivity component and the income distribution re-ranking component.

By using this methodology, analysis of inequality trends in countries' groups suggests that over time, there is not any kind of convergence across countries leading to a situation of inequality increase. Other findings underline that countries tend to record lower growth rates against a rising tendency of populations growth rates.

As mentioned by Jenkins & Van Kerm [25], this decomposition framework is very promising because it allow not only studying and evaluating the social fabric according to some relevant variables like income inequality, poverty, or social welfare, but moreover it allow decomposing the change over time in the social evaluation into terms related to progressivity of income growth and to re-ranking components.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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