



Cross-Country Inequality: A Markov Chain Approach

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Introduction

Covid-19 shock is determining significant effects on inequality (e.g. Ghosh, 2020) and the importance of investigating inequality is reinforced by the pandemic. In this contribution some results of a study on the dynamics of inequality in a large set of countries in the past two decades are briefly presented; in our research we consider both the gross national income per capita (GNI in PPP) in 189 countries and the human development index (HDI) in 179 economies as measures of inequality, including both developing and developed countries.

Main results

First of all, we simply investigate beta and sigma convergence in per capita income (GNI 1995-2018). When the dispersion of real per capita income (henceforth, simply “income”) across a group of economies falls over time, there is σ -convergence; when the partial correlation between growth in income over time and its initial level is negative, there is β -convergence (i.e. poor economies grow faster than rich ones). Beta convergence is confirmed (with a significant parameter of -0.005) while the dynamic of standard deviations indicates sigma divergence for almost all the period. In order to better study the evolution in national per capita incomes, we divided the 189 countries into 5 classes according to the approach of Quah (1993), based on the per capita GNI for the initial year of 1995: 1) less than 20% (the poorest countries); 2) between 20 and 50%; 3) between 50 and 100%; 4) between 100 and 200%; 5) and higher than 200%. As for the HDI, the indicators were normalized (0-1) and all countries were divided into 5 classes with the following range in normalized HDI scores: 1) 0-0.3; 2) 0.3-0.5; 3) 0.5-0.65; 4) 0.65-0.8; 5) > 0.8 .

We calculated the transition probability matrix of countries across classes. The transition probability matrix of a Markov chain gives the probabilities of transitioning from one class to another in a single time unit. We investigated if it is Markov first-order (i.e., if the data in one year significantly depends only on the situation in the previous year) and homogeneous (not statistically changing over time). To verify these properties, we used the test of Bickenbach and Bode (2003).

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In the case of per capita GNI, the Markov property of the transition matrix was confirmed, but the homogeneity was not confirmed. Possibly, this was due to the fact that dynamics of the economy has changed after the financial crisis in 2007-2008. Therefore, we decided to use the transition matrix for 2006-2018 that resulted to be Markov first-order and also homogeneous.

This matrix (Table 1) has large values for the diagonal elements, which indicates a high probability of remaining in the same class, namely a low probability of mobility: the probability of moving (up or down) to a neighboring class is already very small as between 0.009 to 0.032, while transition to a class beyond the neighboring classes are at zero probability. Shorrock's Index, characterizing the degree of mobility of countries between classes, is equal to 0.0418, indicating a low mobility of countries.

Table 1. Transition probability matrix (GNI) 2006-2018

Group in t-1 period	Group in t period				
	1	2	3	4	5
1	0,97058824	0,02941176	0	0	0
2	0,0212766	0,95390071	0,0248227	0	0
3	0	0,0102459	0,95696721	0,03278689	0
4	0	0	0,02258065	0,96129032	0,01612903
5	0	0	0	0,0097561	0,9902439

Source: authors' elaboration

As for HDI, data were available only since 2000 and we used data for 179 countries. We found confirmation that this matrix is Markov first-order and homogeneous. We calculated transition probability matrix (see table 2) and found that also this matrix has large values for the diagonal elements. And the Shorrock's Index, which characterizes the degree of mobility of countries between classes, is equal to 0.0312, even smaller than in the case of per capita GNI. This tells us that countries are less mobile when changes in HDI are considered, as upgrading from one human development class to another is even more difficult than upgrading in terms of per capita GNI only.

Table 2 - Transition probability matrix (HDI) 2000-2018

Group in t-1 period	Group in t period				
	1	2	3	4	5
1	0,97916667	0,02083333	0	0	0
2	0,01195219	0,98207171	0,0059761	0	0
3	0	0,00153846	0,96461538	0,03384615	0
4	0	0	0,01445087	0,96242775	0,02312139
5	0	0	0	0,0132626	0,9867374

Source: authors' elaboration

Key conclusions and policy implications

Inequality is a persisting phenomenon. The generally positive dynamics evidenced also a significant inertia – especially considering HDI. The results of our analysis strongly suggest the adoption of more appropriate growth policies to improve the upward mobility in terms of per capita GNI, and, more necessarily and importantly, development policies favouring a higher positive mobility in terms of Human Development Index, which point to the importance of education and health policies alongside economic

growth promotion.

When the 2020 data become available, it will be interesting to investigate newly, for both per capita GNI and HDI, how the pandemic affected the distribution of countries across the 5 classes and the eventual evolution in the transition probability matrix.

References

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