



## World Income Distribution and Mobility

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### Abstract

In this paper, we show that over the period 1970–2007, the world income distribution expressed in terms of GDP per capita invariably scales down as an exponential law. To visualize dynamical characteristics behind this macro-stability, we use a clock form to present the GDP per capita and rank of the 163 countries over 38 years. Correspondingly, the average variations over time are quantified by absolute and relative mobility indexes. Furthermore, a growth mobility index concerning the share of each country is proposed and its decomposition is also presented in the clock form. © 2010 Published by Elsevier Ltd

### Keywords:

GDP per capita, Distribution, Clock, Mobility, Decomposition

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### 1. Introduction

The world income distribution of GDP per capita has been the subject of much empirical and theoretical work over the last two decades [1, 2, 3, 4, 5, 6, 7, 8]. Indeed, two empirical results concerning the income distribution have surfaced in the recent literature: First, while convergence in terms of GDP per capita has been achieved among a restricted set of industrialized countries, i.e. the so-called convergence club [2], divergence has been the rule for the GDP distribution taken as a whole [8]. Second, the density function of the cross-country GDPs distribution has moved from a unimodal shape in the 1960s to a ‘twin-peaks’ shape in the 1990s [5, 6, 7].

In 2003, Guilmi, Gaffeo, and Gallegati presented a third stylized fact regarding the world GDPs distribution from a new perspective [9]. It was the first attempt to examine the relation between GDP per capita and its rank order. They found that the world income distribution between the 30th and the 85th percentiles approximately follows a Pareto distribution, and that this result is extremely robust as moving from 1960 to 1997. Later Roki Iwahashi and Tomohiro

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Machikita looked into this issue, but obtained different result [10]. He pointed out that the real cross-country GDP per capita is significantly approximated to a geometric sequence, furthermore, the Log GDP against its rank, instead of Log rank, displays a more significant relation: It clearly fits a line even for the richest and poorest country groups.

The studies mentioned above mainly discuss the steady world income distribution in the macro level, however, some micro characteristic of intra-distribution, such as the GDP per capita or rank, changes severely with time behind the macro-stability [5, 11, 12]. This fact is meaningful for further understanding the formation of the distribution but has seldom been noticed until Quah's work in 1993 [5]. In this pioneering work, Quah analyzed the dynamics in the rich cross-section of countries income by a so called fractile Markov chain, and he suggested that cross-country incomes tended towards extremes at both high and low endpoints. Following the approach proposed by Quah, Richard Paap and Herman K. van Dijk examined the individual switches of countries between the rich and poor groups [11], and argued that the main mobility is from rich to poor and the 'middle' group between poor and rich disappears. In addition, Francois Bourguignon and Christian Morrisson extended this work by concluding that the mobility of individuals in the world distribution of income is strongly history dependent [12].

Those studies on the dynamics of world income all focus on the variance of specific quantiles of the world distribution. However, the micro change of every country, which is more elementary for understanding the income-generating regimes, hasn't been discussed. Besides, considering the measurement for mobility, there has been a lot of related work in the field of personal income [14, 15, 16, 17, 18, 19, 20]. Researchers construct distinct indexes to measure mobility according to different concepts, which could also be used in measuring the world income mobility.

We have two improvements in this paper. First, although statistically stylized facts are found by previous work, it is still controversial as to whether there is a steady law does the world income distribution exactly obey. As a result, we check the macro-stability of world income by approaching the data of GDP per capita to an exponential law using the data from the year 1970 to 2007. Second, we further investigate the micro change of world income by visualizing them in a clock form advanced by Michael Batty [13], and calculating the total variance by a mobility index proposed by Fields & Ok [14]. In addition, we put forward a new index for measuring the mobility of world income and decompose it to make clear the modes or reasons of the income mobility. We believe that the results shown in this paper is important and useful to further understand the development and evolution of world income distribution.

The remainder is organized as follows: Statistical evidence examined by cross-country panel data 1970-2007 is presented in Section 2; The micro change of world income is exhibited in Section 3; Section 4 gives the calculation and decomposition of mobility; In section 5 we conclude.

## 2. Data and distributions

We study the world income distribution in terms of GDP per capita, using the dataset *Penn World Table version 6.3* of Summers, Heston and Aten. This *Table* contains a set of economic time series, based on national accounts covering 189 countries for the period 1950-2007. However, for observations are not available for each country over the whole period, a restriction of the time horizon has been imposed in order to minimize the trade-off between the cross-section dimension and the time dimension of the panel. In our case, the sample we analyze consists of 163 countries over the period 1970-2007.

The world distributions of GDP per capita for 163 countries over the period 1970-2007 in the single-logarithmic coordinates are presented in Figure 1. As can be seen, almost all the curves

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