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Demography and Growth

Two forces leading to rising global income inequality

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Summary

Global income inequality has been declining for several decades. This paper argues that global income inequality will reach its lowest level around 2027 after which it will rise again. This development is the result of both economic and demographic developments.

Global income inequality has been decreasing since the 1970s. Whether or not this trend of income convergence continues depends both on relative economic performance between countries as well as on demographic factors. This paper builds and models several global growth scenarios in order to project global income inequality in the next forty years.

By combining economic projections with demographic developments and, more specifically, by using GDP per worker instead of GDP per capita in projecting income levels, more emphasis is given to the role of demographics in income inequality. Especially in the long run (after 2030), differences in population growth and population structure between countries in different stages of economic development are shown to increase global income inequality.

The main findings can be summarized as follows:

- The trend of decreasing global income inequality, which has been observed for several decades now, will be reversed in the near future. Using the Gini coefficient, the lowest level of income inequality will be reached around 2027, after which global inequality will rise again. Using alternative inequality measures, the reversal may start already around 2017.
- The trend reversal in global income inequality is the result of both economic and demographic developments, as well as the interaction between these two forces.
- Regarding economic developments, several countries in East Asia and South Asia play a large role. Many Asian countries simultaneously catch up with the advanced countries and pull away from other developing countries. This has long been a converging force but will soon result in increasing global income inequality.
- Regarding demographic developments, (Sub-Saharan) African countries are most relevant. High projected population growth rates will slow economic development (especially compared with Asian countries with a 'better' age structure) and will increase the 'weight' of Africa in inequality measures. This diverging force for global income inequality thus gains momentum over time.
- Several alternative scenarios confirm and clarify the income inequality trend reversal. Demographic developments are identified as a force of rising income inequality even when economic variables (GDP per worker) are held constant. Similarly, projected economic developments ultimately also act as a force of rising income inequality even when demographic variables (population) are held constant.

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1 Introduction

The past trends in (global) income inequality are well documented. But what trends can be expected in the future? This paper develops several global growth scenarios in order to project income inequality in the next four decades.

The first industrial revolution brought with it a period of at least a hundred years of increasing income inequality in the world (Bourguignon and Morrisson, 2002). After first stabilizing halfway through the 20th century, a trend of income convergence has been set in after the 1960s, one which continues to this day (Sala-i-Martin, 2006). A natural question to ask is, what will happen in the coming decades? This paper argues that the answer combines developments in both Africa and Asia. Africa has seen unstable growth and might actually have continued diverging away from OECD countries. Asia, in contrast, has been the driving force behind the recent income convergence. Many Asian countries, among which populous nations like China and India, are rapidly developing. They are simultaneously catching up with OECD countries and pulling away from other developing countries, resulting in two opposing forces that will shape the trend in global income inequality in the near future.

This paper develops several global growth scenarios up to 2050 in order to project global income inequality in the next 40 years. Economic growth, driven by productivity increases, naturally plays a large part in this process, but given the long time horizon, demographic developments do so as well. For example, the population of Africa is projected to double in the coming four decades. At the same time Asian countries profit from a beneficial age structure, as many advanced countries have over the past decades. These countries are now starting to struggle with aging populations and fertility rates below replacement levels. All these development directly (through economic growth) or indirectly (through the share of working age population) impact on global inequality. These developments are the central theme in this paper, which is the first paper to include both future population growth and population dynamics (age structure) by using GDP per worker as the underlying variable for future growth projections. This combined projection allows for differentiating between economic and demographic effects on income inequality.

Chapter 2 gives an overview of the main findings of previous research with regard to growth, inequality, demography, and the interplay between them. Chapter 3 describes the data and methodology. Chapter 4 presents the obtained results and chapter 5 introduces a number of alternative scenarios which function as robustness checks. The final chapter summarizes the most important conclusions.

2 Literature review

Many interactions exist between economic and demographic variables. Future income inequality will be shaped by economic growth differences between countries as well as population growth and the relative size of working age population in each country.

2.1 Inequality in the past

The academic discussion on economic growth and income inequality has, for obvious reasons, mainly focussed on the past (Brat, 1995; Jones, 1998; Schultz, 1998; Park, 2001; Bourguignon and Morrisson, 2002; Milanovic and Yitzhaki, 2002; Sala-i-Martin, 2006; Pinkovskiy and Sala-i-Martin, 2009). Rising global income inequality in the past two centuries has been the rule rather than the exception, driven by the strong and continuous growth of a small number of (OECD) countries after the industrial revolution. This resulted in a twin-peaks world income distribution, characterized by a large number of people (countries) with a low income and a smaller group of people (countries) with a high income, and not much in between (Dikhanov and Ward, 2001). Milanovic and Yitzhaki (2002) therefore conclude that the world as a whole did not have a middle class.

Towards the end of the 1970s the economic growth rate in the emerging markets of the Asian tigers, China and later also India and a select number of African countries led to a halt of rising income inequality. Eventually a trend towards lower global inequality was realized. When using a decomposable inequality measure, such as the Mean Log Deviation (MLD) or the Theil index, the global inequality decline from 1979 to 1996 can be shown to be caused by a decrease of between-country inequality despite a rise of within-country inequality (Sala-i-Martin, 2006). It is thus possible that the overall convergence is mainly caused by income growth in the high-income quintiles of poor countries, leaving the income of the poorest people virtually unchanged. However, absolute poverty numbers have also declined (Dollar, 2005). The poorest people have thus in general been able to profit from the convergence trend, at least to some extent.

2.2 Similar research

It is quite common to investigate future income growth trends. Large investment banks (Wilson and Purushothaman, 2003; Hawksworth and Cookson, 2008; Buiter and Rahbari, 2011), as well as research institutes (Poncet, 2006; Dadush and Stancil, 2010; Fouré, Bénassy-Quéré et al., 2010) have presented growth predictions up to the year 2050. This literature is, however, silent on the possible implications for global income inequality. Understandably, results are not completely uniform. This is in part due to differences in focus and/or data and partly because the time frame extrapolates minor variations in assumptions. Nonetheless, there is a general consensus on which countries will be the biggest growers over the next forty years: Asian countries. Eight out of the top ten growers identified by Buiter and Rahbari (2011) are Asian countries. In Hawksworth, Cookson et al. (2008) the only non-Asian countries among the top ten are Nigeria and Egypt.

Besides Asia, Dadush and Stancil (2010) also have high expectations for Latin America and some African countries: Ethiopia, Kenya, Nigeria, and Ghana.

With regard to inequality a natural question to pose is: what effect will growth differences have on future global inequality? Although the question was posed by Sala-i-Martin (2002, 2006) it was given only minor further attention in the papers and is only briefly modelled with some extreme assumptions (such as no growth between 1998 and 2050 for many African countries). The growth predictions mentioned above are also only marginally useful in such an exercise, as the models are data intensive such that many countries will have to be excluded. Furthermore, there is a bias in the countries chosen to evaluate, namely the likely winners.

A study analysing future income inequality trends requires a different approach, namely one that allows for inclusion of virtually all countries as well as the possibility to evaluate several scenarios, thus acknowledging that a lot can happen in 40 years time. Quah (1993) tries to tackle a similar question using a probability model, which calculates the probability of a country moving to the next income threshold. It proves to be an elegant but rather abstract approach. Countries converge towards extremes (either rich or poor), but the mechanics behind this outcome remain difficult to grasp. Jones (1997) initially holds on to neoclassical theory and assumes convergence towards 'predetermined' income levels but also includes a long-run probability model in extension of the work done by Quah. He concludes that there has been a tendency to move up in the income distribution, which is likely to continue due to developments in China and India. In retrospect, this has indeed been the case.

To our knowledge Hillebrand (2008) is the only other paper analysing future poverty and inequality. Using Bhalla's (2002) simple accounting procedure, an estimation is made for income inequality in 2050 using two differing growth scenarios. Hillebrand's focus is on the implications of growth for poverty rates (headcount). He estimates a continuing decline in global income inequality from 2005 to 2050 in his base case (the 'Market First' scenario). Only by assuming drastically lower growth rates for a large group of developing countries (Sub-Saharan Africa, the Middle East, and Latin America; the 'Trend Growth' scenario) does he find a reversal of this trend sometime in the future. In contrast, this analysis finds an imminent reversal to rising global income inequality measures, somewhere around the mid 2020s, for a range of different and plausible scenarios without the need to artificially impose decline in growth for certain parts of the world. The main reason for these diverging outcomes is a different treatment of demographic factors and more attention for the age distribution of the population, with a focus on the working age population relative to the total population. The methodology allows for modelling a continuous process showing the dynamics behind the relative welfare shifts found whereas Hillebrand 'jumps' to 2050 without describing the process in between.[1] This is where this paper fits in and contributes to the existing literature.

2.3 Contribution to literature

The premise of this paper is that the combination of economic and demographic developments (both of which differ greatly between countries) might result in a comeback of rising income inequality somewhere in the next few decades. The initial industrial revolution has greatly increased

[1] Hillebrand (2008) does provide estimates for the year 2015.

global inequality, a new wave of industrializing countries might do the same, once the pull-away (from less fortunate countries) factor starts to outweigh the catch-up (to OECD countries) factor. This will likely be enhanced by demographic developments. Most of the world's population growth in the next few decades will come from high fertility, low-income countries.

The African continent is expected to grow from just over 1 billion inhabitants now, to more than 2.2 billion in 2050 (United Nations Population Department, 2011). Many of these people are born into poverty. Demographic developments thus play a vital role in predicting the future world distribution of income. Naturally, demographic developments affect not only in how many slices the 'income pie' has to be cut but also interact with economic developments. Brander and Dowrick (1994), for example, use cross-country panel data to examine the effects of fertility and population growth on economic growth and find that fertility and per capita income simultaneously influence each other. As per capita income rises, fertility tends to decline. At the same time, as fertility declines, investment effects enable rapid increases in per capita income.

Brander and Dowrick (1994) also note that a sudden fertility decline can have an important impact on the relative size of the working age population in the medium run, thus enabling a period of rapid economic growth. Bloom, Canning et al. (1999) show this mechanism at work in explaining the East-Asian miracle. They pinpoint South-East Asia as the next region to experience a big growth spurt. On the other hand, they emphasize that demographic transition is a necessary rather than a sufficient condition for economic growth acceleration; South-Asia, for example, seemed unable to fully profit from its positive demographic developments. Williamson (1998) concludes on this matter: "Demographic forces need not always have a profound impact on growth or distribution. They depend on the historical time and place. For it to matter, the demographic shocks must be big, they must be mostly exogenous with respect to the growth itself, and they must translate into changes in the age distribution."

Going back to inequality and poverty, Bloom & Sachs (1998) depict the lack of fertility slow-down, and thus the lack of demographic transition, in Africa as one of the main reasons poverty is still plaguing the continent. Instead of a traditional demographic transition this has thus far only led to a high share of young people in the population. Only about 50% of the total population is of working age whereas other continents sometimes come close to 70%. Needless to say, this has had a profound impact on development and is likely to be one of the reasons why Asia has been outgrowing Africa for the past few decades. Hall and Stone (2010) give an indication of the direct population- and working age population-effects on economic growth for the next 10 years. They conclude that many advanced countries (Germany, Japan, Italy and the US) should count on lower growth figures due to an aging population and rising dependency ratios. To a lesser extent the same holds for many Asian countries (China, India, Indonesia, South Korea) and Mexico. Lindh and Malmberg (2007) look even further into the future, to 2050. They make demography-based predictions of economic growth and find a general pattern of already advanced countries experiencing stagnating growth whereas developing countries take off.
Sub-Saharan Africa is expected to be the only exception to this rule, mainly due to continuing high fertility and the AIDS epidemic. The validity and consequences of observations like this one with regard to global income inequality are the main subject of the rest of this paper.

3 Methodology

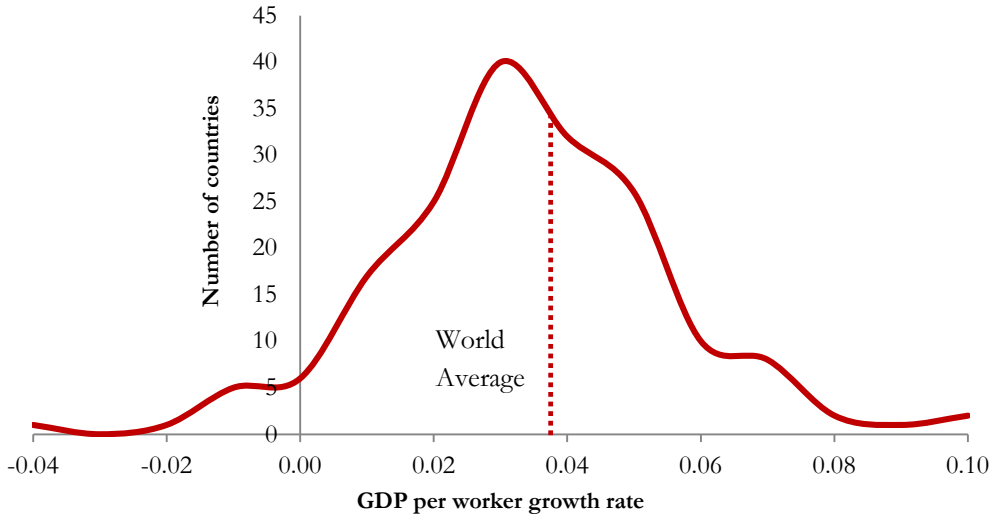
GDP per worker growth figures for 176 countries are extrapolated and combined with country level information on income quintiles and age distribution to construct income growth scenarios for the period 2009-2050. The scenarios are then used to project global income inequality measures in that same period.

3.1 Economic variables

Combining the UNU-WIDER database (2008) and Penn World Tables (2011) provides income quintile information for 137 countries divided over six continents (Africa, Asia, Latin America, Europe, North America, and Oceania), together accounting for about 96 per cent of the world population. Using this information, income quintiles per continent in 2009 are calculated, based on the population, income, and quintile information for the countries for which this information is available. For the 39 remaining countries with missing income quintile information, together accounting for the remaining four per cent of the world population, these respective continent-wide income quintiles are used. The quintile distributions are kept constant for the projection period for all countries. Appendix A provides an overview of all included countries.

The base scenario uses a country-specific GDP per worker projection based on the period 1990-2009. Figure 3.1 shows the distribution of these growth rates for individual countries. The country median growth rate is 3.83 per cent, which is close to the world average growth rate (using world GDP per worker data) of 3.79 per cent.

Figure 3.1 *Distribution of GDP per worker growth rates; per country 1990-2009*



Source: Authors' calculations based on United Nations (2008), United Nations Population Department (2011) and Heston et al (2011).

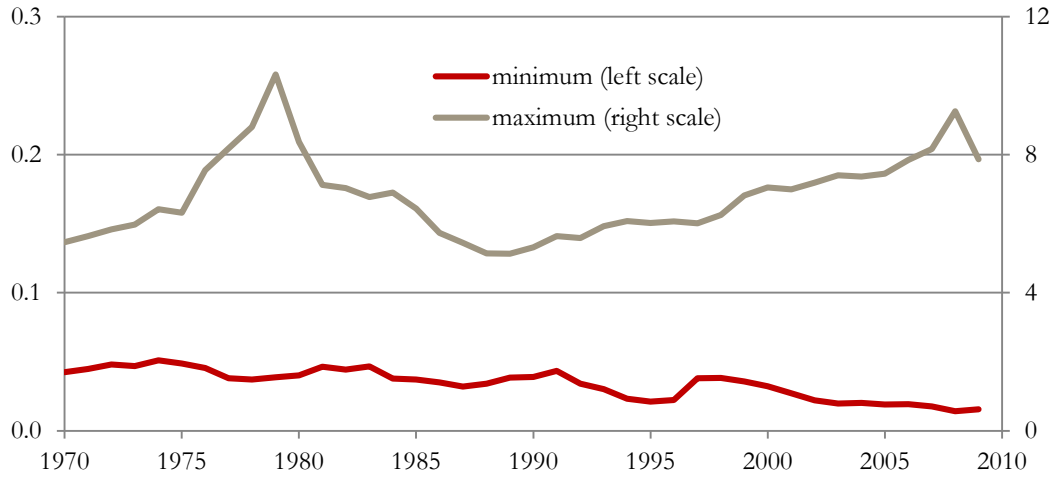
On both sides of the distribution is a number of smaller countries with an exceptional development of GDP per worker growth rates. These are typically due to oil discoveries or (recovery from) wars. The impact of estimated growth rates for future projections is mitigated in three ways:

First, three outliers are eliminated by imposing the second-lowest growth rate for the country with the lowest growth rate (Congo, Dem. Rep.) and the third-largest growth rate for the two countries with the highest growth rates (Eritrea and Bosnia Herzegovina).

Second, since the performance of countries that currently grow fast is likely to decline and for countries that currently grow slowly is likely to improve, continent-wide average growth rates (using continent GDP per worker data) are calculated on which a gradual reversal to the continent-average per country is imposed, namely linearly over a period of 40 years.[2] If, hypothetically, a country's growth rate in the period 1990-2009 is 8 per cent per worker and this country's continent-wide growth rate is 2 per cent, then the imposed growth rate per worker is 8 per cent in 2010, declining to 7.85 per cent in 2011, to 7.70 per cent in 2012, etc.

Third, a minimum and maximum GDP per worker relative to the world average GDP per worker level is imposed. Figure 3.2 illustrates that both the minimum and the maximum relative to the world average fluctuated over time in the period 1970-2009 without a clear trend. To avoid extremes going beyond these historical limits, bounds of 1.5 per cent of the world average as a minimum and 10 times the world average as a maximum are imposed. These are close to the observed extremes.[3]

Figure 3.2 Minimum and maximum GDP per worker relative to world average, 1970-2009



Source: Authors' calculations based on United Nations (2008), United Nations Population Department (2011) and Heston et al (2011).

Taking into account these three mitigating procedures, GDP per worker growth is modelled for each of the 176 countries over the period until 2050. These projections are then supplemented with data on the developments with regard to size and structure of the respective populations, as described in the next paragraph.

2 The continent-wide growth rate in the period 1990-2009 was 3.1 per cent per worker in Africa and Latin America, 3.9 per cent in North America, 4.1 per cent in Europe, 4.8 per cent in Oceania, and 5.0 per cent in Asia.

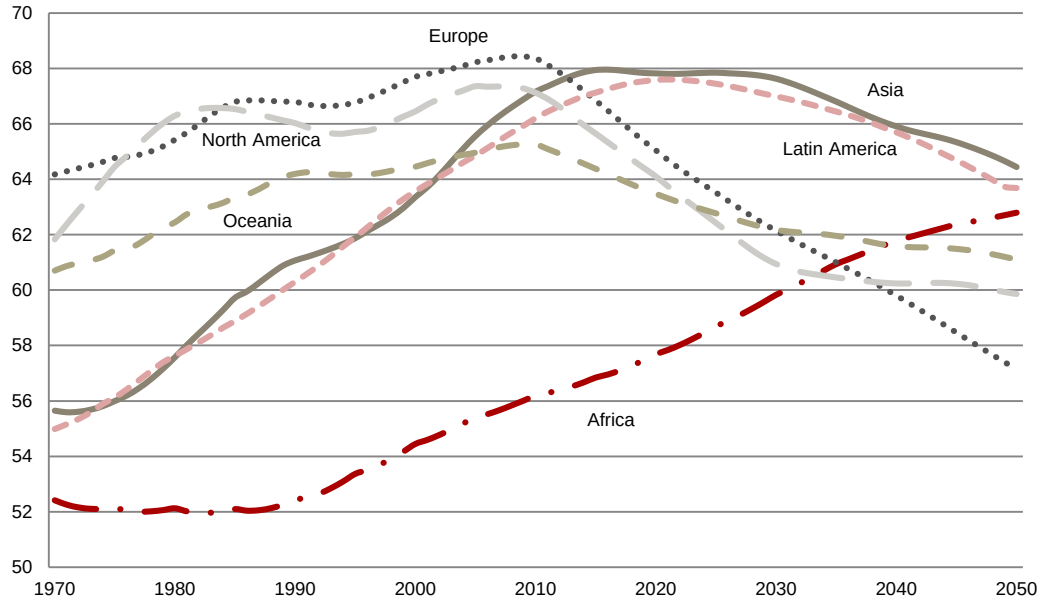
3 For the base scenario, for example, the minimum is ultimately imposed for one country (Zimbabwe) and the maximum for three countries (Kuwait, Qatar, and Luxembourg).

3.2 Demographic variables

The United Nations Population Department (2011) provides detailed predictions regarding population developments per country up to the year 2100, including the share of the young population, the working population, and the old population. Using the medium variant the predicted GDP per worker for a particular country is multiplied by the *working* population to get a prediction for total GDP. Then the respective quintile shares are calculated and divided by the relevant fraction of the *total* population to get an estimate of the income levels for the different fractions of the population in that country over the projected period.[4]

Figure 3.3 gives an indication of the importance of using GDP per worker instead of GDP per capita for this exercise. Over the time period 1990-2009, Europe, North America and Oceania all enjoyed high shares of working age population and, not completely unrelated, high per capita growth rates. These continents were the first ones to enter into the demographic transition and have enjoyed the benefits over the past few decades. Rising life expectancy combined with rapidly falling fertility rates in Latin America and Asia since the 1970s have resulted in a 13-14 per cent point increase of the working age population in 40 years time. Working age population here will peak between 2015 and 2030, approximately 15 years after the advanced countries in Europe, North America and Oceania.

Figure 3.3 1970-2050 Working age population, % of total population



Data source: United Nations Population Department (2011)

The figure above makes two important points with regard to Africa. First, Africa lags behind other continents in its demographic transition: the working age population share only started to increase in the 1990s. Second, continuing high fertility rates slow down the growth of the share of the working age population. Whereas Asia's share of the working age population rose 13 per cent points in 40 years, Africa's is expected to increase only 11 per cent points over 60 years. As a direct

[4] Using an estimation method such as Bhalla (2002) to smooth the Lorenz curve per country gives similar results with, obviously, somewhat lower Gini coefficients.

result of these developments, the United Nations Population Department (2011) predicts the working age share to peak in 2075 at just over 64%, significantly lower than that of Asia or Europe at their respective peaks.

Needless to say, demographic developments as described above will have an impact on GDP growth, not only for specific countries and regions but also relative to one another. Most importantly in this respect is the gap (about 11 per cent points) in working age population between Asia and Africa. Over time the gap will diminish, but most African countries will be faced with less favourable demographic developments compared to their Asian counterparts in the upcoming decades.

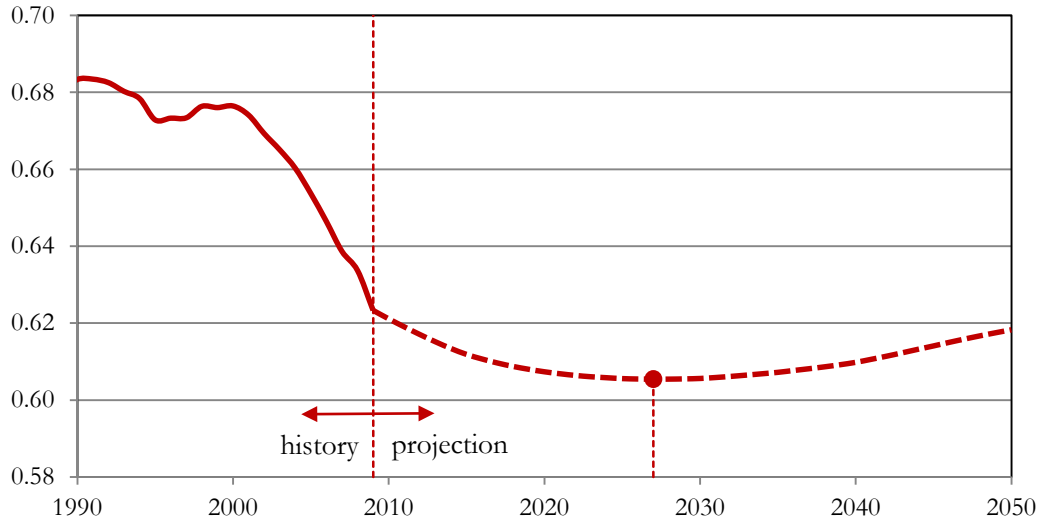
4 Results

The base scenario projects a reversal of the current income inequality trend. Global income inequality will decrease until 2027, when an increase will set in. Rising income levels in many Asian economies and continuing high population growth rates in Sub-Sahara Africa are most the important drivers behind this trend reversal.

4.1 Lorenz curve and Gini-coefficient

Figure 4.1 summarizes the outcome for the evolution of global income inequality, measured using the Gini coefficient, for the period 1990-2050. The period 1990-2000 shows a minor decrease in global inequality, in particular due to the Asian- and consequent Latin American crisis of 1997 and 1998 which resulted in a short period of income divergence. From 2000 onwards a clear decrease in global inequality is visible. The prediction, starting in 2009, suggests that the decline in global income inequality, which started at the end of the 1970s, comes to a halt around 2027 and then reverses to a process of rising income inequality.

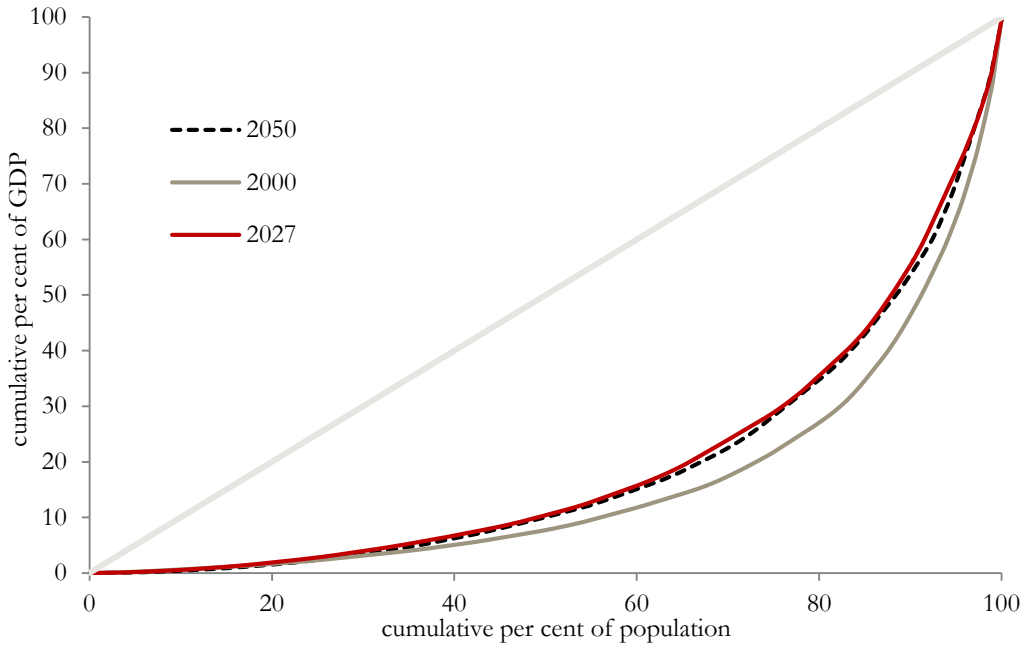
Figure 4.1 Global Gini coefficient; base scenario, 1990-2050



Source: Authors' calculations

By 2050 global income inequality is expected to have returned to levels similar to that of today. The Lorenz Curves shown in Figure 4.2 illustrate that most of the decrease in inequality in the period between 2000 and 2027 can be attributed to the creation (or expansion) of a global middle income class. Especially the third and the fourth quintiles command a larger share of total income in 2027 compared to 2000. The rise in inequality projected to occur between 2027 and 2050 is visible in the Lorenz curves, but does not yet take us back to the 2000 level. The next paragraphs will delve deeper into the mechanics behind this central finding.

Figure 4.2 *Global Lorenz curves; base scenario, 2000, 2027 and 2050*



Source: Authors' calculations

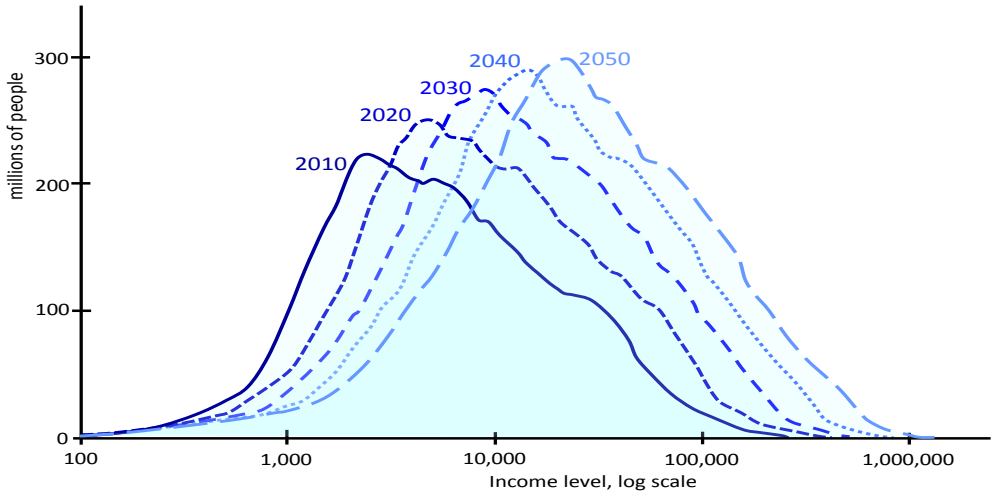
4.2 Income distributions

The base scenario predicts another 15 years of income convergence after which a diverging trend reappears. To analyse the dynamics behind this development, a closer look at the data is required. One way of doing is, is by constructing a *World Distribution of Income* (WDI). The WDI is the result of a Kernel Density Function in which all 880 income groups[5] are population weighted and effectively integrated into one global income distribution. This paper follows Sala-i-Martin (2006) in using a kernel bandwidth $w = 0.9 \times sd \times n^{1/5}$ where sd is the standard deviation of log income and n is the number of observations.

Figure 4.3 has the income level (log scale) on the horizontal axis and millions of people on the vertical axis. The density function comprises of a hundred different points, each of which corresponds to a number of people and matching income level. The area under the lines is equal to the total world population in the respective years. The WDI allows for analysing the relative income levels of different groups of people and incorporates both population and income growth.

5 Quintile data of 176 countries resulting in a total of 880 income groups with differing income and population size

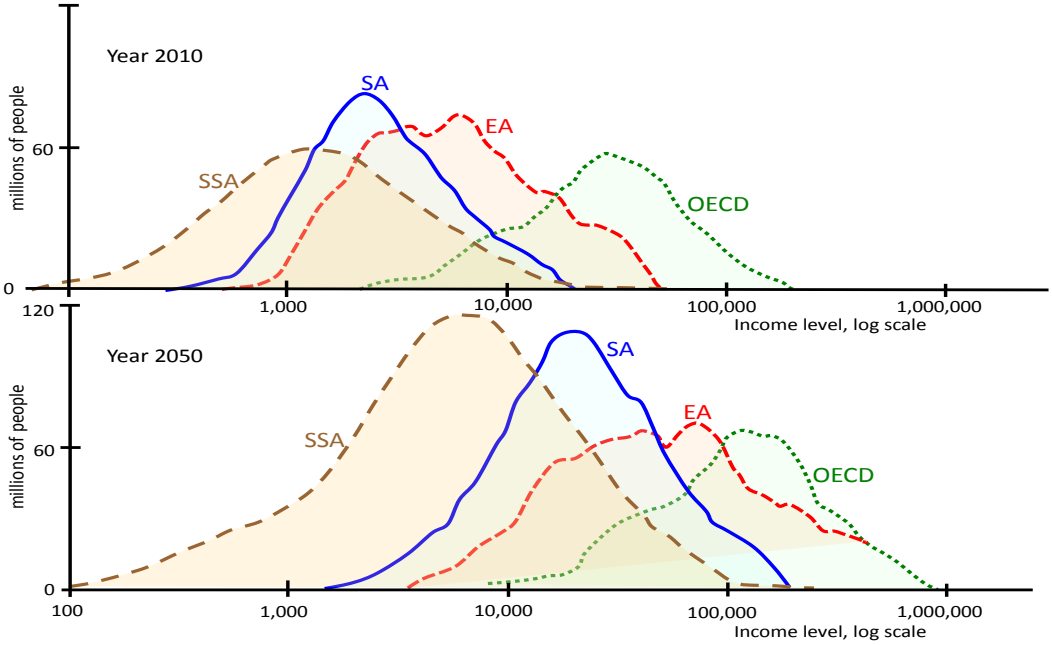
Figure 4.3 World Distributions of Income, 2010-2050.



Source: Authors' calculations

Each consecutive WDI above is larger (a larger area under the graph) and shifted to the right in comparison to the one before. This corresponds with growing world population and rising income levels. Because of these two large-scale developments most other shifts are small in comparison and therefore hardly visible. Figure 4.4 takes this approach one step further and looks at different regions[6] in relation to one another. Sub-Sahara Africa (SSA), South Asia (SA), East Asia (EA) and the OECD countries are each shown as individual distributions[7] for 2010 and 2050.

Figure 4.4 Regional distributions 2010-2050.



Source: Authors' calculations; EA = East Asia, SA = South Asia, SSA = Sub-Sahara Africa.

6 Based on the geographic classifications used by the World Bank.
7 These distributions are each made up of 50 kernel data points.

This added detail provides for a number of interesting insights with regard to the reversal of the income inequality trend depicted in Figure 4.1:

First: Considerable shifts are visible, both in individual distributions as well as in distributions in relation to each other. All distributions shift to the right, but South Asia and East Asia move relatively faster. A consequence of this is that East Asia has more overlap with the income distribution of the OECD countries in 2050 that it had in 2010. The same holds true for South Asia.

Second: Where continents shift relative to each other, some shifts result in an overall decrease of inequality and some result in an overall increase of inequality. For example, a shift bringing Sub-Sahara Africa incomes closer to OECD income levels would result in a decrease of global inequality. With respect to South Asia and East Asia the situation is more complex. While these countries *catch up* to OECD countries, they simultaneously *pull away* from most other African and Asian countries (the latter is not shown in the graph). For example, China has over the past few decades grown faster than the OECD average. At the same it outgrew most African countries resulting in diverging (from Africa) and converging (toward the OECD) trends at the same time. The net result for global income inequality depends on the relative size of the divergence- and convergence forces in relation to each other.

Third: The OECD countries and East Asia (mainly China) show a modest population growth. South Asia (India) and Sub-Sahara Africa are projected to significantly increase in population[8]. This impacts global inequality in at least two ways. First, a rapid increase in population is often associated with a higher youth dependency ratio and subsequent lower economic growth. Countries with an extremely high population growth are thus at risk to (economically) lag behind countries with a lower population growth. A similar observation can be made for very low population growth which results in a larger old age dependency ratio[9]. Second, population size also directly influences inequality measures such as the Gini-coefficient. The bulk of low-income countries are situated in Sub-Sahara Africa. As population in Sub-Sahara Africa grows more rapidly than in the rest of the world, the relative weight of the continent increases. Therefore, inequality would increase *even if* GDP per capita is assumed to stay the same in all countries over the entire period, as explained in an alternative scenario in paragraph 5.1.

The projected reversal of the current trend of income convergence can thus be better understood by separating a number of simultaneous developments. Projected growth in Asian countries can lead to income convergence as well as income divergence. In the past decades the converging force has been the stronger one resulting in a net decrease of global income inequality. As income levels in Asian countries start approaching those of the OECD the effect on income inequality diminishes while the diverging force resulting from *pulling-away* from a number African countries increases. On top of this demographic developments act as a separate diverging force. Not only the distance[10] but also the size of the relevant population matters when calculating inequality. A larger population

8 Population growth between 2010 and 2050 according to United Nations Population Department (2011): OECD from 1,23 to 1,40 billion, East Asia from 1,89 to 2,01 billion, South Asia from 1,63 to 2,31 billion and Sub-Sahara Africa from 0,85 to 1, 95 billion people.

9 This is most relevant for OECD countries such as Germany and Japan.

10 That is, the difference in income level.

in Sub-Sahara Africa thus results in a higher global Gini-coefficient even without changes in income levels.

5 Robustness checks

Alternative scenarios and inequality measures confirm the conclusions drawn from the base scenario projection. Demographic projections are identified as contributing to income divergence even when differences in economic growth between countries are ignored.

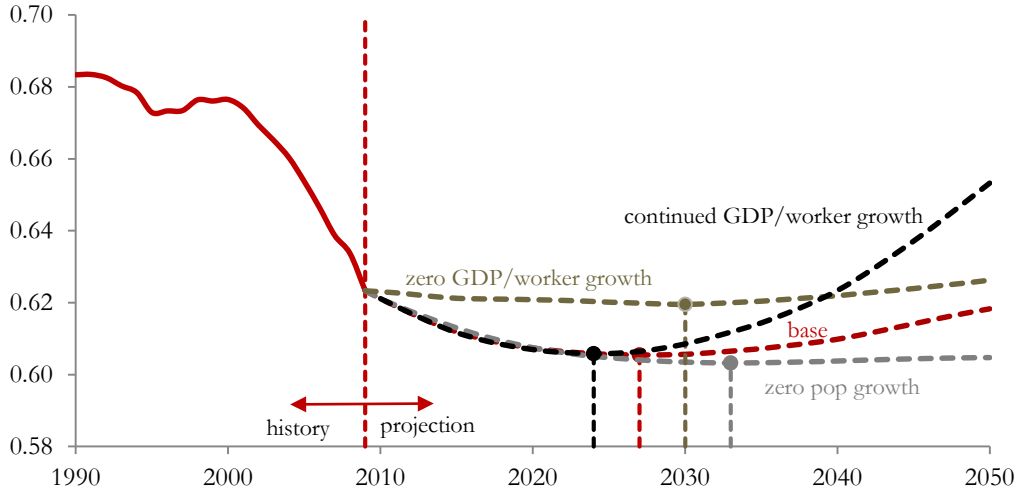
5.1 Alternative scenarios

Chapter four has discussed a number of implications of the base scenario. Here a number of alternative scenarios will be introduced. These alternative scenarios provide additional insights as they allow us to separate the effects of economic growth and demographic developments. At the same time they are useful robustness checks for the base scenario. Three alternative scenarios are specified, namely:

- *Zero Population growth*. Stagnant population in all countries; GDP per worker projections as in the base scenario.
- *Zero GDP per worker growth*. Stagnant GDP in all countries; population demographics as in the base scenario.
- *Continued GDP per worker growth*. No reversal of GDP per worker projections to the continent mean, population demographics as in the base scenario.

The *zero population growth* and zero *GDP per worker growth* scenarios allow for analysing the relative impact of demographic developments. The *continued GDP per worker growth* scenario signifies the difference between simply extrapolating 1990-2009 trends and the more eloquent method based on a gradual reversal of GDP per worker to the continent average that is used in the base scenario.

Figure 5.1 Global Gini coefficient, various scenarios



Source: Authors' calculations

Figure 5.1 illustrates the impact of the various scenarios on global income inequality for the Gini coefficient. The *zero population growth* scenario allows for additional focus on the impact of growth projections and the convergence - divergence forces touched upon in section 4.2. Regarding global inequality, the zero population growth scenario starts to diverge from the base scenario essentially from 2030 onwards. This indicates that the growth projection impact and the reversal from converging to diverging forces for East Asia and South Asia relative to the the OECD on the one hand and Africa on the other hand is mostly noticeable in the long run. Evidently, what was a converging force in the past will cease to be so around 2030. This scenario also illustrates the diverging impact of the projected demographics; the base scenario with population growth results in higher inequality than the zero population growth scenario, essentially because of the rising importance (weight) of Sub-Sahara Africa. Most importantly, however, the basic trend continues to hold: even without population growth global income inequality is projected to increase from 2033 onwards.

The *zero GDP per worker growth* scenario allows us to focus attention on the demographic developments. As is evident from Figure 5.1, this is a rather extreme scenario where the developments of the past decade are abruptly transformed to an almost static development in global income inequality. This can be expected, of course, because the focus on demographic factors alone obviously lead only to a gradual change in inequality. As before, however, the same pattern emerges: first a continued decline in global income inequality until 2030, followed by a rise in inequality afterwards. It is reassuring for our base projections that the two main forces that play a role in determining future global income inequality, the growth projections and the demographic developments, both lead to the same first-decline-and-then-rise pattern. As illustrated by the base scenario, the interaction of these two forces reinforces these developments: the minimum is reached earlier and the changes in inequality are larger.

In light of the above, the results for the *continued GDP per worker growth* scenario can be readily explained. In this case the growth projections are sharpened which, in interacting with the demographic developments, further reinforces the pattern of the base scenario. The minimum income inequality is reached earlier (namely in 2024) and the changes in inequality are larger still.

5.2 Alternative inequality measures

The discussion so far has been based on the Gini coefficient as a measure of global income inequality, partially based on the finding of Sen (1976) that the Gini can be seen as a distribution-free inequality index that represents the views on inequality of a society with very general distributional preferences. Alternative inequality measures are, of course, also available. They lead, in general, to the same overall picture: global income inequality first declines, then reaches a minimum and starts to increase again. This is illustrated in Table 5.1 for the Mean Log Deviation and three versions of the Generalized Entropy measure for all four scenarios discussed above.

Table 5.1 Year of reaching minimum global income inequality

Scenario	Gini	MLD	GE(0.25)	GE(0.5)	GE(0.75)
Base	2027	2016	2017	2017	2016
Zero GDP/worker growth	2030	2035	2030	2030	2029
Zero population growth	2033	2016	2017	2017	2016
Continued GDP/worker growth	2024	2018	2023	2023	2025

Source: Authors' calculations; MLD = Mean Log Deviation, GE = Generalized Entropy.

Using the alternative measures, the base case switches from declining to increasing global income inequality about 10 years earlier. This effect is a bit stronger for the zero population growth case, where the switch occurs around 16 years earlier. In contrast, the other two scenarios, the zero GDP per worker growth case and the continued GDP per worker growth case, are hardly affected regarding the timing of the switch. In all cases, however, the same pattern is observed: first declining and ultimately rising global income inequality. Only the timing of the switch differs.

6 Conclusions and discussion

As a result of projected economic and demographic developments global income inequality will start rising again after 2027. Within income inequality is held stable in this analysis, a reduction of within inequality in large rapidly growing countries may result in a further decline of global inequality despite the trend forces described.

This paper has combined growth projections and demographic projections to analyse likely future trends in global income inequality. The economic – demographic interactions were analysed by using GDP per worker for the growth projections and combining these with the UN's population dynamics on age structure. This allowed for calculating GDP per capita for different income groups in each country on the basis of the GDP per worker projections.

The base scenario finds that the trend of decreasing global income inequality, which has been observed for the past several decades, will be reversed in the near future. Using the Gini coefficient, the lowest level of income inequality will be reached around 2027, after which global inequality will rise again. Using alternative inequality measures, the reversal may already start around 2017.

This trend reversal is the result of both economic and demographic developments, as well as the interaction between these two forces. Regarding economic developments, several countries in East Asia and South Asia play a large role. These Asian countries simultaneously catch up with the advanced countries and pull away from other developing countries. This has long been a converging force but will soon result in increasing global income inequality. Regarding demographic developments, (Sub-Saharan) African countries are relevant. High projected population growth rates will slow economic development (especially compared with Asian countries with a 'better' age structure) and will increase the 'weight' of Africa in inequality measures. This diverging force for global income inequality thus gains momentum over time.

Several alternative scenarios' confirm and clarify the income inequality trend reversal. Projected demographic developments are identified as a force of rising income inequality even when economic variables (GDP per worker) are held constant. Similarly, projected economic developments ultimately also act as a force of rising income inequality even when demographic variables (population) are held constant.

The two forces that will lead to rising global income inequality, based on economic and demographic developments and the interaction between them, are powerful forces, which cannot easily be overturned. This raises the question whether it is possible to avoid the imminent return to rising global income inequality. In our analysis we only see one way to do so. Within-country income inequality has been held constant by taking the most recently available quintile income distribution as given.[11] If countries therefore reduce the within-country income inequality levels, global income inequality may yet further decline despite the trend forces described above. Particularly if large and rapidly growing countries like China and India do so. Since these two

[11] This does not mean that for decomposable income inequality measures the within-country inequality contribution is constant, because with different economic and population growth rates the decomposition weights change over time.

countries played a big role in lowering between-country income inequality since the 1970s, we may yet again expect them to lower global inequality further, this time by reducing within-country income inequality.

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Appendix A: Countries by continent

Africa	Uganda	Thailand	**Latin America**
Algeria	Zambia	Turkey	Argentina
Angola	Zimbabwe	Turkmenistan	Bahamas
Benin	Tanzania	United Arab Emirates	Barbados
Botswana	Togo	Uzbekistan	Belize
Burkina Faso	Tunisia	Vietnam	Bolivia
Burundi		Yemen	Brazil
Cameroon	**Asia**		Chile
Cape Verde	Afghanistan	**Europe**	Colombia
Central African Republic	Armenia	Albania	Costa Rica
Chad	Azerbaijan	Austria	Cuba
Comoros	Bahrain	Belarus	Dominican Republic
Congo, Dem. Rep.	Bangladesh	Belgium	Ecuador
Congo, Republic of	Bhutan	Bosnia and Herzegovina	El Salvador
Cote d`Ivoire	Brunei	Bulgaria	Grenada
Djibouti	Cambodia	Croatia	Guatemala
Egypt	China	Czech Republic	Guyana
Equatorial Guinea	Cyprus	Denmark	Haiti
Eritrea	Georgia	Estonia	Honduras
Ethiopia	Hong Kong	Finland	Jamaica
Gabon	India	France	Mexico
Gambia, The	Indonesia	Germany	Nicaragua
Ghana	Iran	Greece	Panama
Guinea	Iraq	Hungary	Paraguay
Guinea-Bissau	Israel	Iceland	Peru
Kenya	Japan	Ireland	Puerto Rico
Lesotho	Jordan	Italy	St. Lucia
Liberia	Kazakhstan	Latvia	St.Vincent & Grenadines
Libya	Korea (Rep)	Lithuania	Suriname
Madagascar	Kuwait	Luxembourg	Trinidad &Tobago
Malawi	Kyrgyzstan	Malta	Uruguay
Mali	Laos	Montenegro	Venezuela
Mauritania	Lebanon	Netherlands	
Mauritius	Macao	Norway	**Oceania**
Morocco	Malaysia	Poland	Australia
Mozambique	Maldives	Portugal	Fiji
Namibia	Mongolia	Romania	Micronesia, Fed. Sts.
Niger	Nepal	Russia	New Zealand
Nigeria	Oman	Slovak Republic	Papua New Guinea
Rwanda	Pakistan	Slovenia	Samoa
Sao Tome and Principe	Philippines	Spain	Solomon Islands
Senegal	Qatar	Sweden	Tonga
Sierra Leone	Saudi Arabia	Switzerland	Vanuatu
Somalia	Singapore	Ukraine	
South Africa	Sri Lanka	United Kingdom	**North America**
Sudan	Syria		Canada
Swaziland	Tajikistan		United States