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Global Income Distribution and Poverty: Implications from the IPCC SRES Scenarios

Alvaro Calzadilla

Abstract:
The Special Report on Emissions Scenarios (SRES) has been widely used to analyze climate change impacts, vulnerability and adaptation. The storylines behind these scenarios outline alternative development pathways, which have been the base for climate research and other studies at global, regional and country level. Based on the global income distribution and poverty module (GlobPov), we assess the implication of the IPCC SRES scenarios on global poverty and inequality. We find that global poverty and inequality measures are sensitive to the downscaling methodology used. Our results show that future economic growth is crucial for poverty reduction. Higher per capita incomes tend to favour poverty reduction, while higher population growth rates delay this progress. Scenarios that combine high economic growth and convergence assumptions with low population growth rates produce better outcomes. China and India play a central role on poverty reduction and global inequality. While high economic growth rates in China and India may lift millions out of poverty, high population growth and stagnation in African economies could offset the situation.

Keywords: Global, poverty, income distribution, inequality, emission scenarios

JEL classification: O50, I32, O15, Q54

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1 Introduction

In 2000, the Intergovernmental Panel on Climate Change (IPCC) released the Special Report on Emissions Scenarios (SRES). The new set of emission scenarios replaced the IPCC IS92 scenarios and was used as an input in the IPCC Third Assessment Report (TAR) and Fourth Assessment Report (AR4). Emission scenarios are used for driving global circulation models to develop climate change scenarios and their corresponding impact scenarios. The SRES scenarios cover a wide range of the main demographic, technological, and economic driving forces of future global emissions; and exclude any climate policy but current ones (IPCC 2000).

Emission scenarios are crucial for understanding energy and climate change issues. However, the SRES scenarios have not only been used for energy and climate change research, the storylines behind the SRES scenarios have also been the base for different studies at global, regional and national level (van Vuuren and O'Neil 2006; Faber et al. 2007). Despite the wide use of the SRES scenarios, the assumptions on which they are based have received several criticisms. Castles and Henderson (2003a, 2003b) criticize the use of market exchange rates (MER) rather than the purchasing power parity (PPP) exchange rates to measure gross domestic product (GDP). While the MER approach simply converts GDP in national currencies into US dollars using the market exchange rates, the PPP approach corrects for differences in purchasing power using the ratio of prices in local currencies for a given basket of goods and services. Therefore, the PPP approach is more appropriate for international welfare comparison, because it accounts for the difference in domestic prices. Castles and Henderson pointed out that the gap between rich and poor countries is smaller under the PPP approach. Therefore, economic growth and hence emissions growth rates are expected to be overestimated in the SRES scenarios.

Nakicenovic et al. (2003) and Grübler et al. (2004) argued that the use of the MER or PPP approach by itself should not lead to totally different emission projections. Modelling insights to the problem have lead to different results. Some authors found that the choice between MER and PPP alter carbon dioxide emissions, but that the differences are small compared to other uncertainties (Manne et al. 2005; Holtsmark and Alfsen 2005; Tol 2006). Others found substantial differences (McKibbin et al. 2004).

In addition, the IPCC SRES scenarios assume absolute convergence of per capita income over the scenario horizon. Barro and Sala-i-Martin (1995) point out that absolute convergence of per capita income has not happened, instead conditional or club convergence is observed.[1] Since current GDP for developing countries is lower when expressed in MER, convergence in the SRES scenarios implies higher growth rates for developing countries than those expected under the PPP approach. Therefore, poor countries are expected to quickly catch up with rich countries. This of course has implications on the projected regional distribution of income and emissions, and on the regional climate change impacts and vulnerability (Castles and Henderson 2003a and 2003b; McKibbin et al. 2004; Tol 2006).

In this paper, we explore the implication of the IPCC SRES scenarios on the global income distribution and poverty levels. We do not attempt to measure the resulting income distribution and poverty levels due to climate change impacts based on the SRES scenarios. On the contrary, we focus on the expected evolution of the income distribution and the level of poverty behind the economic development in each of the SRES scenarios. Therefore, our analysis is based on the dynamics in the demographic and economic driving forces in the SRES scenarios.

The remainder of the paper is organized as follows: next section describes the IPCC SRES scenarios, giving special emphasis on the downscaling methodologies. Section 3 summarizes recent studies on global income distribution and poverty. Section 4 introduces the global income distribution and poverty module (GlobPov). Section 5 discusses the principal results and section 6 concludes.

2 The IPCC SRES scenarios

To cover the long-term nature and uncertainty of climate change and its driving forces, the IPCC has developed four main narratives up to 2100. The storylines and associated families of scenarios are labelled A1, A2, B1 and B2. Each storyline describe a different direction for future development. The “A” scenarios place more emphasis on economic growth, while the “B” scenarios focus on environmental protection. The “1” scenarios assume an increasing globalization, while the “2” scenarios show a more fragmented and regionalized development patterns. Six groups of scenarios were drawn from the four families, one group within each A2, B1 and B2 family, and three groups in the A1 family, showing different technological

[1] Absolute convergence means that poor countries grow faster than rich countries, implying a reduction in the income gap between poor and rich countries over time. Under the conditional or club convergence, similar countries converge to the same income level.

developments in the energy systems (fossil fuel intensive (A1FI), balanced across energy sources (A1B) and predominantly non fossil fuel (A1T)).

In total 40 alternative scenarios were developed using six different models. All scenarios are presumed to be equally valid, with no assigned probabilities of occurrence (IPCC 2000). As each scenario family shares the same demographic, politico-societal, economic and technological storyline, we focus our analysis on the four scenario families summarized as follows (IPCC 2000):

The *A1 storyline* and scenario family describes a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building, and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income.

The *A2 storyline* and scenario family describes a very heterogeneous world. The underlying theme is self-reliance and preservation of local identities. Fertility patterns across regions converge very slowly, which results in continuously increasing global population. Economic development is primarily regionally oriented and per capita economic growth and technological change are more varied and slower than in other storylines.

The *B1 storyline* and scenario family describes a convergent world with the same global population that peaks in midcentury and declines thereafter, as in the A1 storyline, but with rapid changes in economic structures toward a service and information economy, with reductions in material intensity, and the introduction of clean and resource-efficient technologies. The emphasis is on global solutions to economic, social, and environmental sustainability, including improved equity, but without additional climate initiatives.

The *B2 storyline* and scenario family describes a world in which the emphasis is on local solutions to economic, social, and environmental sustainability. It is a world with continuously increasing global population at a rate lower than A2, intermediate levels of economic development, and less rapid and more diverse technological change than in the B1 and A1 storylines. While the scenario is also oriented toward environmental protection and social equity, it focuses on local and regional levels.

2.1. Population

Population data has different sources according to the SRES scenario. The A1 and B1 scenarios use the same population projection. These scenarios are based on the low variant projection of the world population, which combines low fertility and low mortality rates

(Lutz et al. 1996). Under these scenarios world population is expected to increase to 8.7 billion by 2050 and decline toward 7 billion by 2100 (the lowest trajectory used in the SRES scenarios) (Figure 1). The A2 scenario uses the high variant projection from Lutz et al. (1996) that assumes high fertility and high mortality rates. This scenario has the highest population projection, increasing to 15 billion people by the end of the century. The B2 scenario utilizes the long run medium variant projection from the United Nations (UN 1998). Global population grows to 9.4 billion by 2050 and to 10.4 billion by 2100 (Figure 1).

Figure 1 around here

Comparisons between the SRES scenarios and more recent data projections suggest a good performance of the SRES population projection in the short term. However, in the medium and long term, where uncertainties are larger, projections differ between different studies. For instance, van Vuuren and O'Neil (2006) predict lower global population growth rates than the ones observed in the SRES scenarios, which is basically driven by lower than expected fertility rates in Asia, Africa, Latin America and the Middle East, as well as by an expected rise of the AIDS epidemic in Sub-Saharan Africa. By contrast, Fisher et al. (2006) report higher global population growth rates than those observed in the SRES scenarios. Except for the A2 scenario, the scenario with the highest population, where population is expected to reach around 12 billion by 2100, almost 3 billion less compared to the SRES scenario. Fisher et al. (2006) argue that lower global population growth rates are only possible when fertility rates reflect trends observed in the last 20 years, but higher global population growth rates are excepted if fertility rates are constructed based on the long-term empirical evidence (last 50 years). Although recent population projections differ from each other reflecting different assumption regarding future fertility, among others, most of the SRES scenarios still fall within the possible range of population outcomes.

2.2. Economic growth (GDP) and income per capita (GDP/per capita)

Economic growth rates were assumed to be very high in the A1 scenario family, which translates to a global GDP for 2100 of around 530 trillion $US^{1990}$$ (Figure 1). Global income per capita reaches around 21,000 $US^{1990}$$ by 2050 and around 66,500 and 107,300 $US^{1990}$$ by 2100 in developed and developing countries, respectively. This scenario decreases rapidly the income gap between rich and poor countries up to a ratio of around 2 by 2100 (Figure 1). Economic growth in the A2 scenario family is uneven and the income gap between developed and developing countries does not narrow, unlike in the A1 and B1 scenario families. By 2100, the global GDP reaches about 250 trillion $US^{1990}$$. The global average per capita income in the A2 scenario is the lowest, reaching about 7,200 US^{1990}\$ by 2050 and 16,000 US^{1990}\$ by 2100.

The B1 scenario uses the same population growth as the A1 scenario. Although it shows high levels of economic activity and improvements in international income equality, the GDP growth in the B1 scenario is lower compared to the A1 scenario (around 350 trillion US^{1990}\$ by 2100). As a result, global income per capita in 2050 is one-third lower than in the A1 scenario (13,000 US^{1990}\$) (Figure 1). As with the A2 scenario, economic growth rates are assumed to be medium for the B2 scenario. By 2100, the global GDP is expected to reach around 250 trillion US^{1990}\$. Income per capita grows at an intermediate rate to reach about 12,000 US^{1990}\$ by 2050 and 22,500 US^{1990}\$ by 2100. International income differences decrease, although not as rapidly as in storylines of higher global convergence (Figure 1).

Recent long term projections of global GDP show that economic growth perspectives have not changed since the publication of the SRES scenarios. The IPCC (2007) reports a considerable overlap in the range of global GDP projections in post-SRES studies with those used in the SRES scenarios and pre-SRES studies. Although the new studies suggest a slight shift downward of the median, there are no significant changes in the distribution of the global GDP projections.

2.3. Downscaling to the country level

The IPCC SRES scenarios are reported for four aggregated regions only: OECD as of 1990 (OECD90); reforming economies encompassing Eastern Europe and former Soviet Union (REF); Non-OECD, Asia including Oceania (ASIA); and Africa, Latin America and the Middle East (ALM). Although the more disaggregated models used to develop the SRES scenarios only work at the regional level, the SRES scenarios have been downscaled at the country and sub-national level to provide suitable information for impact assessment studies at the country level.

Several studies report downscaling methods for the socio-economic drivers in the IPCC SRES scenarios. These studies focus on population and GDP. Gaffin et al. (2004) use a simple downscaling method assuming that rates of population and GDP growth are uniformly distributed to all countries within the region. This simple method has several shortcomings (Castles and Henderson 2003a; van Vuuren et al. 2007), which have been addressed in recent studies by Grübler et al. (2007) and van Vuuren et al. (2007). They use new techniques to account for country-specific differences in initial conditions, performances and growth expectations.

Both population and economic growth are the most important variables used here to assess future scenarios of poverty and income distribution at the global level. Country level assumptions of future population and GDP growth are crucial to determine national poverty levels and international income inequality. Therefore, we use country-level estimates from Gaffin et al. (2004) and van Vuuren et al. (2007) to address uncertainties in downscaling methodologies.

Gaffin et al. (2004) use a simple downscaling method to downscale the aggregated population and GDP data used in the SRES report to the country level out to 2100. This method assumes that each country's annual growth rate of population or GDP is equal to the regional growth rate where each country belongs. By applying this method, the fractional share of each country's population or GDP at the base year is kept constant along the forecasted period. The results show a general good performance of the downscaling method, when comparing the sum of the population or GDP downscaled with the SRES regional totals. However, the main shortcoming of this methodology is the relatively high per capita incomes in 2100 for countries with high initial income levels that lie within regions with high GDP growth rates. This is mostly observed in Singapore, Hong Kong, French Polynesia, New Caledonia, Brunei Darussalam, Reunion, Republic of Korea, Gabon and Mauritius.

Van Vuuren et al. (2007) use an external-input-based downscaling method for population and a convergence-based downscaling method for GDP. They point out that the age profile of a population is one of the crucial factors in future population growth and represents the main reason for not applying a linear downscaling method. Instead, they use the relative positions of the countries within the region observed in the long-range population projection from the United Nations to downscale the SRES scenarios. This method captures country-specific differences in age profiles from the external source (UN 2003), while keeping consistency with the SRES regional totals.

For GDP downscaling, van Vuuren et al. (2007) assume partial convergence of the income gap in relative terms. The rate of convergence is based on the scenario storyline and the rate at the regional level. They downscale GDP per capita instead of GDP, avoiding in this way high differences in per capita growth rates within a region. The results show a good performance of the downscaling methodology, which prevents high per capita incomes in 2100. However, in the A1 scenario, relatively high income levels are also found in some countries in South America, the Middle East and South-East Asia.

Discrepancies in the downscaled population and GDP data between these two studies result not only because of the use of different downscaling methodologies, but also because of the use of different data sources and base year data. For example, for the A1, A2 and B1 scenarios, Gaffin et al. (2004) downscale the aggregated regional projections from IIASA using the 1990 country-level population estimates from United Nations (UN 1998). By contrast, van Vuuren et al. (2007) use the aggregated regional projections from the IMAGE model and the long-range projections from United Nations (base year 2000) (UN 2003). Similarly, for GDP downscaling, Gaffin et al. (2004) use estimates from the World Bank and United Nations taking 1990 as the base year, while van Vuuren et al. (2007) use updated data from the same sources taking 2000 as the base year.

Such differences are levelled off in this study, because we use as an input in our analysis the country's growth rates for population and GDP per capita, as explained in the next section.

3 Global income distribution and poverty

Three different concepts have been used to address world inequality. Some studies use country means as the unit of observation disregarding its population "*inter-country inequality*" (e.g. Jones 1997; Quah 1997), while others weight each country mean by its population size "*international inequality*" (e.g. Schultz 1998; Firebaugh 1999). Both concepts are considered inadequate, because they capture only between-country differences ignoring inequality within countries. The third concept "*global inequality*" avoids this limitation by combining estimates of within-country inequality from household surveys with those of international inequality to get a better measure of the global income distribution (e.g. Bhalla 2002; Bourguignon and Morrisson 2002; Milanovic 2002, 2005a, 2005b; Sala-i-Martin 2002). This concept is discussed in the text.

The most used measure of income inequality is the Gini index.[2] Bourguignon and Morrisson (2002) show that the world Gini index increased continuously from 0.5 in 1820 to 0.64 in 1950 and then it almost levelled off between 1950 and 1992, reaching 0.66 in 1992. Estimations of the Gini index in recent years made by Bhalla (2002) and Sala-i-Martin (2002) show a downward trend in global inequality, which is mainly driven by rapid economic growth in China and India. Bhalla (2002) estimates a Gini index of 0.65 in 2000. By contrast,

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[2] The Gini index is a measure of statistical dispersion. The Gini index measures the area between the Lorenz curve and the line of absolute equality. The index varies between 0 (complete equality) and 1 (complete inequality).

Milanovic (2005a) estimates that the world Gini index increased by 5 percentage points between 1988 and 1993 (from 0.63 to 0.66), declining later to 0.64 in 1998.

Global poverty estimates from all of the above studies show a continuous decline in both the poverty ratio and the number of people living in extreme poverty.[3] Official estimates from the World Bank (Chen and Ravallion 2004) show that extreme poverty decreased by almost 400 million people between 1981 and 2001 (from 1,482 to 1,093 million people). This is equivalent to a reduction of almost 20 percent in the poverty ratio (from 40 to 21 percent). These studies report poverty measures with respect to the World Bank's international poverty line of "$1 a day" ($1.08 to be more precise) at 1993 international PPP exchange rates. However, the 1993 PPP exchange rates face some problems, particularly the absence of China and India, the two most populous developing countries, in the International Comparison Program (ICP) round in 1993. Therefore, their PPPs are subject to larger margins of errors (World Bank 2008a).

In 2008, the World Bank updated the international poverty line (Ravallion et al. 2009) using the new price data from the 2005 round of the ICP (World Bank 2008a). The new poverty line for extreme poverty is now set to $1.25 a day in 2005 PPP terms, which is the average of the national poverty lines in the 15 poorest countries in the world after correcting for differences in the cost of living (Ravallion et al. 2009).

The new ICP data highlight that the cost of living in many poor countries was underestimated. The new global estimates of the number of poor people show that 1.4 billion people in 2005 are living in extreme poverty, 400 million more than previously estimated (World Bank 2008b). The number of people living in extreme poverty decreased from 1.9 billion in 1981 to 1.8 billion in 1990 and to 1.4 billion in 2005. Similarly, the poverty rates fell from 52 percent in 1981 to 42 percent in 1990 and to 26 percent in 2005; around 1 percentage point per year (World Bank 2008b).

Milanovic (2008 and 2009) re-estimates global inequality using the new results of the ICP 2005. He finds that all inequality measures are greater than previously calculated. For 2002, he estimates a world Gini index of around 0.70, more than 4 percentage points as previously estimated (0.66). Global inequality is greater than inequality within any individual country.

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[3] The World Bank defines extreme poverty as living on less than $1.08 (1993 PPP) per day, and moderate poverty as less than $2.15 a day. Unless explicitly stated otherwise, all references to the number of poor people and poverty rates relates to the extreme poverty.

The new estimates of the number of poor people and poverty rates measured at $1.25 a day in 2005 PPP terms were published by the World Bank as a special supplement of the 2008 World Development Indicators (World Bank 2008b). These estimates are based on the PovcalNet analysis tool (Chen and Ravallion 2008), as does the global income distribution and poverty module (GlobPov) used in this paper.

4 GlobPov: A global income distribution and poverty module

The global income distribution and poverty module is based on the methodology and database used by PovcalNet, which is a web-based interactive computational tool developed by the World Bank's Development Economics Research Group. PovcalNet allows for replication of the calculations made by the World Bank researchers in estimating the magnitude of absolute poverty in the world. It also allows for estimating various poverty and inequality measures under different assumptions and using alternative countries grouping.[4]

PovcalNet has a built-in software called Povcal (Chen et al. 1991) and a built-in database. Povcal uses accurate methods for estimating poverty and inequality measures from grouped data. The approach used by Povcal is the parametric specification of the underlying Lorenz curve, from which all desired poverty measures can then be calculated. Annex A describes in detail the parametric estimation of the Lorenz curve used in Povcal and GlobPov.[5] GlobPov is the GAMS implementation of Povcal developed for and used in this paper.

PovcalNet uses income or consumption data from 675 household surveys conducted in 115 developing countries. The distributional data was obtained directly from the primary survey data and it is available in grouped form. Households are ranked by consumption or income per person.[6] The distributions are weighted by household size and sample expansion

[4] For detailed information see the PovcalNet website (http://iresearch.worldbank.org/PovcalNet).

[5] The same methodology is applied in the SimSIP Poverty simulator (Ramadas et al. 2002), which facilitates the analysis of issues related to social indicators and poverty. SimSIP Poverty is an excel based simulator developed by the Poverty Group at the World Bank, while Povcal is programmed in Microsoft Fortran 5.0. GlobPov is programmed in the GAMS language.

[6] In the construction of the database, consumption data was preferred to income data because consumption provides a better measure of current welfare. Chen and Ravallion (2004) point out that in general income distributions produce a higher inequality measures than consumption distributions. They show that consumption has a lower mean but also a lower inequality, with the effect that poverty measures are quite close.

factors to obtain population estimates from the survey results. The database covers the period between 1979 and 2007.[7]

GlobPov uses the survey data in grouped form from PovcalNet[8] to estimate the parametric specifications of the underlying Lorenz curve using the same functional forms that are used in Povcal. Once the Lorenz curves for each country have been estimated, the principal inputs to compute the poverty measures are the poverty line, the mean income/consumption and the population. The first two values have to be expressed in the same units. And all of them must refer to the same year or simulation scenario.

The main outputs from the GlobPov module are the Gini index, the number of poor people, the headcount index of poverty, the poverty gap index, the squared poverty gap index and the elasticities of these poverty measures with respect to the mean of the distribution and the Gini index. Additionally, GlobPov represents graphically the Lorenz curve, the income distribution function and the cumulative distribution function for each country as well as regional and global figures.

4.1. Baseline estimates for 2005

To reproduce the poverty estimates made by the World Bank in 2005, we use the new international poverty line set to $1.25 a day (equivalent to $38 per month) and the monthly average income/consumption per capita from the survey expressed in 2005 PPP terms. PPP rates account for differences in domestic prices enabling international welfare comparison. Additionally, we use population estimates for 2005 from the World Development Indicators database (World Bank 2008c).

GlobPov computes poverty and inequality measures for 115 developing countries. China, India and Indonesia are disaggregated further in rural and urban areas. In addition, to compute global inequality and global income distribution functions, GlobPov uses distributional data in grouped form for 28 developed countries. This data is derived directly from nationally representative household surveys based on the globalization and income distribution dataset and on the global income distribution dynamics dataset from the World

[7] PovcalNet and global poverty estimates by the World Bank have been criticized about aspects related to the underlying data, including the PPP exchange rates, the accuracy and comparability of the surveys used, and intrinsic limitations of the welfare measurements based on those surveys (e.g. see Reddy and Pogge (2005)).

[8] Source PovcalNet: the on-line tool for poverty measurement developed by the Development Research Group of the World Bank (http://iresearch.worldbank.org/PovcalNet).

Bank.[9] In total, GlobPov covers 143 countries, representing around 96 percent of the world population.

The GlobPov 2005 baseline results are comparable to those reported in the PovcalNet website (http://iresearch.worldbank.org/PovcalNet.) and in the poverty supplement of the World Development Indicators 2008 (World Bank 2008b). Country level estimates of poverty and inequality measures are similar to those observed in PovcalNet. Except for Brazil and Liberia, which have higher Gini indexes when estimated by GlobPov (Table B1, Annex B). Regional and global estimates are comparable with PovcalNet estimates, but there are some discrepancies with the World Bank's estimates, because the latter uses unit record household data whenever possible while GlobPov and PovcalNet use grouped distributions. For instance, GlobPov estimates that 1,313 million people were living in extreme poverty in 2005, while the World Bank's estimate is around 1,374 million people. The corresponding poverty rate in both studies is 25.2 percent (Table B2, Annex B).[10]

The global income distribution curve shown in Figure B1 (Annex B) recalls the "twin peaks" shape of this curve popularized by Quah (1996). It shows that the world is divided between a large but poor population and a small but rich industrialized population. One peak concentrates around China, India, Indonesia and Sub-Saharan Africa with a monthly income around the extreme poverty line; and the other peak around the OECD countries with a monthly income above the $1,000 level.

GlobPov estimates a world Gini index of 0.71 in 2005, which is around 1 percentage point higher than the one estimated by Milanovic for 2002. World inequality is the highest compared to other regions or single countries (Figure B2). Only Namibia has a higher Gini index (around 0.74) (Table B1).

4.2. Future estimates through 2100

Our projections of poverty and income distribution through 2100 are based on the future scenarios of economic growth and population developed by the IPCC. We use country-level

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[9] For detailed information on the datasets and their applications see the globalization and income distribution website (http://go.worldbank.org/N9NHYFQUX0) and the global income distribution dynamics (GIDD) website (http://go.worldbank.org/YY8H2EGYZ0).

[10] We define the global poverty headcount ratio as the number of the poor people in developing countries divided by the total number of people in developing countries (World Bank usage). However, the computation of the global Gini index reflects the total world population and incomes.

estimates from Gaffin et al. (2004) and van Vuuren et al. (2007). Population and GDP per capita growth are used to update each country's income distribution function, while keeping fixed the poverty line. This requires making assumptions about how the growth rate in GDP per capita translates into the growth rate of household consumption per capita. We assume that the survey-based real private consumption per capita in each country will grow at the same rate as the real GDP per capita adjusted by the contribution of private consumption to GDP growth. That is, we only account for the contribution of private consumption to GDP growth.[11] To exclude the effects of inflation, constant prices are used in calculating the growth rates.

This procedure assumes that the Lorenz curve for each individual country does not change. That is, economic growth is distributionally-neutral, keeping within-country inequality constant.[12] However, international and global inequality change and they are computed using the whole sample (146,000 observations).

A similar methodology is used by Hillebrand (2008) to explore the global distribution of income and poverty in 2050 under two scenarios. In his optimistic scenario (economic growth higher than in the last 20 or 50 years), the global poverty rate falls from 17.4 percent in 2005 to 4.3 percent in 2050. However, the global Gini index decreases only slightly. Poverty and inequality increase in his trend scenario (economic growth similar to the last 25 years). The global Gini index rises from 0.63 in 2005 to 0.70 in 2050. Bauer et al. (2008) and the Asian Development Bank (2008) explore global poverty and inequality up to 2020 and based on the Asian and the Pacific region. They suggest that Asia and the Pacific will not be free of extreme poverty by 2020, unless growth is more inclusive. Even in the best case scenario of a pro-poor distribution, extreme poverty decreases from 27 to 5 percent.

5 Results

On average, van Vuuren's downscaling methodology produces higher global per capita incomes than Gaffin's methodology.[13] Figure 2 shows marked differences in the high

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[11] We use regional averages over the period 2000-2007 based on the 2009 World Development Indicators (World Bank 2009).

[12] Within-country inequality in large population size countries like China, India and Indonesia is computed considering urban and rural areas.

[13] For easy reference, we refer to the country-level downscaling data from Gaffin et al. (2004) and van Vuuren et al. (2007) as Gaffin's and van Vuuren's data/methodologies, respectively.

economic growth SRES scenarios, A1 and B1. This implies a correspondingly faster convergence in the SRES A1 and B1 scenarios (Figure 3). In fact, the eight-fold gap between per capita income in developed and developing countries is reduced to less than two-fold by 2100. By the end of the century, the income gap between these two groups is almost close when using van Vuuren's data (Figure 3).

Figures 2 and 3 around here

Economic growth is crucial for poverty reduction. As mentioned by Bourguignon and Morrisson (2002), during the period 1820-1992, economic growth had by far the greatest impact on global poverty and inequality. Our results show that global poverty and inequality decrease faster under the SRES A1 and B1 scenarios, scenarios that combine high economic growth and convergence assumptions with low population growth rates. Under these scenarios, the global extreme poverty ratio decreases from around 25 percent in 2005 to less than 5 percent by 2030, which correspond to less than 300 million people living in extreme poverty in 2030 (Figure 4). During this period (2005-2030), the extreme poverty rate declines by around 0.85 to 0.95 percentage points per year depending on the downscaling methodology.

Figure 4 around here

While the SRES B2 (van Vuuren) scenario reaches less than 300 million people living in extreme poverty by 2030, this threshold is only exceeded ten years later under the SRES B2 (Gaffin) scenario, 20 years later under the SRES A2 (van Vuuren) scenario and 35 years later under the SRES A2 (Gaffin) scenario (Figure 4). As expected, higher population growth rates delay the progress in poverty reduction promoted by economic growth. Under the SRES A2 scenario, the number of poor people initially increases until 2015, mainly driven by a higher poverty in Sub-Saharan Africa, and then starts to decline.

The picture is less optimistic when moderate poverty is analyzed (not shown here).[14] Under the scenarios with rapid economic growth and convergence assumptions (A1 and B1), the headcount ratio decreases from 57 percent in 2005 to around 10 to 20 percent in 2030, depending on the country data used. The corresponding number of people living in moderate poverty is estimated at around 600 to 1,300 million in 2030. Under the SRES A2 scenario, the initial headcount ratio is only halved after 2050. By 2100, it is estimated that around 300

[14] The moderate poverty line ($2.5 a day) is set at twice the extreme poverty line ($1.25 a day), which is the median of the poverty lines for all countries except the poorest 15 countries. The $2.50 a day line is more applicable to middle-income countries (Ravallion et al. 2009).

million people are still living in moderate poverty, around 3 percent of the population in the developing world.

Milanovic (2005a) points out that inequality between countries is the dominant factor in the evolution of the world income inequality. He finds that at least 85 percent of global inequality is attributed to differences in mean incomes between the countries and only the remaining 15 percent is explained by inequality within countries. Our projections of global inequality assume that within-country inequality does not change, accounting only for between-country differences.

Figure 5 shows the evolution of the global distribution of incomes per capita over time (2005, 2025, 2050, 2075 and 2100) and under the four SRES scenarios. The global income distribution shifts rightward in the future, implying that the average per capita incomes of the majority of the world's population increase over time. In fact, the distribution shifts faster under the SRES scenarios of high economic growth and income gap closure (A1 and B1). Additionally, the global income distribution shifts upward as the world's population increases. This shift is significant under the SRES A2 and B2 scenarios. For the A1 and B1 scenarios, the distribution shifts downward after 2075, revealing the decline in global population assumed by these scenarios.

Figure 5 around here

The distribution figures show a decreasing tendency over time in global inequality, which is more evident under van Vuuren's data (Figure 5). However, the twin peaks shape of the global income distribution curve remains visible until 2050 under Gaffin's data. A more precise representation of global inequality gives the measurement of the global Gini index (Figure 6). For the SRES scenarios that assume a faster closure of the income gap (A1 and B1), the global Gini index decreases faster and reaches a lower value. This is more evident when using van Vuuren's data. The global Gini index under these SRES scenarios decreases from 0.71 in 2005 to near 0.47 in 2100 (24 percentage points). The less effective scenario decreasing global inequality is the SRES A2 scenario. Using Gaffin's methodology, the global Gini index decreases only 7 percentage points until the end of the century.

Figure 6 around here

A regional perspective is given in Figure 7, which plots for 2050 regional distribution functions and Lorenz curves under the A2 and B1 scenario (using Gaffin's data). These scenarios represent the less effective and more effective scenarios for overcoming global inequality. By 2050, global inequality decreases by 11 percentage points under the SRES B1 scenario, compared to the 2005 level (from 0.71 to 0.60). Regionally, a significant decrease is estimated in Europe and Central Asia (9 percentage points, from 0.51 to 0.42). The Gini index decreases by 5 percentage points in the Middle East and Nord Africa (from 0.44 to 0.49) and by 4 percentage points in Sub-Saharan Africa (from 0.52 to 0.56).

Figure 7 around here

Under the SRES A2 scenario, global inequality only decreases 2 percentage points by 2050. As the per capita income is low in developing countries and medium in developed countries, the income gap between the two groups is still high to decrease global inequality. In fact, in 2050 the average income in South Asia under the A2 scenario is almost 4 times lower than the estimated income under the B1 scenario; around 3 times lower in Sub-Saharan Africa, the Middle East and North Africa; and half of it in East Asia and Latin America (Figure 7).

Figure 7 shows a higher shift rightward for all distribution functions under the SRES B1 scenario. The fraction of the distribution areas that lies to the left of the extreme poverty line and moderate poverty line are smaller compared to the A2 scenario, which indicates lower poverty rates. In the same way, the absolute areas to the left of both poverty lines are also smaller, which indicates a lower number of poor people.

This is evident in Figure 8. The number of poor people estimated for 2050 under the SRES B1 scenario is negligible (less than 28 million of the world's population). Instead, it reaches 700 million people under the SRES A2 scenario. Figure 8 shows a faster decrease in the number of poor people in South Asia, which is mainly driven by favourable economic growth in India. Poverty in East Asia and Sub-Saharan Africa decreases to a lesser extent.

Figure 8 around here

A country-level perspective is given in Figure 9, which plots the evolution of extreme poverty in the largest nine countries in terms of poor people, covering more than 75 percent of the world's poor population. Under the SRES scenarios that assume high economic growth and low population growth rates (A1 and B1), poverty declines significantly in the first 20 years in all countries, with the exception of Nigeria, the Democratic Republic of Congo and Tanzania, where population growth rates are high enough to lesser the growth in income per capita. In fact, under the SRES scenarios that assume higher population growth rates (A2 and B2), the number of poor people in these countries increases the first 20 years and then starts to decline.

Figure 9 around here

Clearly, China and India play a crucial role in poverty reduction and global inequality. Together, they account for half of the poverty in the world and around one-third of the global population. A rapid economic growth in these countries significantly reduces global poverty. Poverty reduction in rural India develops faster than in other countries (Figure 9). Milanovic (2009) points out that the future evolution of global inequality will depend on the economic development in China, India and the US, countries that explain around 10 percentage points of the global Gini index.

In all the SRES scenarios, poverty reduction is postponed by higher population growth rates and promoted by higher economic growth. Indeed, Figure 10 shows a positive relationship between poverty and population growth. Population alone is able to explain around 38 percent of the variation in poverty (R^2 = 0.38). Contrary, per capita economic growth is negatively related to poverty. Higher per capita incomes favour poverty reduction.

Figure 10 around here

6 Discussion and conclusions

Several studies explore the past evolution of the global income distribution and poverty. This study uses as a starting point the demography and economic development behind the IPCC SRES storylines to look into the future. The SRES scenarios cover a very long time period 1990 – 2100. To address the high level of uncertainty in the long run, we use the four SRES scenario families (A1, A2, B1 and B2) to analyze how global inequality and poverty might change in the future.

We use country-level data on population and GDP per capita growth from two studies applying different downscaling methodologies. We find that van Vuuren's methodology produces, on average, higher regional and global per capita incomes than Gaffin's methodology. Therefore, van Vuuren's data generates better outcomes concerning poverty reduction and global inequality.

Disregarding downscaling methodologies and SRES scenarios, we find that future economic growth is crucial for poverty reduction. Higher per capita incomes tend to favour poverty reduction. Contrary, higher population growth rates delay the progress in poverty reduction promoted by economic growth. In fact, our results show that global poverty and inequality decrease faster under the scenarios that combine high economic growth and convergence assumptions with low population growth rates (A1 and B1). Under these scenarios, global extreme poverty decreases from around 25 percent in 2005 to less than 5 percent by 2030. Extreme poverty declines by around 0.85 to 0.95 percentage points per year, which is close to the observed decline for the period 1981-2005. The substantial reduction in regional differences in per capita income assumed in these scenarios declines global inequality from 0.71 Gini points in 2005 to near 0.47 in 2100.

For the SRES scenarios that assume a continuously increasing global population and intermediate levels of economic growth (A2 and B2), the picture is less optimistic. Under the SRES A2 (Gaffin) scenario, the number of poor people initially increases until 2015, mainly driven by higher population growth rates in Sub-Saharan Africa, and then it starts to decline at a lower rate than in other SRES scenarios. In this scenario, global poverty accounts for less than 5 percent of the developing population after 2055, 25 years later than in the A1 and B1 scenarios. Improvements in global inequality are marginal, the global Gini index declines only 7 percentage points until the end of the century.

The population size effect of China and India gives them a crucial role on poverty reduction and global inequality. High economic growth rates in China and India may lift millions out of poverty. However, high population growth and stagnation in African economies could offset any positive impact.

Several limitations apply to the above results. First, we use economic growth rates derived using MER exchange rates, which implies higher growth rates for developing countries than those expected under the PPP approach. Therefore, our results might overestimate global gains in poverty reduction and inequality. Second, our estimates of future global poverty and inequality consider within-country inequality, but keep it constant. Therefore, the final effect of economic growth on global poverty and inequality will depend on how the income is distributed across the population and, in particular, how this distribution changes over time. These issues should be address in future research.

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We had useful discussions about the topics of this article with Siwa Msangi, Katrin Rehdanz, Claudia Ringler, Rainer Thiele and Richard Tol. We would like to thank Ramiro Parrado for helping plotting the distribution functions. This article is supported by the Federal Ministry for Economic Cooperation and Development, Germany under the project "Food and Water Security under Global Change: Developing Adaptive Capacity with a Focus on Rural Africa," which forms part of the CGIAR Challenge Program on Water and Food.

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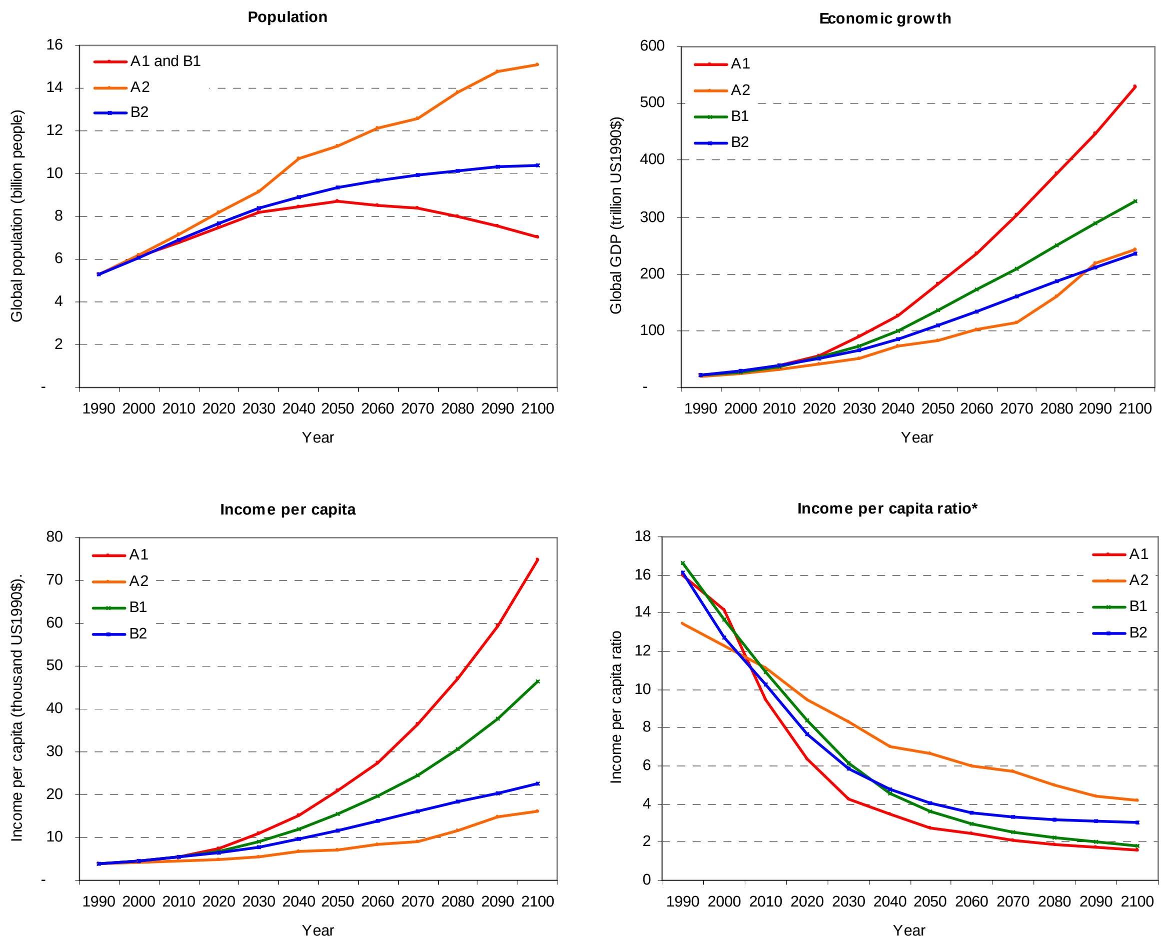


Figure 1. Global population, economic growth, income per capita and income per capita ratio under the IPCC SRES scenarios

* Ratio between income per capita in developed (OECD, REF) and developing (ASIA, ALM) countries.

Source: Marker scenarios, IPCC (2000).

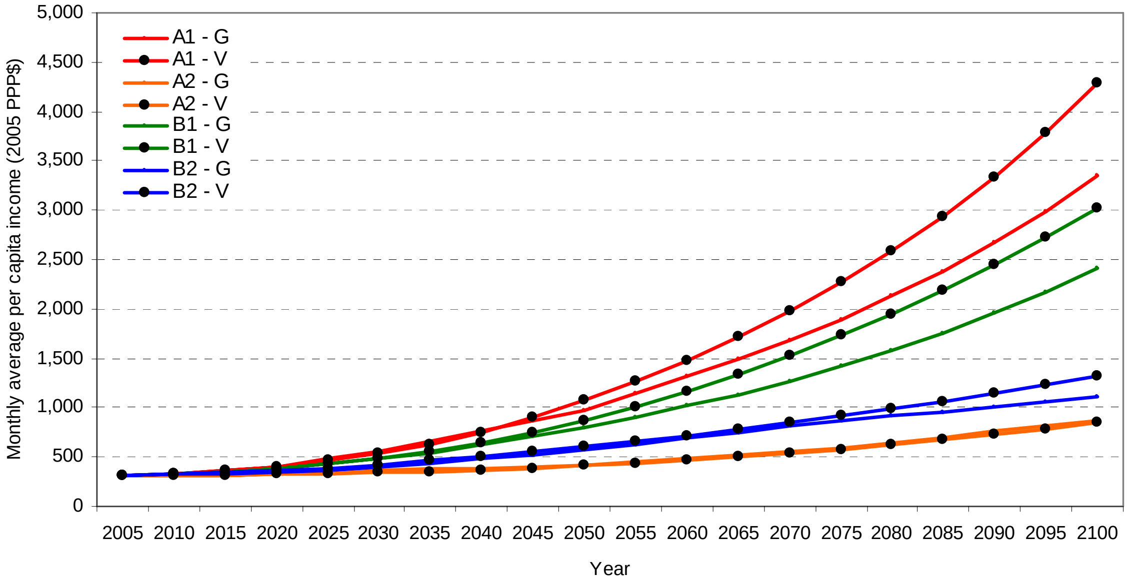


Figure 2. Monthly average per capita income by SRES scenario (2005 PPP$)

Note: G refers to Gaffin's methodology and V to van Vuuren's methodology.

Source: Own calculations.

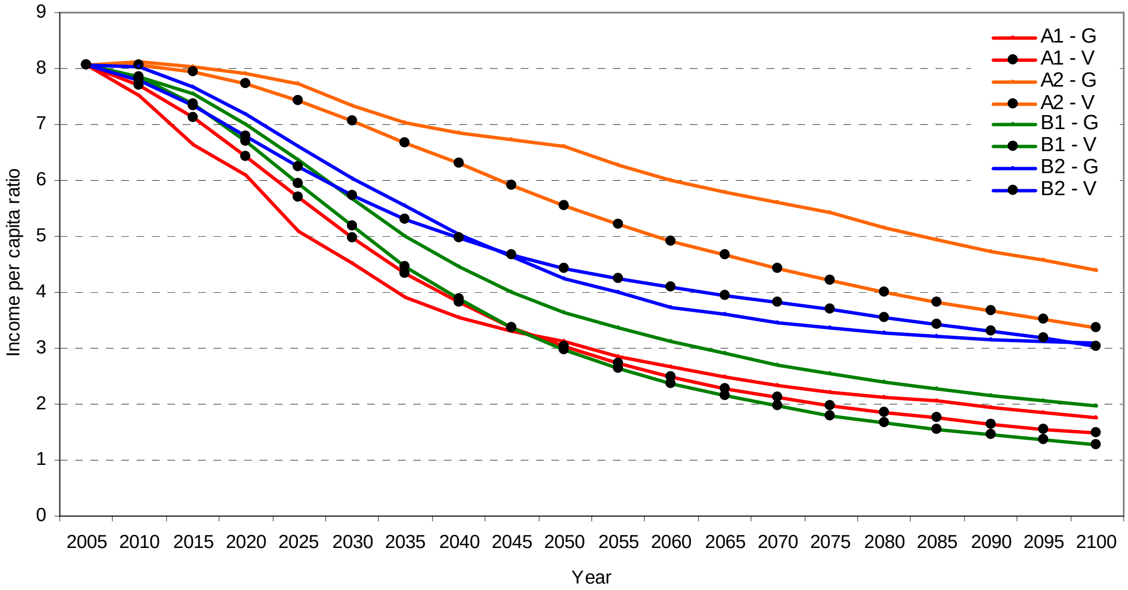


Figure 3. Ratio between the monthly average per capita income in developed (OECD, REF) and developing (ASIA, ALM) countries by SRES scenario

Note: G refers to Gaffin's methodology and V to van Vuuren's methodology.

Source: Own calculations.

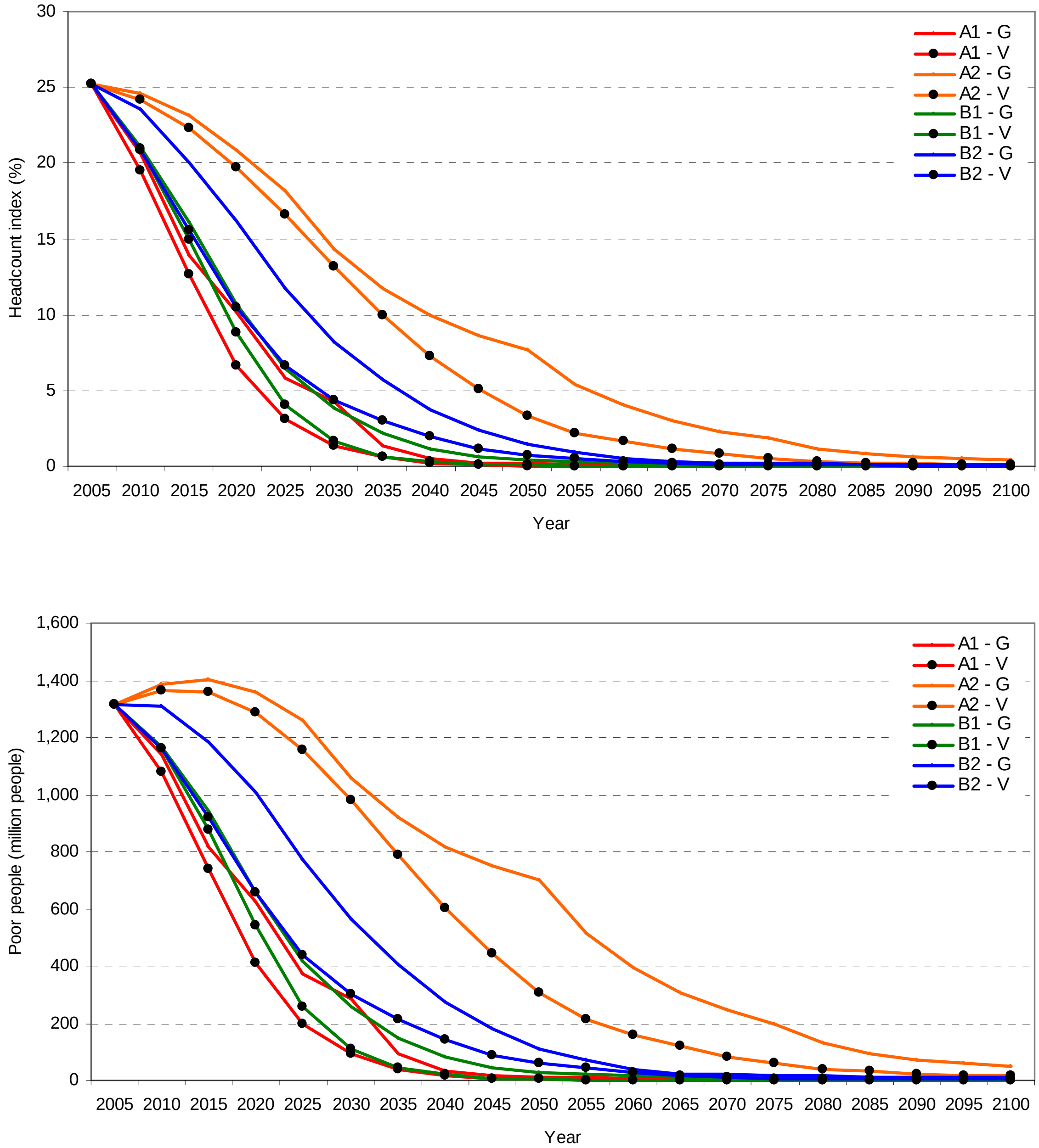


Figure 4. Extreme poverty: headcount index and number of poor people by SRES scenario

Note: G refers to Gaffin's methodology and V to van Vuuren's methodology.

Source: Own calculations.

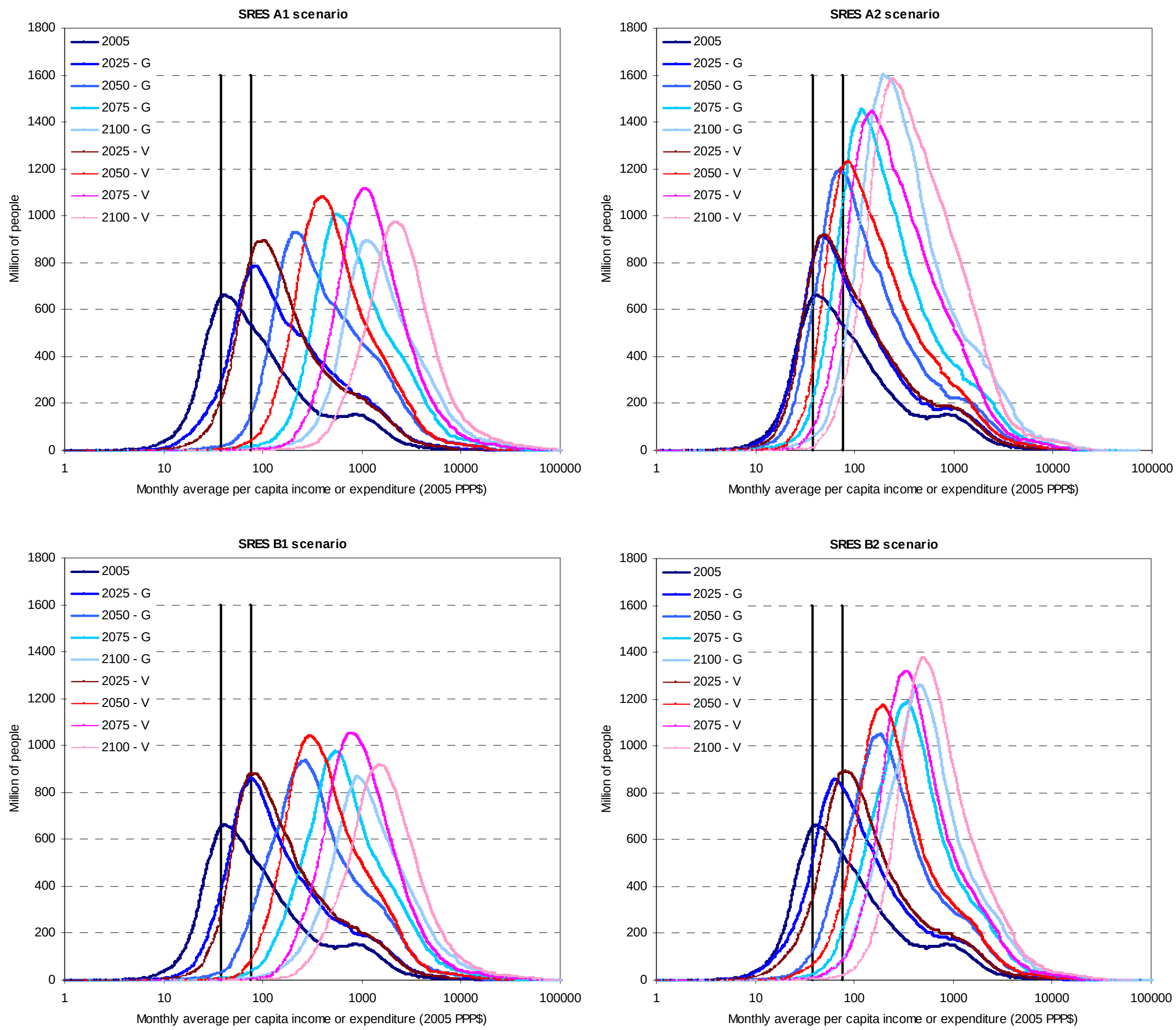


Figure 5. Evolution of world income distribution by SRES scenario, 2005-2100

Note: The two vertical lines represent the extreme poverty line and the moderate poverty line.

Source: Own calculations.

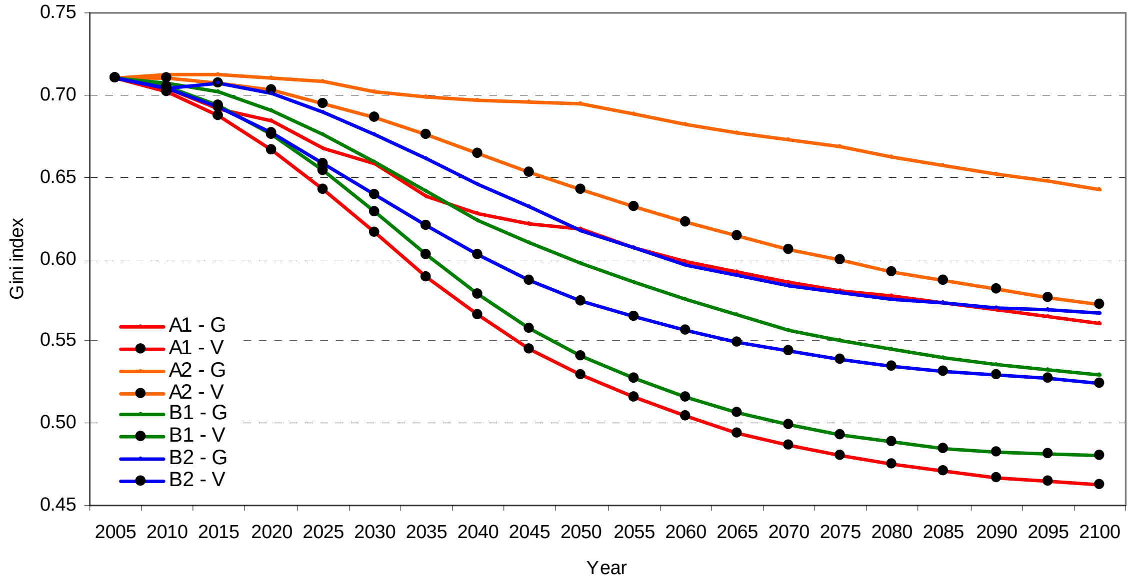


Figure 6. Global Gini index by SRES scenario

Note: G refers to Gaffin's methodology and V to van Vuuren's methodology.

Source: Own calculations.

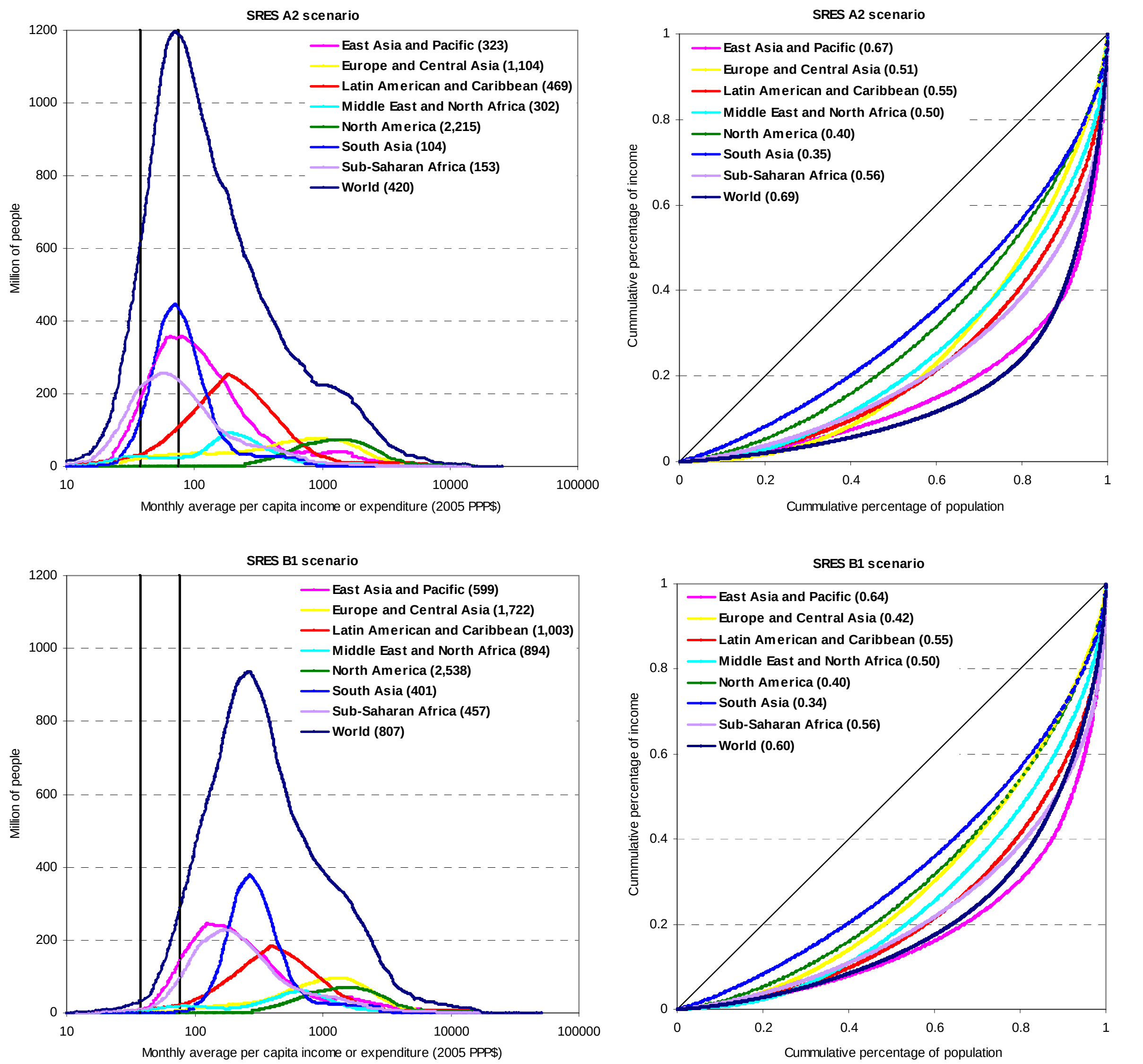
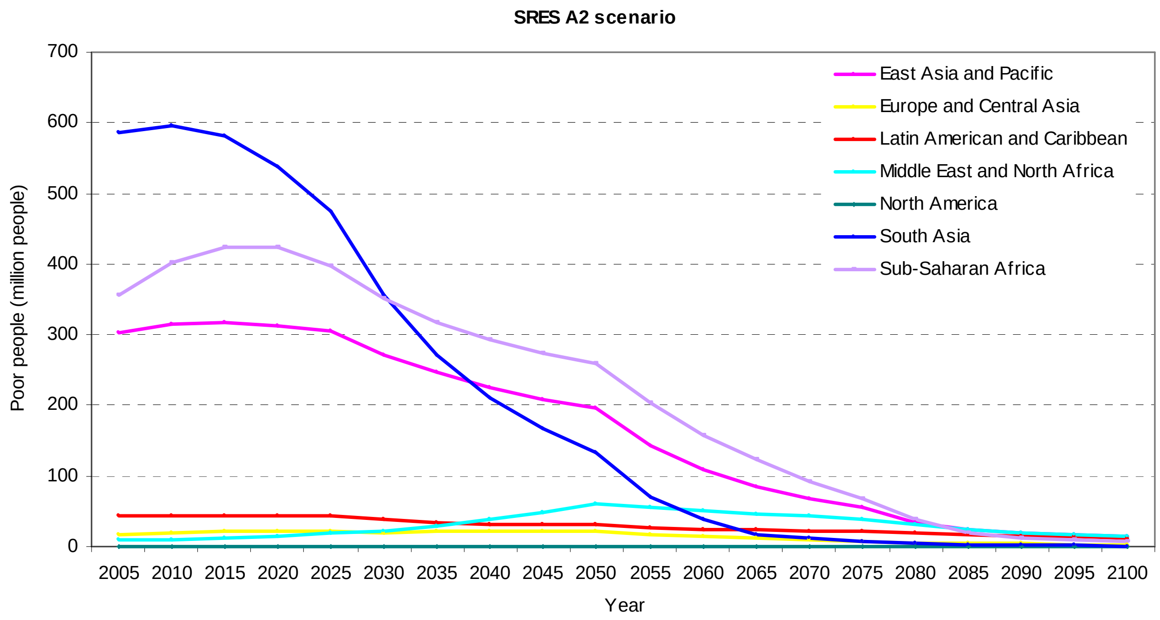


Figure 7. Regional income distribution and Lorenz curves under the SRES A2 and B1 scenarios (2050) (Gaffin's data)

Note: Monthly average per capita income and Gini index by region is shown in parenthesis.

Source: Own calculations.



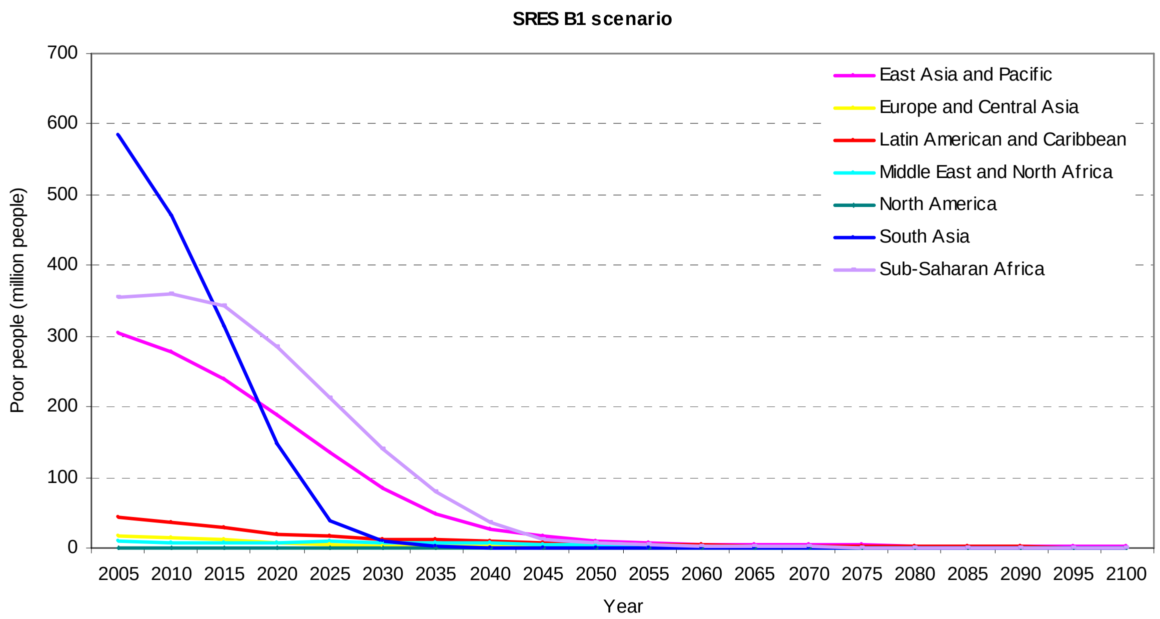


Figure 8. Regional number of poor people living in extreme poverty under the SRES A2 and B1 scenarios (Gaffin's data)

Source: Own calculations.

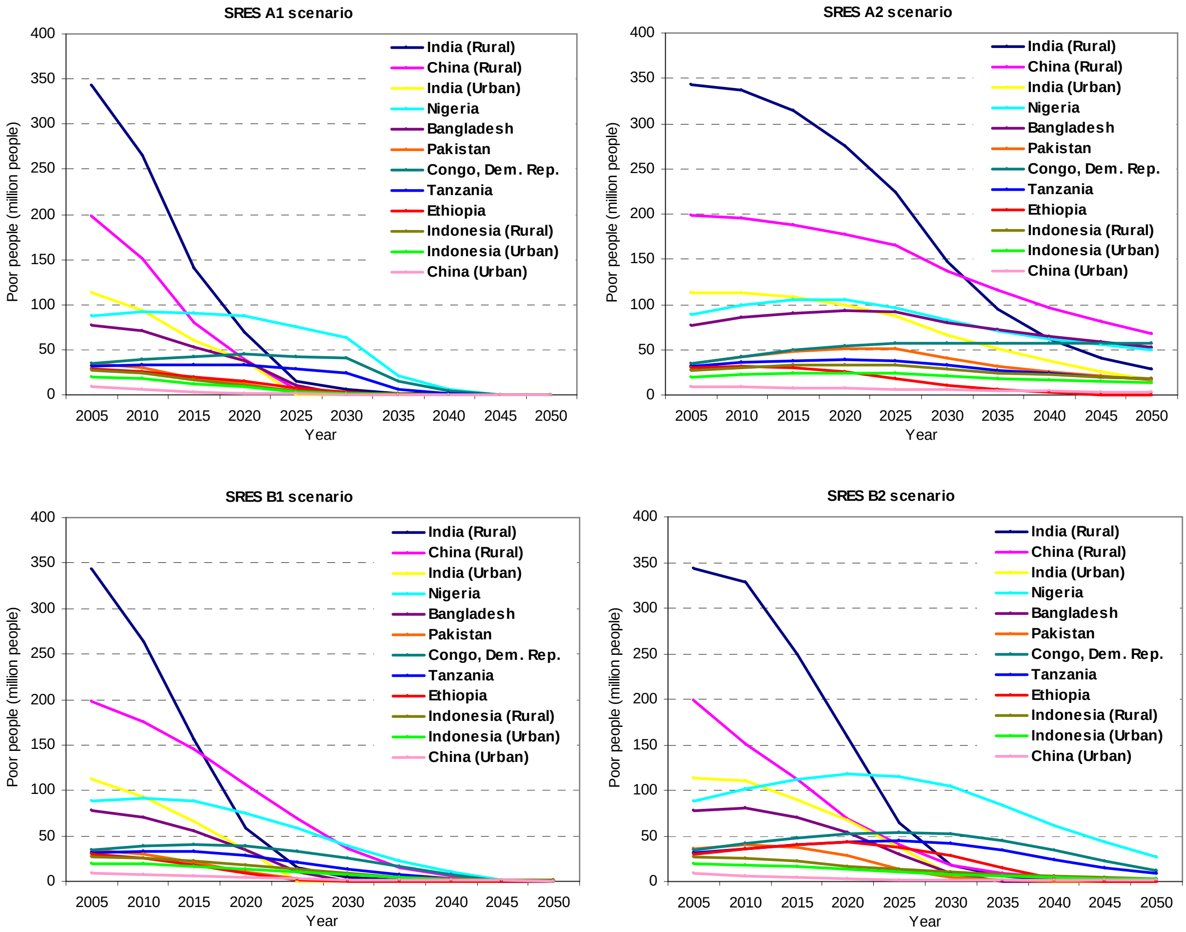
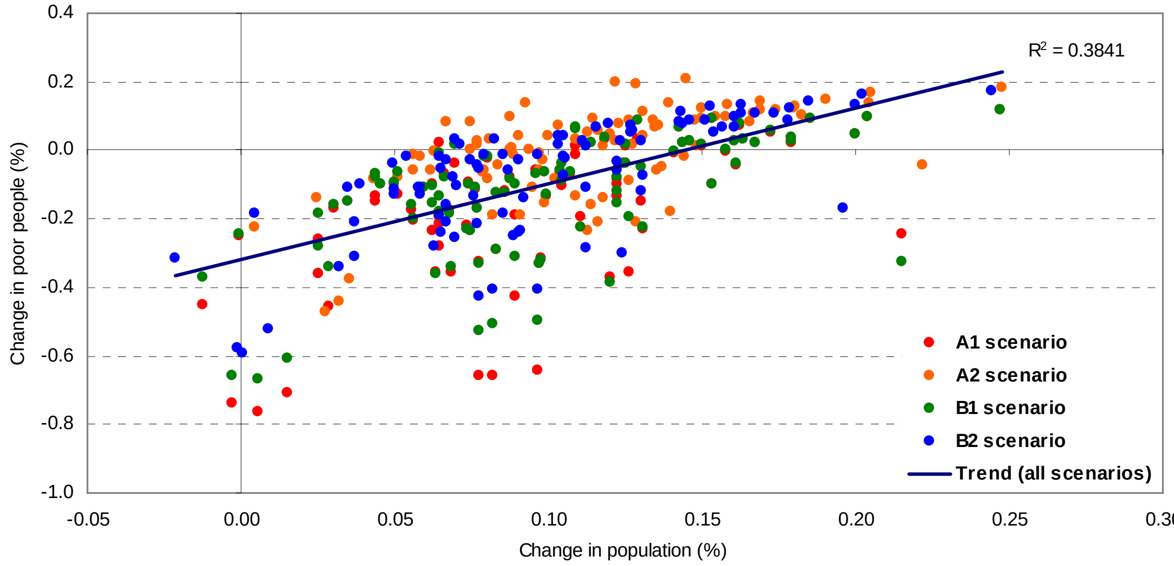


Figure 9. Number of poor people living in extreme poverty for selected countries by SRES scenarios (Gaffin's data)

Source: Own calculations.



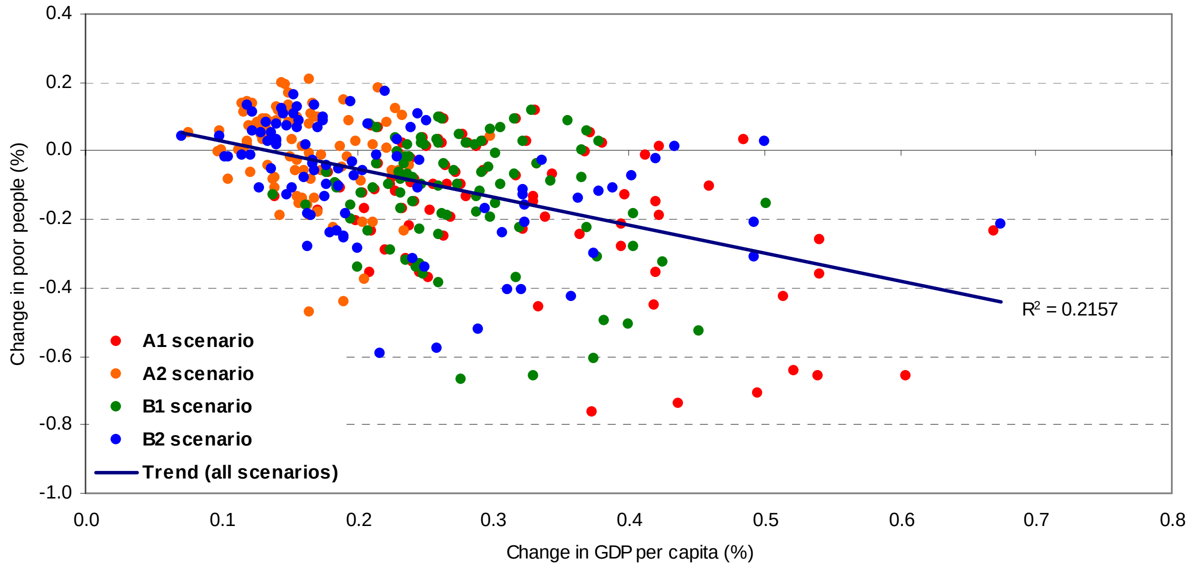


Figure 10. Change in poor people as a function of population and GDP per capita, country information for the period 2005-2010 (van Vuuren's data)

Source: Own calculations.

Annex A: Parametric estimation of the Lorenz Curve from grouped data

There are two approaches mentioned in the literature to obtain a Lorenz curve from grouped data: simple interpolation methods and methods based on parameterized Lorenz curve. PovcalNet uses the second approach because of its relative accuracy and the ease with which it helps to perform a number of poverty simulations. Datt (1998) explains in detail this approach, which is summarized here.

The implementation of the parameterized Lorenz curves is based on the following two equations.

Lorenz curve: $L = L(p, \pi)$ (1)

Poverty measure: $P = P(\mu/z, \pi)$ (2)

The Lorenz curve is a function of the cumulative proportion of ordered individuals mapped against the corresponding cumulative proportion of their size. Thus p is the cumulative proportion of population and $L(p, \pi)$ is the cumulative consumption share of group p, π is a vector of (estimable) parameters of the Lorenz curve. The poverty measure P is a function of the ratio of the mean consumption μ to the poverty line z and the parameters of the Lorenz curve π. The Lorenz curve is an indicator of relative inequalities in the population. It is independent of any considerations of absolute living standards, while the poverty measure captures the assessment of the absolute living standards.

The function L defined in equation (1) involves alternative parametric estimations of the Lorenz curve. Povcal and GlobPov provide estimates for two different functional forms: the General Quadratic Lorenz curve proposed by Villaseñor and Arnold (1989) and the Beta Lorenz curve proposed by Kakwani (1980).

Datt (1998) point out that between different functional forms used for the estimation of Lorenz curves, the General Quadratic and the Beta functions are two of the best performers. An assessment of the biases associated with the methods implemented by Povcal is realized by Minoiu and Reddy (2007). The authors analyze unit data from several household surveys and a wide range of theoretical distributions. They find that poverty and inequality is better estimated when the data is generated from unimodal distributions than multimodal distributions. Inequality, measured by the Gini index, is well estimated in most cases considered. Neither of the two Lorenz curve estimation methods provide a consistently superior performance, and performance does not always improve with the number of data points analyzed.

In a similar way, the function P defined in equation (2) involves different poverty measures. The ones considered here are those in the Foster-Greer-Thorbecke (FGT) class (Foster, Greer and Torbecke 1984).

The FGT poverty measures are defined as:

$$P_\alpha = \int_0^z \left[\frac{z-x}{z} \right]^\alpha f(x)\,dx \qquad \alpha \geq 0 \tag{3}$$

Where x is the household consumption expenditure, $f(x)$ is its density (the proportion of the population consuming x), z is the poverty line and α is a non negative parameter. Higher values of the parameter α indicate greater sensitivity of the poverty measure to inequality among the poor. The poverty measures computed here are when α takes the values 0, 1 and 2. The corresponding poverty measures for those values of α are the headcount index (H), the poverty gap index (PG) and the squared poverty gap index (SPG), which are the most commonly used poverty index.

Table A1 shows the Lorenz functions for these two estimation methods, as well as the formulas for the headcount index, the poverty gap index and the squared poverty gap index. The parameters θ, γ and δ of the Beta Lorenz curve can be estimated by ordinary least squares (OLS) method after applying a logarithmic transformation. The parameters a, b and c of the General Quadratic Lorenz curve can be directly estimated by OLS. The last observation for (p, L) which is $(1,1)$ has to be excluded since the functional form of both Lorenz curves already forces them to pass through the point $(1,1)$. The estimation of the Beta Lorenz curve requires an intercept term, while the General Quadratic does not.

Table A1 about here

The implementation of the General Quadratic model is computationally simpler than the Beta model, because the last one requires solving an implicit nonlinear equation in order to estimate the headcount index and evaluating incomplete beta functions to estimate the squared poverty gap.

The estimated parameters using both methods have to satisfy certain conditions for a theoretically valid Lorenz curve. Table A2 shows these conditions and how they can be validated for each parameterization of the Lorenz curve. The first two conditions are boundary conditions, this implies that 0 and 100 percent of the population account for 0 and 100 percent of the total income or expenditure. The third and fourth conditions ensure that the Lorenz curve is monotonically increasing and convex. When both estimation methods yield a valid Lorenz curve, the standard procedure is to select the method with a lower sum of squared residuals.

Table A2 about here

Table A3 shows the formulas for the first and second derivatives and the Gini index. The formulas for the elasticities of poverty measures with respect to the mean consumption and the Gini index are derived from Kakwani (1990) (Table A4). The formulas for the elasticities with respect to the Gini index assume a proportional shift of the Lorenz curve over the whole range.

Table A3 and A4 about here

Table A1. Poverty measures for alternative parameterizations of the Lorenz curve

	Beta Lorenz Curve	General Quadratic Lorenz Curve
Equation of the Lorenz curve (L(p))	$L(p)=p-\theta p^{\gamma}(1-p)^{\delta}$ or $\ln(p-L(p))=\ln\theta+\gamma\ln p+\delta\ln(1-p)$	$L(1-L)=a(p^2-L)+bL(p-1)+c(p-L)$ or $L(p)=-\frac{1}{2}\left[bp+e+\left(mp^2+np+e^2\right)^{1/2}\right]$
Headcount index (H)	$\theta H^{\gamma}(1-H)^{\delta}\left[\frac{\gamma}{H}-\frac{\delta}{(1-H)}\right]=1-\frac{z}{\mu}$	$H=-\frac{1}{2m}\left\{n+r(b+2z/\mu)\left[(b+2z/\mu)^2-m\right]^{-1/2}\right\}$
Poverty gap index (PG)	$PG=H-(\mu/z)L(H)$	$PG=H-(\mu/z)L(H)$
Squared poverty gap index (SPG)	$SPG=(1-\mu/z)\left[2(PG)-(1-\mu/z)H\right]+\theta^2(\mu/z)^2 \begin{bmatrix}\gamma^2 B(H,2\gamma-1,2\delta+1)-2\gamma\delta B(H,2\gamma,2\delta)\\ +\delta^2 B(H,2\gamma+1,2\delta-1)\end{bmatrix}$	$SPG=2(PG)-H-\left(\frac{\mu}{z}\right)^2\left[aH+bL(H)-\left(\frac{r}{16}\right)\ln\left(\frac{1-H/s_1}{1-H/s_2}\right)\right]$

Note: $B(k,r,s)=\int_0^k p^{r-1}(1-p)^{s-1}dp$

$e=-(a+b+c+1)$ $m=b^2-4a$

$n=2be-4c$ $r=(n^2-4me^2)^{1/2}$

$s_1=(r-n)/(2m)$ $s_2=-(r+n)/(2m)$

Table A2. Conditions for a theoretically valid Lorenz curve

Condition	Beta Lorenz Curve	General Quadratic Lorenz Curve
$L(0,\pi)=0$	Automatically satisfied by the functional form	$e<0$
$L(1,\pi)=1$	Automatically satisfied by the functional form	$a+c\geq 1$
$L'(0^+,\pi)\geq 0$	$L'(0.001,\theta,\gamma,\delta)\geq 0$	$c\geq 0$
$L''(p,\pi)\geq 0 \quad for \quad p\in(0,1)$	$L''(p,\theta,\gamma,\delta)\geq 0$ $for \quad p\in\{0.01,0.02,...,0.99\}$	i) $m<0$ or ii) $0<m<(n^2/(4e^2)), \quad n\geq 0$ or iii) $0<m<-(n/2), \quad m<(n^2/(4e^2))$

Table A3. First and second derivatives of the Lorenz curve and the Gini index

	Beta Lorenz Curve	General Quadratic Lorenz Curve
First derivative (L'(p))	$L'(p)=1-\theta p^{\gamma}(1-p)^{\delta}\left[\frac{\gamma}{p}-\frac{\delta}{1-p}\right]$	$L'(p)=-\frac{b}{2}-\frac{(2mp+n)(mp^2+np+e^2)^{-1/2}}{4}$
Second derivative (L''(p))	$L''(p)=\theta p^{\gamma}(1-p)^{\delta}\left[\frac{\gamma(1-\gamma)}{p^2}+\frac{2\gamma\delta}{p(1-p)}+\frac{\delta(1-\delta)}{(1-p)^2}\right]$	$L''(p)=\frac{r^2(mp^2+np+e^2)^{-3/2}}{8}$
Gini index	$Gini=2\theta B(1+\gamma,1-\delta)$	$Gini=\frac{e}{2}-\frac{n(b+2)}{4m}+\frac{r^2}{8m\sqrt{-m}}\left[\sin^{-1}\frac{(2m+n)}{r}-\sin^{-1}\frac{n}{r}\right]\quad if\quad m<0$ $Gini=\frac{e}{2}-\frac{n(b+2)}{4m}-\frac{r^2}{8m\sqrt{m}}\ln\left[abs\left(\frac{2m+n+2\sqrt{m}(a+c-1)}{n-2e\sqrt{m}}\right)\right]\quad if\quad m>0$

Note: $B(1+\gamma,1-\delta)$ is the Beta function $\int_0^1 p^{\gamma}(1-p)^{\delta}\,dp$

For the General Quadratic Lorenz curve, the Gini formulas are valid under the condition $a+c\geq 1$

Table A4. Elasticities of poverty measures with respect to the mean and the Gini index

Elasticity of	With respect to	
	Mean (μ)	Gini index
H	$-z/(\mu H L''(H))$	$(1-z/\mu)/(H L''(H))$
PG	$1-H/PG$	$1+(\mu/z-1)H/PG$
SPG	$2(1-PG/SPG)$	$2\left[1+(\mu/z-1)PG/SPG\right]$

Annex B: Baseline estimates for 2005

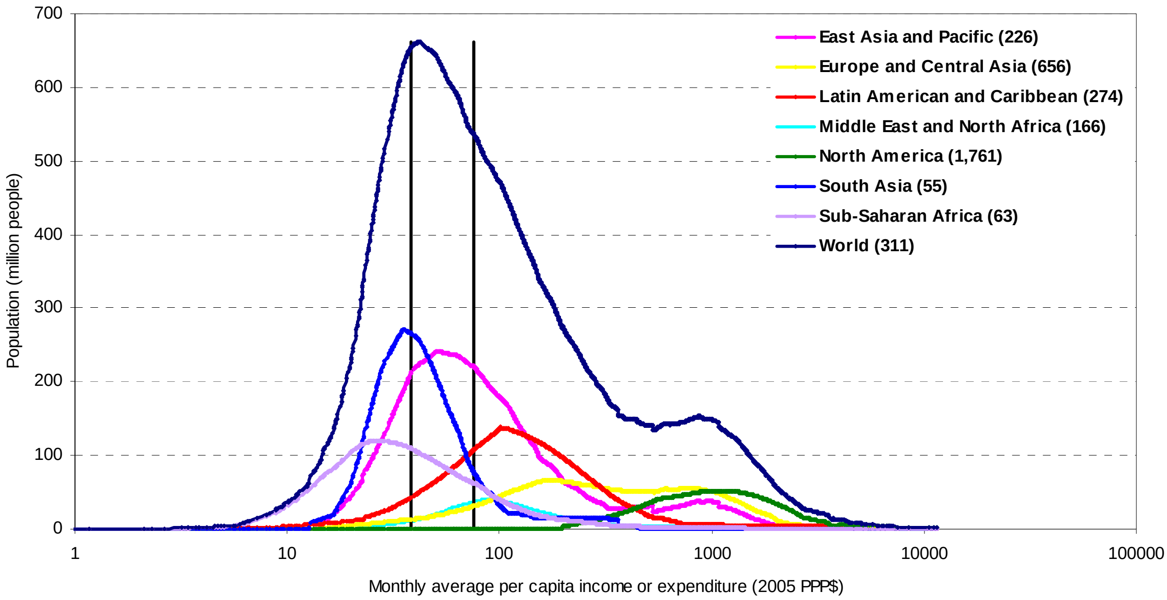


Figure B1. World income distribution (2005)

Note: Monthly average per capita income is shown in parenthesis.

Source: Own calculations.

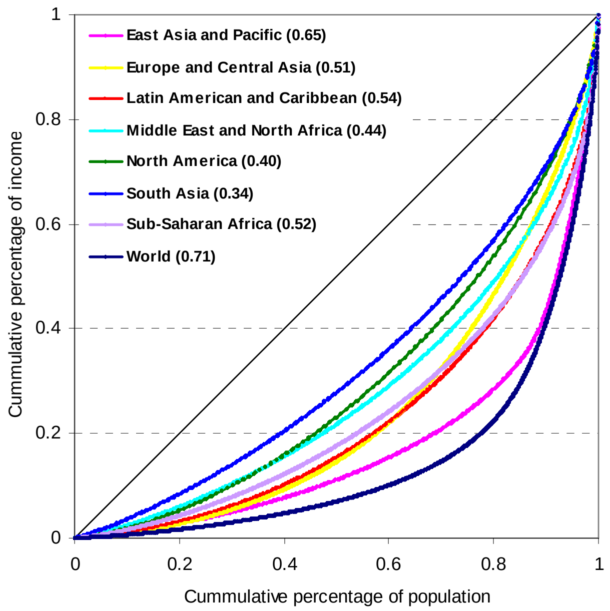


Figure B2. Lorenz curve (2005)

Note: Gini index is shown in parenthesis.

Source: Own calculations.

Table B1. Poverty and inequality measures by country, baseline year 2005

Country	Country code	Monthly income (in 2005 PPP$)	H	PG (in percentage)	SPG	GINI	Population (in million)	Poor people (in million)
Albania	alb	162	0.8	0.2	0.1	33.1	3.2	0.0
Algeria	dza	136	4.3	0.8	0.3	35.5	32.9	1.4
Angola	ago	89	42.5	22.1	14.6	58.6	16.1	6.8
Argentina (Urban)	arg	333	4.5	1.0	0.3	50.1	38.8	1.7
Armenia	arm	100	4.7	0.9	0.3	33.8	3.0	0.1
Azerbaijan	aze	135	0.0	0.0	0.0	16.8	8.4	0.0
Bangladesh	bgd	48	50.5	14.2	5.2	33.2	153.3	77.4
Belarus	blr	311	0.0	0.0	0.0	27.9	9.8	0.0
Benin	ben	51	50.0	17.1	7.7	38.6	8.4	4.2
Bhutan	btn	94	26.8	7.2	2.6	46.8	0.6	0.2
Bolivia	bol	204	19.6	9.7	6.3	58.2	9.2	1.8
Bosnia and Herzegovina	bih	348	0.2	0.1	0.1	35.8	3.9	0.0
Botswana	bwa	159	23.0	7.5	3.2	60.8	1.8	0.4
Brazil	bra	279	7.8	1.6	0.4	53.3	186.8	14.5
Bulgaria	bgr	236	0.0	0.0	0.0	29.2	7.7	0.0
Burkina Faso	bfa	48	55.0	19.4	8.9	39.5	13.9	7.7
Burundi	bdi	29	81.3	36.4	19.1	33.3	7.9	6.4
Cambodia	khm	64	39.5	11.5	4.5	41.8	14.0	5.5
Cameroon	cmr	86	27.5	7.8	2.9	44.6	17.8	4.9
Cape Verde	cpv	131	18.4	5.0	1.8	50.5	0.5	0.1
Central African Rep.	caf	40	64.4	29.7	17.2	43.6	4.2	2.7
Chad	tcd	44	58.7	23.6	12.1	39.8	10.2	6.0
Chile	chl	466	0.7	0.2	0.1	54.8	16.3	0.1
China (Rural)	chn	71	26.1	6.5	2.3	36.0	759.7	198.4
China (Urban)	chn	162	1.7	0.5	0.2	34.8	544.8	9.3
Colombia	col	251	13.9	5.3	2.8	58.7	45.0	6.2
Comoros	com	94	46.1	20.8	12.1	64.3	0.6	0.3
Congo	cog	54	54.1	22.8	12.1	47.3	3.6	2.0
Congo, Dem. Rep.	cod	46	59.2	25.3	13.6	44.4	58.7	34.8
Costa Rica	cri	309	2.4	0.5	0.2	47.2	4.3	0.1
Cote d'Ivoire	civ	108	20.4	5.7	2.4	48.4	18.6	3.8
Croatia	hrv	693	0.0	0.0	0.0	29.0	4.4	0.0
Czech Rep.	cze	614	0.0	0.0	0.0	25.8	10.2	0.0
Djibouti	dji	94	18.5	5.2	2.1	40.0	0.8	0.1
Dominican Rep.	dom	245	5.0	0.9	0.2	50.0	9.5	0.5
Ecuador	ecu	229	9.8	3.2	1.5	53.6	13.1	1.3
Egypt	egy	113	2.0	0.4	0.2	32.1	72.9	1.5
El Salvador	slv	180	13.9	6.1	3.6	49.4	6.7	0.9
Estonia	est	309	0.0	0.0	0.0	36.0	1.4	0.0
Ethiopia	eth	51	39.0	9.6	3.3	29.8	75.2	29.3
Gabon	gab	150	4.8	0.9	0.3	41.5	1.3	0.1
Gambia	gmb	86	31.3	10.6	4.7	47.3	1.6	0.5
Georgia	geo	116	13.4	4.4	2.2	40.8	4.5	0.6
Ghana	gha	78	30.0	10.5	5.1	42.8	22.5	6.8
Guatemala	gtm	188	13.1	4.0	1.7	53.6	12.7	1.7
Guinea	gin	37	69.8	32.0	18.1	43.3	9.0	6.3
Guinea-Bissau	gnb	53	42.5	13.5	5.9	35.6	1.6	0.7
Guyana	guy	186	8.2	2.6	1.1	44.5	0.7	0.1
Haiti	hti	60	57.1	30.3	20.2	59.3	9.3	5.3
Honduras	hnd	164	22.2	10.2	6.2	56.7	6.8	1.5
Hungary	hun	386	0.0	0.0	0.0	30.0	10.1	0.0
India (Rural)	ind	50	43.8	10.7	3.6	30.5	782.3	342.9
India (Urban)	ind	62	36.2	10.2	3.8	37.6	312.3	112.9
Indonesia (Rural)	idn	63	24.0	5.0	1.6	29.5	114.5	27.5
Indonesia (Urban)	idn	89	18.7	4.1	1.3	40.0	106.1	19.8
Iran, Islamic Rep. of	irn	198	1.4	0.3	0.2	38.4	69.1	1.0
Jamaica	jam	274	0.2	0.0	0.0	45.5	2.7	0.0
Jordan	jor	210	0.4	0.1	0.1	37.8	5.4	0.0
Kazakhstan	kaz	160	1.2	0.2	0.0	33.9	15.2	0.2
Kenya	ken	112	19.7	6.1	2.7	47.7	35.6	7.0
Kyrgyzstan	kgz	73	21.8	4.4	1.2	32.9	5.1	1.1
Lao People’s Dem. Rep.	lao	57	35.7	8.8	3.1	32.7	5.7	2.0
Latvia	lva	351	0.0	0.0	0.0	35.7	2.3	0.0
Lesotho	lso	82	38.7	18.1	10.9	52.5	2.0	0.8
Liberia	lbr	25	85.5	43.5	26.4	38.1	3.4	2.9
Lithuania	ltu	308	0.4	0.2	0.2	35.9	3.4	0.0
Macedonia	mkd	315	0.3	0.1	0.1	39.0	2.0	0.0
Madagascar	mdg	45	69.6	26.9	13.3	47.0	18.6	13.0
Malawi	mwi	34	73.9	32.3	17.4	39.0	13.2	9.8
Malaysia	mys	204	0.5	0.1	0.0	38.0	25.7	0.1
Mali	mli	49	51.4	18.8	9.0	39.0	11.6	6.0
Mauritania	mrt	111	13.0	2.7	0.8	39.0	3.0	0.4
Mexico	mex	319	0.8	0.1	0.1	48.1	103.1	0.8

Moldova, Rep. of	mda	107	8.1	1.7	0.6	35.6	3.9	0.3
Mongolia	mng	73	22.4	6.2	2.5	33.1	2.6	0.6
Morocco	mar	156	2.9	0.6	0.2	40.9	30.1	0.9
Mozambique	moz	42	68.2	30.0	16.5	47.1	20.5	14.0
Namibia	nam	176	43.7	20.3	11.4	74.3	2.0	0.9
Nepal	npl	57	54.0	19.4	8.9	47.3	27.1	14.6
Nicaragua	nic	151	15.8	5.2	2.5	52.3	5.5	0.9
Niger	ner	41	65.9	28.1	15.1	43.9	13.3	8.7
Nigeria	nga	41	62.4	28.2	16.2	42.9	141.4	88.2
Pakistan	pak	66	22.6	4.4	1.3	31.2	155.8	35.2
Panama	pan	294	9.2	2.7	1.1	54.9	3.2	0.3
Papua New Guinea	png	99	29.7	9.2	3.7	50.9	6.1	1.8
Paraguay	pry	257	9.3	3.4	1.8	53.9	5.9	0.5
Peru	per	224	8.2	2.0	0.7	52.0	27.3	2.2
Philippines	phl	99	22.6	5.5	1.7	44.0	84.6	19.1
Poland	pol	306	0.1	0.0	0.0	34.9	38.2	0.0
Romania	rom	190	0.8	0.3	0.3	31.5	21.6	0.2
Russian Federation	rus	301	0.2	0.0	0.0	37.6	143.2	0.2
Rwanda	rwa	36	74.0	36.1	21.4	46.7	9.2	6.8
Saint Lucia	lca	109	17.8	5.9	2.9	42.4	0.2	0.0
Senegal	sen	67	33.5	10.8	4.7	39.2	11.8	3.9
Sierra Leone	sle	55	49.9	18.3	8.6	42.5	5.6	2.8
Slovakia	svk	491	0.0	0.0	0.0	25.8	5.4	0.0
Slovenia	svn	687	0.0	0.0	0.0	31.1	2.0	0.0
South Africa	zaf	181	20.5	5.4	1.9	57.8	46.9	9.6
Sri Lanka	lka	109	10.3	1.8	0.5	40.7	19.7	2.0
Suriname	sur	199	14.2	5.3	2.7	52.8	0.5	0.1
Swaziland	swz	48	61.4	28.9	17.0	50.5	1.1	0.7
Tajikistan	tjk	74	21.5	5.1	1.7	33.6	6.6	1.4
Tanzania, United Rep. of	tza	27	82.4	39.2	22.5	34.6	38.5	31.7
Thailand	tha	190	0.4	0.0	0.0	42.5	63.0	0.3
Timor Leste	tls	58	43.6	14.2	6.0	39.5	1.0	0.4
Togo	tgo	56	38.7	11.4	4.5	34.4	6.2	2.4
Trinidad and Tobago	tto	371	0.5	0.2	0.1	40.3	1.3	0.0
Tunisia	tun	222	1.0	0.2	0.1	40.9	10.0	0.1
Turkey	tur	235	2.7	0.9	0.5	43.3	72.1	2.0
Turkmenistan	tkm	117	11.7	2.5	0.8	40.9	4.8	0.6
Uganda	uga	53	51.5	19.1	9.1	42.6	29.0	14.9
Ukraine	ukr	250	0.1	0.0	0.0	28.3	47.1	0.0
Uruguay (Urban)	ury	345	0.0	0.0	0.0	45.0	3.3	0.0
Uzbekistan	uzb	57	38.8	11.8	5.1	36.7	26.2	10.2
Venezuela	ven	191	10.8	4.0	2.0	47.6	26.6	2.9
Viet Nam	vnm	82	22.4	5.3	1.7	37.8	83.1	18.6
Yemen	yem	84	17.5	4.2	1.6	37.7	21.1	3.7
Zambia	zmb	43	64.3	32.8	20.8	50.7	11.5	7.4
Australia	aus	1,091				35.2	20.4	
Austria	aut	1,263				31.0	8.2	
Belgium	bel	1,251				28.7	10.5	
Canada	can	1,425				31.8	32.3	
Cyprus	cyp	1,111				30.4	0.8	
Denmark	dnk	1,280				27.1	5.4	
Finland	fin	1,075				24.7	5.2	
France	fra	1,133				29.9	60.9	
Germany	deu	1,309				30.3	82.5	
Greece	grc	826				36.3	11.1	
Hong Kong	hkg	972				44.8	6.8	
Ireland	irl	1,062				39.3	4.2	
Israel	isr	756				38.1	6.9	
Italy	ita	844				36.3	58.6	
Japan	jpn	1,226				24.1	127.8	
Korea, Rep. of	kor	1,168				29.3	48.1	
Luxembourg	lux	2,065				31.5	0.5	
Netherlands	nld	1,310				30.1	16.3	
New Zealand	nzl	1,027				37.1	4.1	
Norway	nor	1,494				25.9	4.6	
Portugal	prt	568				39.5	10.5	
Singapore	sgp	804				43.6	4.3	
Spain	esp	1,032				32.9	43.4	
Sweden	swe	1,443				25.5	9.0	
Switzerland	che	1,531				33.1	7.4	
Taiwan	twn	900				29.9	21.8	
United Kingdom	gbr	1,056				36.8	60.2	
United States of America	usa	1,797				40.8	295.6	
Total		**311**	**25.2**	**7.5**	**3.2**	**71.0**	**6,173.6**	**1,313.5**

Note: Poverty line $1.25 a day (or $38 a month) in 2005 PPP terms. Monthly income is the monthly average income/consumption per capita from the survey. Global poverty ratios are based on the total population of developing countries.
Source: Own calculations based on PovcalNet.

Table B2. Regional and global poverty and inequality measures, baseline year 2005

Region	Monthly income (in 2005 PPP$)	H	PG (in percentage)	SPG	GINI	Population (in million)	Poor people (in million)
Extreme poverty (poverty line $1.25 a day)							
SRES Regions							
OECD90	1,284	2.7	0.9	0.5	40.5	952	2
ASIA	107	27.2	6.8	2.4	53.7	3,343	889
REF	268	3.8	1.1	0.5	41.8	393	15
ALM	157	27.6	10.9	5.7	60.2	1,486	408
Geographical regions							
East Asia and Pacific	226	16.8	4.1	1.4	64.5	2,044	304
Europe and Central Asia	656	3.6	1.0	0.5	51.0	865	17
Latin American and Caribbean	274	8.1	2.6	1.3	54.1	539	43
Middle East and North Africa	166	3.6	0.8	0.3	44.3	249	9
North America	1,761	0.0	0.0	0.0	40.2	328	0
South Asia	55	40.3	10.3	3.6	34.1	1,451	585
Sub-Saharan Africa	63	50.9	20.7	11.1	51.8	698	356
Total	*311*	*25.2*	*7.5*	*3.2*	71.0	*6,174*	*1,313*
Moderate poverty (poverty line $2.5 a day)							
SRES Regions							
OECD90	1,284	14.7	4.5	2.1	40.5	952	11
ASIA	107	65.4	28.0	14.7	53.7	3,343	2,133
REF	268	12.3	4.5	2.3	41.8	393	49
ALM	157	50.9	25.7	16.0	60.2	1,486	752
Geographical regions							
East Asia and Pacific	226	50.3	19.3	9.6	64.5	2,044	910
Europe and Central Asia	656	12.7	4.5	2.3	51.0	865	59
Latin American and Caribbean	274	22.9	9.1	4.9	54.1	539	123
Middle East and North Africa	166	28.3	7.7	3.1	44.3	249	69
North America	1,761	0.0	0.0	0.0	40.2	328	0
South Asia	55	84.3	38.9	21.1	34.1	1,451	1,223
Sub-Saharan Africa	63	80.3	44.7	29.1	51.8	698	560
Total	*311*	*56.6*	*25.3*	*14.0*	71.0	*6,174*	*2,945*

Note: Monthly income is the monthly average income/consumption per capita from the survey. Global poverty ratios are based on the total population of developing countries.
Source: Own calculations based on PovcalNet.