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National Scenarios of Economic Activity (GDP) - A Downscaling Analysis based on SRES

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Abstract

This report presents national scenarios of economic activity (GDP) for the time period 1990 to 2100 based on three scenarios (A2, B1, and B2) from the IPCC Special Report on Emissions Scenarios (SRES; Nakicenovic et al, 2000). Two scenarios (B1 and B2) follow (with minor adjustments due to scenario improvements) the original SRES quantifications at the level of 4 and 11 world regions respectively. The quantification of the original SRES A2 scenario has been revised in order to reflect recent changing perceptions on the demographic outlook of world population growth. In this revised "high population growth" scenario A2 world population reaches some 12 billion by 2100 (as opposed to some 15 billion in the original SRES A2 scenario) and is characterized by a "delayed fertility transition" that is also mirrored in a delayed (economic) development catch-up. Our downscaling approach emphasizes the scenario dependency of the national development path. I.e., national income convergence within a region varies across the scenarios and is guided by the scenario's specific assumptions for convergence on the macro-regional level. The approach explicitly distinguishes also between countries at different stages of economic development as opposed to earlier downscaling approaches which have employed the (by now widely recognized) problematic method of regionally uniform growth rates as downscaling algorithm. While the results are similar at the regional level to SRES, there are significant differences compared to earlier results from downscaling at the national level.

About the Authors

Keywan Riahi is a Research Scholar in the Transitions to New Technologies Program (TNT) and Scientific Coordinator of the Greenhouse Gas Initiative (GGI). He joined IIASA to work with the Environmentally Compatible Energy Strategies Program (ECS) in 1997.

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Dr. Riahi is the author of several scientific articles and serves as a Lead Author to the Special Report on CO_2 Capture and Storage (CCS) of the Intergovernmental Panel on Climate Change (IPCC). He was also a Lead Author to the mitigation assessment chapter of the IPCC's Third Assessment Report (TAR) and the Special Report on Emissions Scenarios (SRES).

Dr. Riahi is involved in several international modeling efforts, such as the Stanford-based Energy Modeling Forum (EMF-19, and EMF-21). His modeling work focuses on the spatial and temporal characteristics of technology diffusion, and the path-dependent development of the energy system under alternative policy configurations.

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Arnulf Grübler first joined IIASA in 1976 to work with the Energy Systems Program; between 1979 and 1984 he was affiliated with the Resources and Environment Area. He returned to the Institute in 1986, currently working as a senior research scholar in the Transitions to New Technologies Program on a part-time basis. He also holds a part-time appointment as Professor in the Field of Energy and Technology at the School of Forestry and Environmental Studies at Yale University, New Haven, USA, teaching there every fall semester (September-December). His teaching and research focuses on the long-term history and future of technology and the environment with emphasis on energy, transport, and communication systems.

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National Scenarios of Economic Activity (GDP) - A Downscaling Analysis based on SRES

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1 Introduction

This report presents national scenarios of economic activity (GDP) for the time period 1990 to 2100 based on three scenarios (A2, B1, and B2) from the IPCC Special Report on Emissions Scenarios (SRES; Nakicenovic et al., 2000). Our analysis is part of a comprehensive downscaling exercise, which was performed in order to respond to both short-term as well as long-term research objectives within an institute-wide collaborative effort at IIASA aiming at assessing uncertainties, feasibilities, environmental consequences, and policy implications of climate stabilization scenarios, an effort referred to as the IIASA Greenhouse-Gas-Initiative (GGI). Methods, data, as well as results from this downscaling exercise are documented in four related IIASA Reports summarizing national scenarios for population (O'Neill et al., 2005) and GDP (this report) as well as sub-national spatially explicit scenarios for both indicators (Grübler et al., 2005a). A summary and overview of the full downscaling exercise is summarized in Grübler et al., 2005b.

The original SRES scenarios have been documented extensively at the level of 4 "macro-regions" in the SRES report (Nakicenovic et al., 2000). The aim of the GDP downscaling described here is twofold: first, to provide a break-down of the regional economic projections of SRES to enhance the applicability of the scenarios for national studies and policy making, and secondly, to provide the required input for the further downscaling of the scenario's economic projections to grid-cell level (Grübler et al., 2005b). The latter indicators are central for the spatially explicit assessment of the relative economics (in terms of international comparative advantage) of biomass supply and forest carbon sequestration options within the context of long-term climate stabilization scenarios. In other words, the downscaled scenario indicators reported here are used in subsequent spatially-explicit modeling studies that need consistent, internationally comparable indicators (such as relative land prices) defining the relative comparative advantage of agricultural and forestry based GHG mitigation options.

The SRES emissions scenarios comprise four alternative scenario families and storylines, each characteristic for a specific demographic and economic development path. We have updated these projections using recent information that has become available since the development of the SRES scenarios. The updates concern in particular short term GDP data for the year 2000; revisions of the long-term demographic outlook based on recent population studies (van Vuuren and O'Neill, in press; Lutz and Sanderson, 2001; and UN 2004; e.g., depicting more rapid decline in fertility rates particularly in developing countries such as China)[1]; as well as adjustments of the long-term regional GDP projections, mainly in order to reflect the new underlying demographic trends.

The revised regional GDP projections are used as the basis for the downscaling of regional GDP to the national level for three of the four SRES scenario families (A2, B1, B2). Our downscaling approach emphasizes the scenario dependency of the national development path. I.e., national income convergence within a region varies across the scenarios and is guided by the scenario's specific assumptions for convergence on the macro-regional level. The approach explicitly distinguishes also between countries at different stages of economic development. These characteristics of the new downscaling approach constitute major improvements compared to earlier attempts of SRES-based GDP downscaling (Gaffin et al., 2004), which have applied uniform GDP growth rates to countries within a region. The new methodology results in national projections that are internally plausible and consistent with the respective storyline. While the results are similar at the regional level to SRES, there are significant differences compared to earlier results from downscaling at the national level.

The sequel of this paper is structured as follows: Section 2 briefly discusses the main differences of the revised GDP projections compared to SRES on the regional level. Section 3 summarizes the downscaling methodology and assumptions that were made to obtain the national projections. Section 4 discusses results on the national level and Section 5 concludes.

2 Comparison of the revised regional GDP projections to SRES

The starting point for our downscaling exercise are three of the SRES scenarios labeled B1, B2 and A2. We chose these scenarios in order to be able to bracket main scenario uncertainties in terms of demographic and economic patterns ranging from "low" to "high", where scenarios B1 and A2 assume the role of describing the upper and lower bounds of scenario uncertainty respectively, and the B2 scenario describing more intermediary, "middle of the ground" developments. B1 combines high income and low population assumptions with rapid income convergence and "catch-up" of developing countries over the course of the century. In contrast A2 is based on high population, low income, and slow income convergence. B2 combines intermediate assumptions for population, income, and income convergence, lying in-between the other two scenarios with respect to all three scenario indicators.

The most significant modification compared to SRES is that we have updated the high population projections of the A2 scenario. This was necessary in order to reflect the recent downwards shift of population projections (Lutz and Sanderson, 2001; UN, 2004) since the publication of the SRES scenarios (2000). As the high population trajectory we have selected the recently published UN high population projection (UN, 2004). Global population in the new A2 scenario is about 12 billion by 2100. This corresponds to a decrease in population size by 3 billion compared to the original SRES

[1] For details on the modifications of the scenario's population projections compared to SRES see O'Neill et al., 2005.

A2 scenario (15 billion in 2100). Global population of the B1 and B2 scenarios were not modified, and we still use the original SRES numbers. On the regional level, however, for B2 we apply a different method of converting the original 8 regional split of the UN 1996 projections (i.e., the original population projection used for B2-SRES) into the 4 SRES regions. Thus, on the 4-regional level the new B2 population data differs slightly from the original SRES (for further details on the regional population see O'Neill et al., 2005). A comparison of global population trends to SRES is given in Figure 1a.

GDP projections of the new scenarios were modified to reflect changes of the population projections. Again, the differences on the global level for the B1 and B2 scenarios are negligible, since also the shifts in population changes were minor. In the case of A2, the new GDP assumptions mirror the changes in the population trajectory. Generally, the lower population assumptions of the new A2 scenario lead also to lower long-term GDP levels by 2100. It is important to note, however, that changes in population do not translate in proportional changes of GDP. In the revised A2 scenario, faster fertility decline in the new population projections, particularly over the short term, cause shifts in dependency ratios and lead to higher productivity growth. This trend is most pronounced in Asia, which exhibits higher levels of economic development under the revised and lower population trajectory. On the aggregated global level this leads to higher GDP in the revised A2 scenario up to 2070 (see Figure 1b).

A comparison between the new scenarios and SRES for the global development of population, GDP, income (GDP per capita), and income convergence between industrialized and developing regions is illustrated in the panels a to d of Figure 1. As shown the differences for B1 and B2 are negligible for all the indicators. Also the new A2 scenario shows only small differences compared to its SRES counterpart. The main characteristics remain the same, i.e., the revised A2 scenario depicts on the global level the highest population, the lowest income and slowest income convergence relative to the other two scenarios. The maximum deviation between SRES and the new world GDP projections in A2 is about 17 percent (in 2100).

The difference between the revised scenarios and SRES is more pronounced on the level of the four SRES macro-regions.[2,3] Figure 2 illustrates the difference in GDP per capita between the revised scenarios and SRES as their ratios for the year 2100. The revised B2 scenario deviates the least from its SRES counterpart, with the difference being below 10 percent for all the regions. As the reader may recall, these adjustments in GDP stem from minor changes of the population trajectories using a different method of converting the original UN population data. The most significant change of regional income compared to SRES is given by the A2 scenario. The deviations of GDP are primarily due to significant changes in the population outlook and the corresponding

[2] The four SRES regions comprise OECD90, REF, ASIA, and ALM: The OECD90 region includes the countries belonging to the OECD in 1990. The REF ("reforming economies") region aggregates the countries of the Former Soviet Union and Eastern Europe. The ASIA region represents the developing countries on the Asian continent. The ALM region covers the rest of the world, aggregating countries in sub-Saharan Africa, Latin America and the Middle East. For more details see Nakicenovic et al., 2000.

[3] Our GDP downscaling to the national level starts from the SRES scenarios formulated the level of 4 world regions and their corresponding 11 world regions that define the spatial resolution of the IIASA modeling set used to derive the quantifications of the SRES scenarios. For the definition of regions see Appendix 1.

shift of the demographic transition. The difference in income is most pronounced in ASIA (+50%) and ALM (-45%), followed by REF (+30%) and OECD (+5%).

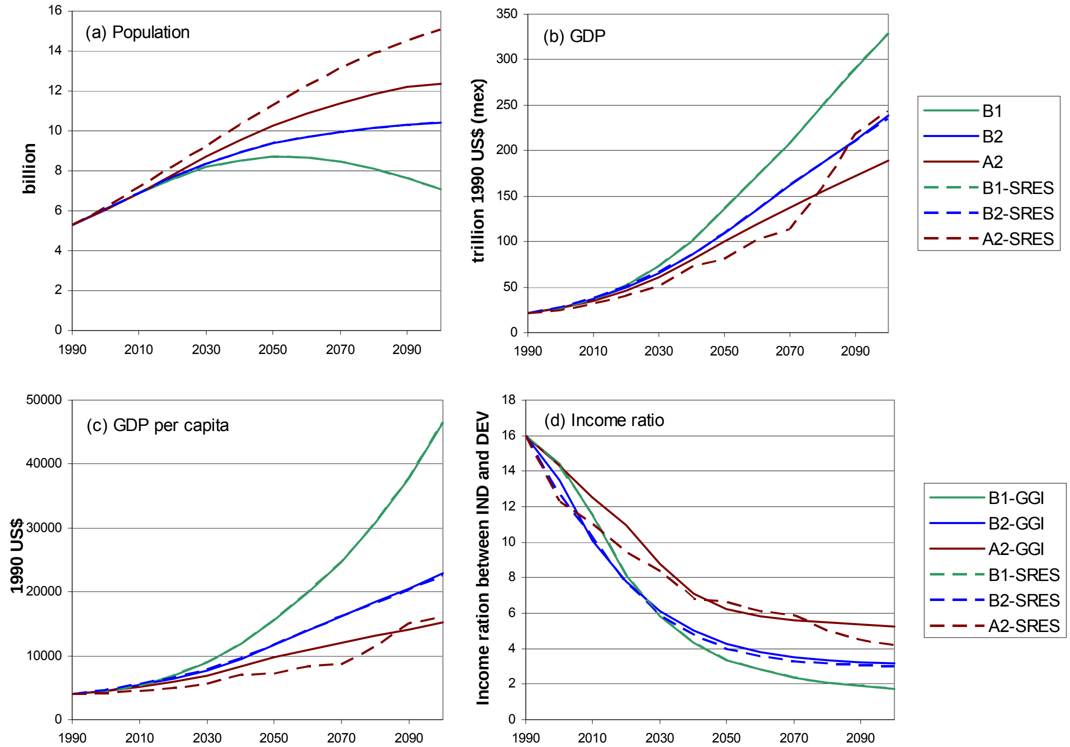

Figure 1: Global development of a) population, b) GDP, c) income (GDP per capita), and d) income convergence (measured as the ration of income in the industrialized world and the developing world).

As to the B1 scenario, income deviations compared to SRES are uneven across regions. While income is identical with SRES in the industrialized regions (OECD and REF), there are significant differences for the ASIA and ALM (see Figure 2). In contrast to B2 (and also A2), this deviation is not due to changes in population assumptions, but due to revisions of the income trajectory of Asia. Consistent with the B1 storyline of strong economic convergence, we have adjusted economic growth rates in Asia upwards in order to reflect the continuation of the Asian economic “catch-up” of the last two decades. We maintain highest possible consistency with the original B1 scenario by introducing changes to the regional GDP without effecting the global development path, i.e., GDP was redistributed across the two developing regions so that 1) the higher income in ASIA is compensated by income reductions in ALM, and 2) the new income projections are still consistent with the underlying regional population trajectories. Compared to SRES the revised B1 scenario depicts 30 percent higher GDP per capita in Asia, and 20 percent lower income in ALM by 2100 (see Figure 2). For absolute numbers of regional GDP and population see the Appendix 2, and for definition of regions see Appendix 1.

In summary, it is important to note that although the revised scenarios represent updated quantifications of the SRES storylines, the global economic development path of all the scenarios still follows closely the central tendencies depicted by SRES. Also on the regional level, the changes for B2 and B1 (for the industrialized world) are minor. Main changes compared to SRES concern the regional development of A2 as well as the developing regions in B1. It is important to keep these differences in mind when comparing our downscaling results on the national level with the earlier SRES-based downscaling results (Section 4).

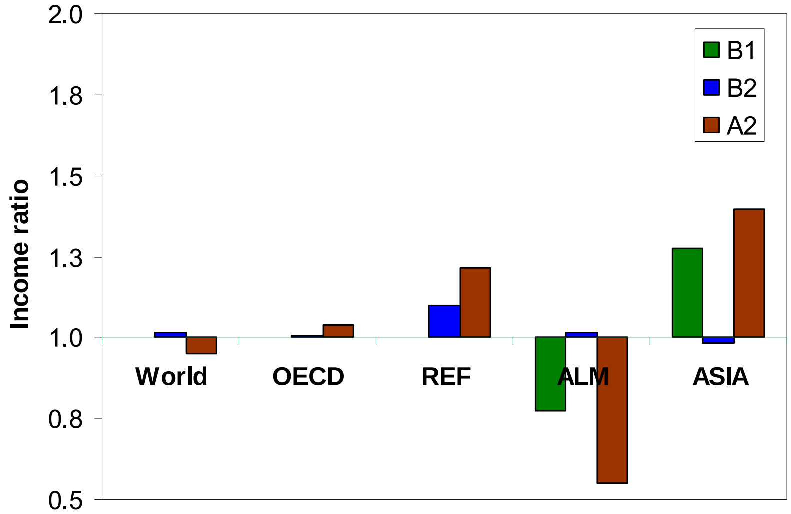

Figure 2: Ratio of income (GDP per capita) between the revised scenarios and original SRES scenarios for the year 2100. For absolute numbers for regional GDP see Appendix 2.

3 Downscaling methodology and assumptions

The key conceptual model underlying our national level GDP scenarios is the same as deployed in the original SRES scenarios. Economic growth is an uneven process, resulting if differences of economic growth over time and space. Following Rostow (1980) and Barro (1996) that provide a convincing interpretation of the historical experience of successful economic development in most OECD and "Asian tiger economies", economic growth is *ceteris paribus* higher for economies further away from the productivity frontier that for countries close or at that productivity frontier. Theory and empirical data also suggest the existence of important threshold effects: "poverty traps" resulting e.g. from unfavorable terms of trade, limited access to capital, information, and new technology, or poor institutions can preclude any "take-off" into accelerated growth catching up to the productivity frontier. Conversely, once favorable initial conditions for accelerated catch-up to the productivity frontier are established positive feedback mechanisms can result in accelerated economic growth due to increasing demand for the build-up of new infrastructures as well as from increasing consumer demands that are at the heat of the "industrialization take off" hypothesis of

Rostow (1980). These trends continue until the shift from a pre-industrialized society to an industrialized economy is completed. The further a country develops and the closer it gets to the productivity frontier, the harder it is to increase productivity further. This results in comparatively lower "post-industrial" GDP growth rates. Thus, GDP growth from pre- to post-industrial stage is typically characterized by an inverted U-shaped curve, with a peak during early stages of industrialization.

This behavioral relationship is also illustrated by the regional development paths of the original SRES scenarios. Using income as a surrogate indicator for the stage of industrialization, Figure 3 gives an illustrative example of the regional GDP growth rates in B2 as a function of income (GDP per capita). As illustrated, the GDP growth rates for developing regions follow the inverse U-shaped curve along the logarithmic scale of the x-axis. Growth rates of the regions belonging to the OECD are comparatively lower and mostly characterized by a modest downwards slope. The same general trends can be observed for the other scenarios (B1, A2), although the regional peaks of GDP growth occur at different times and different levels compared to B2. Also the long-term growth rates of the OECD regions differ across the scenarios.

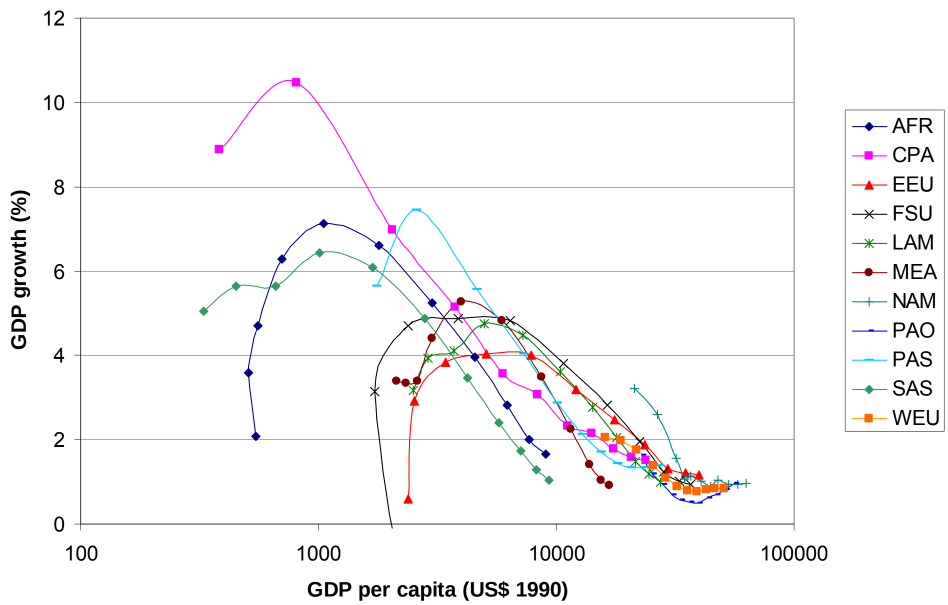

Figure 3: Regional relationship between GDP growth and GDP per capita in the B2 scenario.

The existence of the relationship between income and economic growth in the scenarios forms the backbone of our downscaling approach. We further assume that individual countries would follow the economic growth path defined by the functional form of the respective regional pathway. This is an important assumption, as it permits us to take into account the heterogeneity and large income differences of countries belonging to the same region. I.e., national growth rates within a region reflect differences in stages of economic development, and hence low and high income countries yield significantly different growth rates *over time*.

Linear GDP downscaling as employed in earlier approaches (Gaffin et al., 2004) neglect this difference by applying uniform GDP growth over time to all countries irrespective to the income difference. This leads in some cases to significant overestimation of national economic growth, particularly in countries with presently significant higher income as compared to the regional average. Using a functional form for the GDP growth rates has also the advantage that it leads to scenario dependent income convergence between high and low income countries within a region. In contrast, linear downscaling of GDP leads to (everything else being equal) no change in national income disparities within regions, which is inconsistent with the scenarios storylines of differentiated income convergence.

Downscaling process:

Our downscaling process is divided into two main steps.

Step 1: As the first step, we estimate a mathematical equation for the relationship between GDP growth and income (GDP per capita) at the regional level. We use for this purpose regional GDP and population time series for 11 macro-regions, the highest level of disaggregation for which regional information of the scenarios is available.[4,5] The equation is estimated for each region separately, and defines the growth path of individual countries within a specific region. One problem that occurs by applying the functional relationship to the countries is that the sum of the GDP of the countries does not necessarily add up to the regional total.

Step 2: Thus, as the next step we correct for the deviation from the regional total, by formulating a simple non-linear optimization problem. The central equation of the optimization problem is the functional relationship derived in step one above (relating national GDP growth to income). We adapt the equation by adding an error term (δ), which permits individual countries to deviate slightly from their predefined growth path. In addition, we set the boundary condition that the sum of national GDP for each time step matches the predefined regional GDP of the scenarios. By defining an objective function, which minimizes the square of all error terms (δ), we derive an optimization problem with two main characteristics: (1) the deviation of the national GDP growth path from the respective regional path is minimized, and (2) at the same time the sum of the national GDPs have to match the exogenously specified regional GDP time series.

The two-step approach permits us to achieve consistency of the national projections with the underlying regional scenario assumptions at a functional scale as well as over time.

For the downscaling a number of exogenous input data sets are used, comprising:

1) the scenario's regional GDP and population projections for 11 regions,

2) national population projections for 185 countries (obtained from the downscaling of population to national level presented in O'Neill et al., 2005), and

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[4] Our GDP downscaling to the national level starts from the SRES scenarios formulated the level of 4 world regions and their corresponding 11 world regions that define the spatial resolution of the IIASA modeling set used to derive the quantifications of the SRES scenarios.

[5] For the definition of the 11world regions, i.e. group of countries belonging to each region see Appendix 1 or http://www.iiasa.ac.at/Research/ECS/docs/11worldregions.html

3) a database of national GDP estimates for the year 2000, and historic GDP growth rates between 1990 and 2000 collected from various sources (World Bank, 2003, Penn World Tables: Heston et al., 2002).

We shall next describe the mathematical formulations used for Step 1 and proceed later to the main equations of the optimization problem (Step 2).

Mathematical formulation of regional GDP growth:

We distinguish between two types of equations for describing the scenario's regional relationship between GDP growth and GDP per capita. We find that the equation of Type I provides a reasonable fit for the developing regions, where GDP growth over income follows an inverted U-shaped curve. For industrialized regions we use a simple logarithmic fit (equation of Type II), reflecting the scenario's assumptions of modestly decreasing incomes with further increase in affluence.

Equation of Type I uses a quadratic function for the relationship between GDP growth (*GR*) and GDP per capita (*GDPCAP*). Its functional form is defined as follows:

$$GR_t = \left(\frac{a \cdot (GDPCAP_t)}{(GDPCAP_t)^2 + b} + c \right)$$

t in the equation above denotes time; and *a*, *b*, and *c* are regional specific variables, which are estimated from the exogenously given regional time series of GDP and population. The function neatly defines the inverse U-shaped curve, since by further decomposition of *a* and *b* as given below, we can define the properties of the regional path by simply specifying 1) the peak of the growth rate (GR_{max}), 2) the income at which the peak will occur ($GDPCAP_{max}$), and 3) the long-term GDP growth rate to which the region will converge at higher per capita income (*c*).

$$a = 2 \cdot GDPCAP_{max} \cdot GR_{max}$$
$$b = (GDPCAP_{max})^2$$

For equation of Type II, we use the following logarithmic fit for the relation between GDP growth (*GR*) and GDP per capita (*GDPCAP*), whereas *a* and *b* are derived from regressions using the scenario's regional time series of GDP and population.

$$GR_t = (a \cdot \log(GDPCAP_t) + b)$$

Figure 4a, gives an illustrative example of the functional fit for the LAM (Latin American) region, using the equation of Type I. The figure shows results for the B1 scenario. Consistent with the scenario's trend, we selected the peak of GDP growth (GR_{max}) to be 8 percent per year, occurring at an income ($GDPCAP_{max}$) of 4500 US$1990.[6] For the tail (*c*) we choose -1, which means that GDP growth rates would converge to -1 in infinity. We selected a negative value for *c*, since this gives the best fit to the exogenously given scenario data. It is important to note that since the intercept with the x-axis (GDP per capita) lies at about 81,000 US$1990 (beyond incomes

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[6] If not otherwise mentioned all GDP values are given in US1990$ at market exchange rates (mex).

considered for LAM), a negative value for *c* does not lead to negative GDP growth rates for the downscaled countries (see Figure 4a). We follow the same approach for estimating the parameters of the equations of Type I and II for the other regions and scenarios. The parameters for the three scenarios (A2, B1, and B2) and 11 regions are summarized in Tables 1 to 3.

Before continuing with this example for the LAM region and its implications for the national GDP growth rates, we shall describe next the main equations of the optimization model (Step 2).

Mathematical formulation of the optimization model:

The optimization is performed for each region separately. The central equation of our model is the functional relationships derived in step one (relating regional GDP growth to regional income). By assuming that individual countries within a region follow the same regional pathway, we derive the two equations below for the national GDP growth rates ($GR_{n,t}$). The equations correspond to the Types I and II of regional relationships (described above),

Type I.... $$GR_{n,t} = \left(\frac{a \cdot (GDPCAP_{n,t})}{(GDPCAP_{n,t})^2 + b} + c \right) \cdot (1 + \delta_{n,t})$$

Type II.... $$GR_{n,t} = (a \cdot \log(GDPCAP_{n,t}) + b) \cdot (1 + \delta_{n,t})$$

where *n* and *t* are the identifiers for individual countries and time; *a*, *b*, and *c* are constants derived from the regional fit under Step 1. δ denotes an important extension of the regional equation, representing an error term, which allows for small deviations of the national growth path from the original regional function (Type I or II).

Time series for national projections (O'Neill et al., 2005; Appendix 3) are exogenous inputs to the model. Changes in national population size are mirrored by corresponding adjustments in GDP as given by the equations of Type I and II above. Thus, consistency between GDP growth and changes in national population size is achieved by defining GDP per capita in the above equation as follows:

$$GDPCAP_{n,t} = \frac{GDP_{n,t}}{POP_{n,t}}$$

The model calculates national GDP from 2000 to 2100 in 10 year time steps. GDP between two time periods are linked via the GDP growth rate ($GR_{n,t}$), using the following functional form (*pl* denotes the period length):

$$GDP_{n,t} = GDP_{n,t-1} \cdot \left(\frac{GR_{n,t}}{100} + 1 \right)^{pl}$$

Besides a number of constraints defining initial conditions, such as base year GDP and population as well as initial growth rates between 1990 and 2000, the optimization problem includes one main constraint framing the boundary condition. The constraint ensures that the sum of the national GDPs equals the exogenously given regional GDP for each time step. Its functional form is the following,

$$GDP_{R,t} = \sum_{n=1}^{N} GDP_{n,t}$$

whereas, R denotes the region, and N the number of countries within the region.

As the objective function the model minimizes the sum of the squares of the error terms for all countries and time steps:

$$f(min) = \sum_{n=1}^{N} \sum_{t=1}^{T} \left(\delta_{n,t}\right)^2$$

The result of the optimization yields national GDP trajectories that follow closely the equations of Type I and II. At the same time the sum of the national GDP matches the regional total of the scenarios.

An example for a typical result from the model for the region LAM (Latin America) of scenario B1 is given in Figure 4a-d. As described earlier, the upper left panel (a) gives the approximation of the regional trend using the functional form of Type I. The upper right panel (b) shows the present income and GDP growth rates (1990-2000) for all countries belonging to the LAM region. It is apparent from the Figure that LAM consists of heterogeneous set of countries with large per capita income differences between 400 and 12000 US$ in 1990. We select two countries from the set: Argentina, representative for the middle income range, and secondly, Bahamas, the richest country in LAM. The result of the optimization model for these two countries is illustrated in panel (c) of Figure 4. As shown, both countries follow the regional trend, but perhaps more importantly, the growth path of each of the two countries differs significantly. While Argentina, the poorer of the two countries, follows the inverse U-shaped curve; Bahamas is (because of its relatively high initial income) growing at a much lower pace along the tail of the functional relationship. As a result, the income gap between the two countries is reduced considerably over time. The specific example illustrates clearly two important as well as related features of our downscaling approach: (1) the *path-dependency of economic growth* on a national scale, which in turn is leading to (2) the *scenario-dependent (i.e., conditional) convergence* of income between the countries.

For reasons of completeness, panel (d) of Figure 4 shows the development path of all 30 countries of the LAM region (scenario B1). As the figure illustrates, the countries follow broadly the same trend as depicted by the regional development path (i.e., the thick black lines in panels a to c).

Reflecting the differences in the scenario-specific input assumptions, we use different parameterizations of the equations of Type I and II for each scenario. The scenario-specific parameters for the 11 regions are summarized in Tables 1 to 3. For a number of regions we group countries according to ranges for high, medium, and low income. For these regions alternative parameterization for each country group was used in order to enhance consistency of national income convergence with the respective scenario storyline.

We shall next discuss the main results of the GDP downscaling.

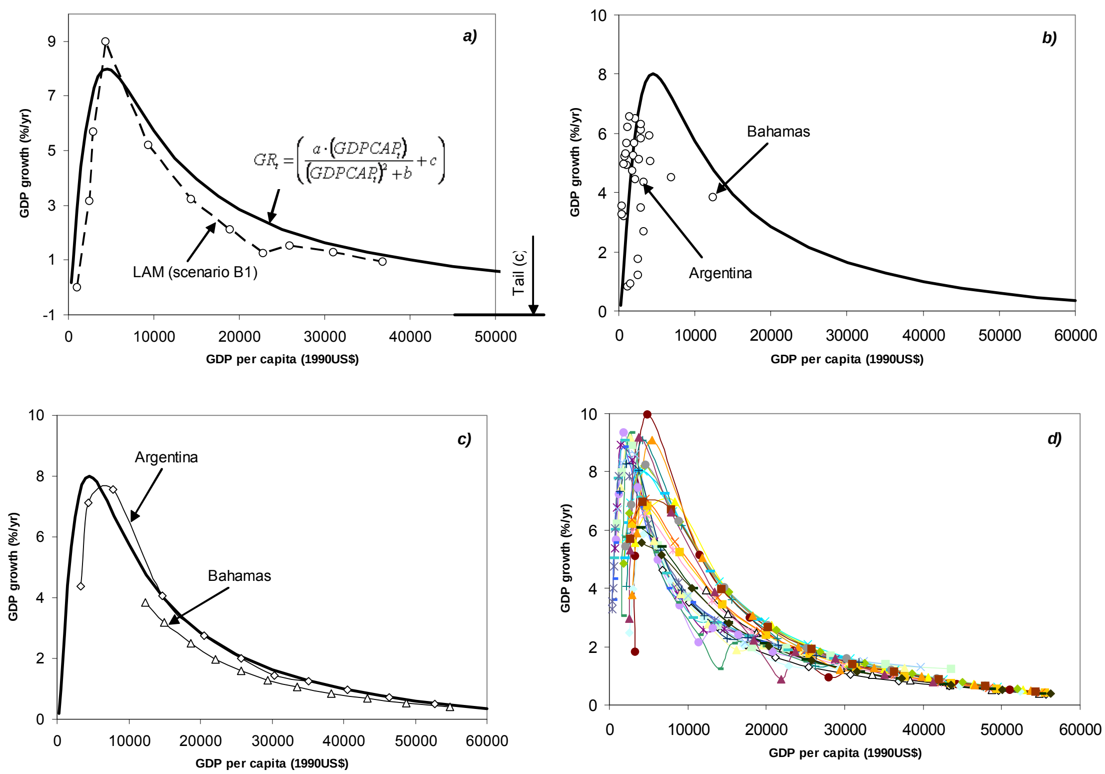

Figure 4: Relationship between GDP growth and GDP per capita. The four panels give an illustrative example of the GDP downscaling for the region LAM of scenario B1. Panel a) compares the regional development path as given by the scenario's exogenous input data (dashed lines) with the functional relationship that was used for the national downscaling (straight line). Panel b) shows the relationship between GDP growth (1990-2000) and GDP per capita (1990) for individual countries in the base year (dots), and compares them to the assumed functional relationship. Panel c) denotes the resulting development path of the downscaling for two representative countries (Argentina and Bahamas) between 1990 and 2090 in ten year time steps. Panel d) shows the results of the downscaling for all individual countries (1990 to 2090).

Table 1: Downscaling model parameters – Scenario B1.

Region	Income Range	Model Type	GR_{max}	$GDPCAP_{max}$	c	a	b
AFR	< 200	Type I	10.6	600	0.6		
	200 - 520	Type I	9.0	1100	0.0		
	> 520	Type I	8.1	1400	0.1		
CPA	< 8000	Type II				-1.85	20.22
	≥ 8000	Type II				-1.40	15.95
EEU		Type I	4.5	3000	1.0		
FSU	< 1650	Type I	6.2	2000	0.2		
	≥□1650	Type I	5.3	4000	0.8		
LAM	< 1700	Type I	9.5	2000	0.5		
	≥ 1700	Type I	8.0	4500	-1.0		
MEA	< 1200	Type I	8.2	1500	1.2		

	≥ 1200	Type I	6.7	4000	-0.3		
NAM		Type II				-1.46	17.29
PAO		Type II				-1.55	17.59
PAS	< 1000	Type I	6.5	2500	1.4		
	≥ 1000	Type I	5.0	3500	-0.1		
SAS	< 340	Type I	9.0	1100	2.0		
	≥ 340	Type I	7.0	3600	0.0		
WEU	< 12400	Type II				-1.22	14.13
	≥ 12400	Type II				-1.22	14.33

Table 2: Downscaling model parameters – Scenario B2.

Region	Income Range	Model Type	GR_{max}	$GDPCAP_{max}$	*c*	*a*	*b*
AFR	< 210	Type I	7.5	500	1.0		
	210 - 500	Type I	7.5	550	1.0		
	500 - 2000	Type I	6.5	1000	1.0		
	> 2000	Type I	6.3	4000	1.0		
CPA	< 8000	Type II				-2.62	27.11
	≥ 8000	Type II				-2.03	22.82
EEU	non EU [a]	Type I	5.0	3500	0.0		
	EU [b]	Type II				-1.08	12.36
FSU	< 2000	Type I	9.7	1250	0.2		
	≥ 2000	Type I	4.0	3200	0.0		
	EU [c]	Type I	6.1	2200	0.6		
LAM	< 1000	Type I	7.0	1000	1.0		
	1000 - 8000	Type I	5.0	3500	0.0		
	> 8000	Type I	3.5	6250	0.0		
MEA	< 650	Type I	7.1	1000	0.1		
	650 - 8000	Type I	5.5	2500	0.0		
	> 8000	Type II				-1.09	12.58
NAM	< 10000	Type II				-2.02	22.90
	≥ 10000	Type I	6.0	3000	0.0		
PAO		Type II				-1.25	14.30
PAS	< 10000	Type I	9.5	1800	0.0		
	≥ 10000	Type I	4.0	5000	0.0		
SAS	< 250	Type I	7.0	550	0.0		
	250 - 750	Type I	7.0	1000	0.0		
	> 750	Type I	6.3	1450	0.0		
WEU	≤ 2000	Type I	4.8	2500	0.0		
	> 2000	Type I	4.0	3500	0.0		

[a] "non EU" denotes countries within the EEU region that are not members of the European Union, i.e. Albania, Bosnia and Herzegovina, Bulgaria, TFYR Macedonia, Yugoslavia.
[b] "EU" denotes countries within the EEU region that are members of the European Union or are expected to join the EU in the near future, i.e. Croatia, Czech Republic, Hungary, Slovakia, Slovenia, Poland.
[c] "EU" denotes countries which are members of the European Union, i.e. the Baltic countries – Estonia, Latvia, Lithuania.

Table 3: Downscaling model parameters – Scenario A2.

Region	Income Range	Model Type	GR_{max}	$GDPCAP_{max}$	*c*	*a*	*b*
AFR	< 210	Type I	7.50	400	1.0		
	210 - 500	Type I	7.00	550	1.0		
	500 - 2000	Type I	5.50	900	1.0		
	> 2000	Type I	4.25	3000	1.0		
CPA	< 8000	Type II				-2.11	21.90
	≥ 8000	Type II				-1.41	15.72
EEU	< 8000	Type I	4.40	2200	0.4		
	≥ 8000	Type II				-1.41	15.72
FSU	< 8000	Type I	7.00	2750	0.5		
	≥ 8000	Type I	4.00	4500	0.0		
LAM	< 1000	Type I	5.00	1000	0.0		
	1000 - 8000	Type I	4.20	3000	0.0		
	> 8000	Type I	2.50	6250	0.0		
MEA	< 650	Type I	6.50	1000	0.0		
	650 - 8000	Type I	5.25	2000	0.0		
	> 8000	Type II				-1.41	15.72
NAM	< 10000	Type I	5.30	3000	-0.2		
	≥ 10000	Type II				-1.76	20.41
PAO		Type II				-1.68	18.88
PAS	< 10000	Type II				-2.20	21.27
	≥ 10000	Type I	1.65	15000	0.0		
SAS	< 250	Type I	5.00	450	0.0		
	250 - 750	Type I	5.50	700	0.0		
	> 750	Type I	5.50	1250	0.0		
WEU		Type I	3.85	4250	0.1		

4 Downscaling results for the national level

This section gives a brief summary of the results of the GDP downscaling to national level. We focus on broader trends and comparisons across scenarios rather than exact numerical results for individual countries, which are summarized in Appendix 3. First, we will illustrate the resulting national income development over time, and proceed with exploring the scenario's implications for income disparities at alternative levels of spatial aggregation. We will also quantify the level of income convergence across the scenarios by the means of Lorenz curves (or Gini coefficients). Finally, the section concludes by comparing the results from this downscaling exercise with the ones from an earlier attempt (Gaffin et al., 2004).

Figure 5 shows the development of national income (GDP per capita) from 1990 to 2100 for each of the downscaled scenarios. The different colors indicate countries belonging to each of the four SRES regions. It is apparent from the illustration that income disparities across countries are reduced over time in all three scenarios, however, at different pace as well as significantly different levels of absolute income. This is particularly illustrated by the large variation of the lower-bound estimates across the scenarios, where countries with the lowest income differ by two orders of magnitude, between a few hundred US$ (A2) to more than 10000 US$ (B1) by 2100. Long-term income differences between today's affluent countries are seen to be much less pronounced. The maximum income across the scenarios ranges between 81000 (A2) and 87000 US1990$ per capita (B1) by 2100.

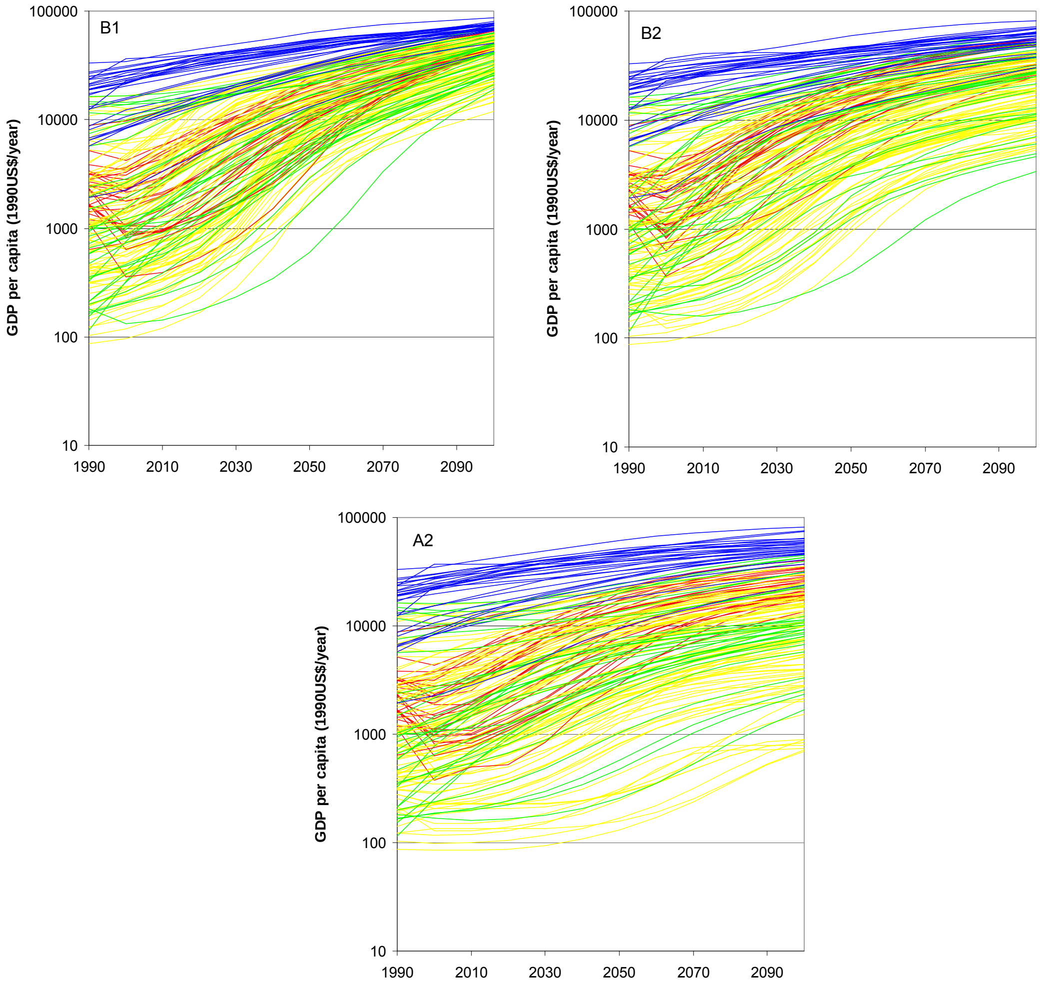

Figure 5: National development of GDP per capita over time. Colored lines denote individual countries in the OECD region (blue), REF region (red), ASIA region (green), and the ALM region (yellow).

The implications for the scenario's income disparities, measured as the income ratio between "poor" and "rich" or Kuznets ratios (after Kuznets 1956), is summarized in Table 4. Clearly, the spatial scale at which income ratios are measured has an important bearing on the numerical results. Generally, higher degree of spatial resolution results in increasing heterogeneity and, hence, also larger numerical results for income ratios. This is also illustrated by the cross-sectional comparisons for the year 1990 given in Table 4, where income ratios differ between 33 and 380 when measured at the level of four SRES regions versus national scale.

More importantly for our analysis, the higher level of disaggregation has also an important implication for longitudinal comparisons over time. While the scenarios depict a closure of the income gap between 1990 and 2100 by a factor of 15.7 (B1) to

4.5 (A2) on the level of four SRES regions, the results on the level of 185 countries suggest an income gap reduction by a factor of 54.3 (B1) to 3.2 (A2). The results clearly indicate the non-linearity of moving from one level of spatial aggregation to the next. By the same token, the results illustrate major implications of the downscaling methodology for e.g., vulnerability assessments, where place specific information (on national and sub-national scales) is essential in understanding the potential magnitude of climate-related impacts.

Table 4: Income ratio between "rich" and "poor" measured at alternative levels of spatial scale – Scenarios B1, B2, and A2.

North to south (2 regions)	1990	2050	2100	Reduction in income gap 1990-2100
B1	*15*	*3.4*	*1.7*	*8.8*
B2	*15*	*4.3*	*3.2*	*4.7*
A2	*15*	*6.2*	*5.3*	*2.8*
4 SRES regions				
B1	*33*	*4.8*	*2.1*	*15.7*
B2	*33*	*5.6*	*3.7*	*8.9*
A2	*33*	*8.4*	*7.3*	*4.5*
11 regions				
B1	*70*	*10.0*	*3.1*	*22.6*
B2	*70*	*14.7*	*6.7*	*10.4*
A2	*70*	*36.0*	*26.4*	*2.7*
185 Countries				
B1	*380*	*105*	*7*	*54.3*
B2	*380*	*148*	*24*	*15.8*
A2	*380*	*470*	*117*	*3.2*

The Kuznets ratios discussed above give useful information about income ranges across countries versus regions, but provide just limited insight concerning inequality in the sense of how the income is distributed across the population, and in particular how this distribution might change over time. For illustrating the income distribution of the scenarios and the relationship between population and shares of income, we use Lorenz curves as shown in Figure 6. We use the downscaled country data to draw the figure, where the cumulative percentage of population is shown on the horizontal axis, and the cumulative share of income received is plotted on the vertical axis. The diagonal line represents strict equality, with inequality reflected by the amount by which the Lorenz curve deviates from it. We also calculate the scenario's Gini coefficient, which is widely used to capture the degree of inequality by a single number. The Gini coefficient can be derived from the Lorentz curve, i.e., if all countries have the same per-capita income and the Lorentz curve coincides with the diagonal, then the Gini coefficient takes the value 0. The more uneven the income distribution, the larger the Gini coefficient in the interval 0 to 1. Hence, a Gini coefficient of 1 depicts the hypothetical case of absolute inequality.

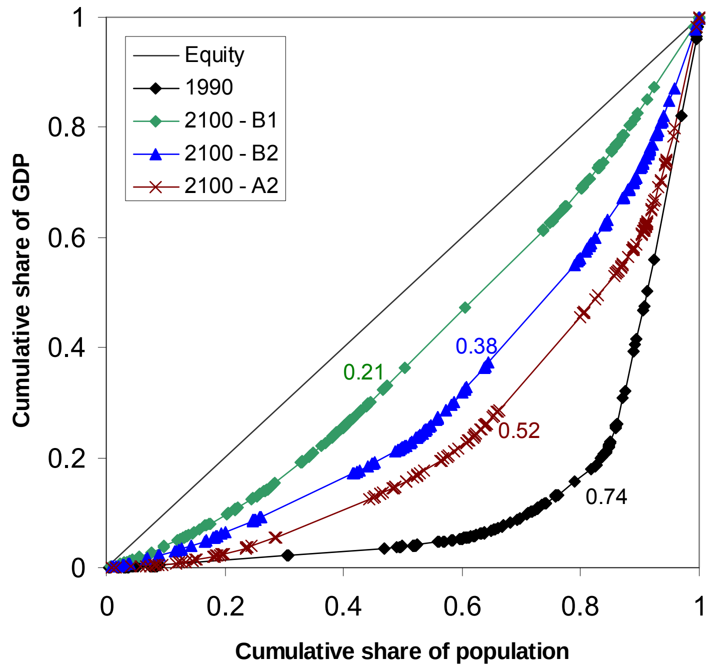

Figure 6: Lorenz curves and Gini coefficients for the year 1990 and the B1, A2, and B2 scenario by 2100 (based on 185 countries).

Figure 6 illustrates the reduction in inequality across all three scenarios compared to 1990. Consistent with the scenario storylines of rapid convergence the Gini coefficient is reduced most in the B1 scenario to about 0.2 by 2100, compared to 0.74 in 1990. By the same token, inequality remains largest in A2, depicting a Gini coefficient of about 0.5 in 2100.

The Lorenz curves give a more detailed account of the income distribution. The curve for 1990 shows that the 80% of the population in the world's poorest countries have access to just about 20% of total incomes. The situation improves over the course of the century in all scenarios. As shown by the colored lines in Figure 6, the 80% poorest have access to more than 40% of total income by 2100 in A2, 50% in B2 and almost 70% in B1 respectively.

Neither Kuznetz ratios nor comprehensive measurements of distribution, such as Gini, give sufficient information about how countries have changed position in the per-capita income ranking over time. In fact, the scenarios differ considerably concerning rank shifts, particularly in the middle income group. The changes in ranking of individual countries by 2100 compared to 1990 are illustrated in Figures 7a-c. The diagonal of the figures depict the hypothetical case where no rank changes did occur. Countries lying above the diagonal have gained in rank, and vice versa those below the diagonal have lost in rank.

Changes in ranking of countries are most pronounced in B1 as opposed to A2, depicting just small variations compared to 1990 and, hence, a preservation of the status quo. This result doesn't come as a surprise as B1 is characterized by rapid economic convergence, leading in the long term to the smallest per capita income differences across countries. And as expected, at smaller per capita income differences the probability that an individual country might overtake other countries increases. We emphasize that our downscaling approach is not intended to provide a rational for the ranking of individual countries, but they illustrate as a rule of thumb an interesting pattern that increasing strength of convergence correlates with more pronounced shifts in the ranking of countries.

Next we shall compare our downscaling at the national level with the results from an earlier SRES-based downscaling (Gaffin et al., 2004).

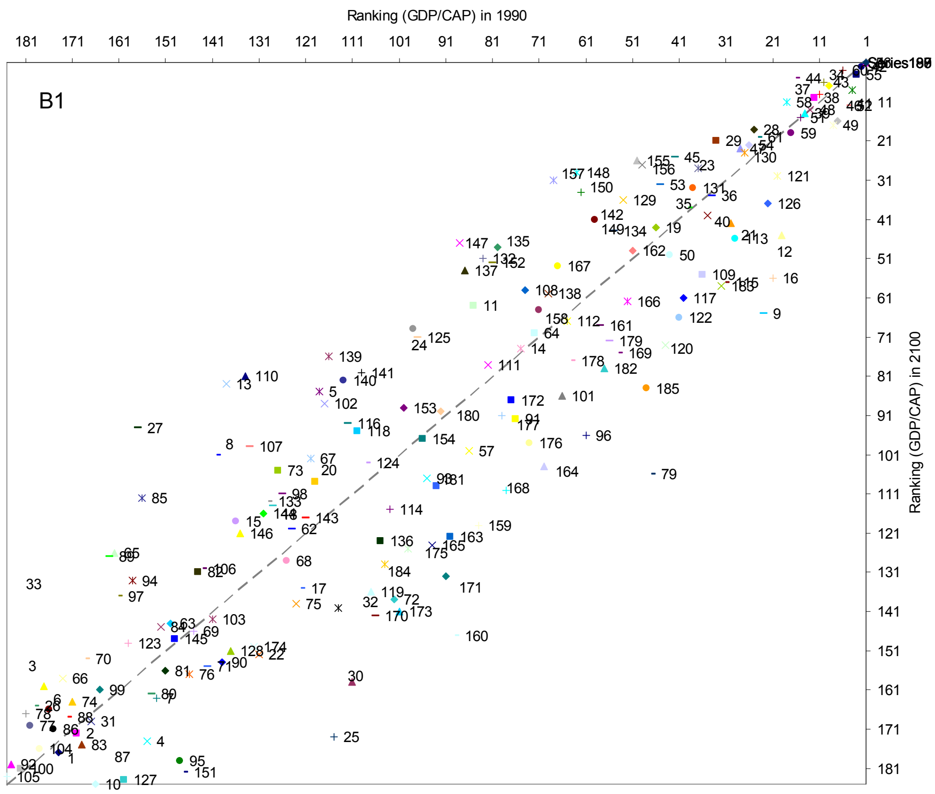

Figure 7a: Relative ranking of GDP per capita in 1990 versus 2100 for the B1 scenario. Numbers represent individual countries (see Appendix 1).

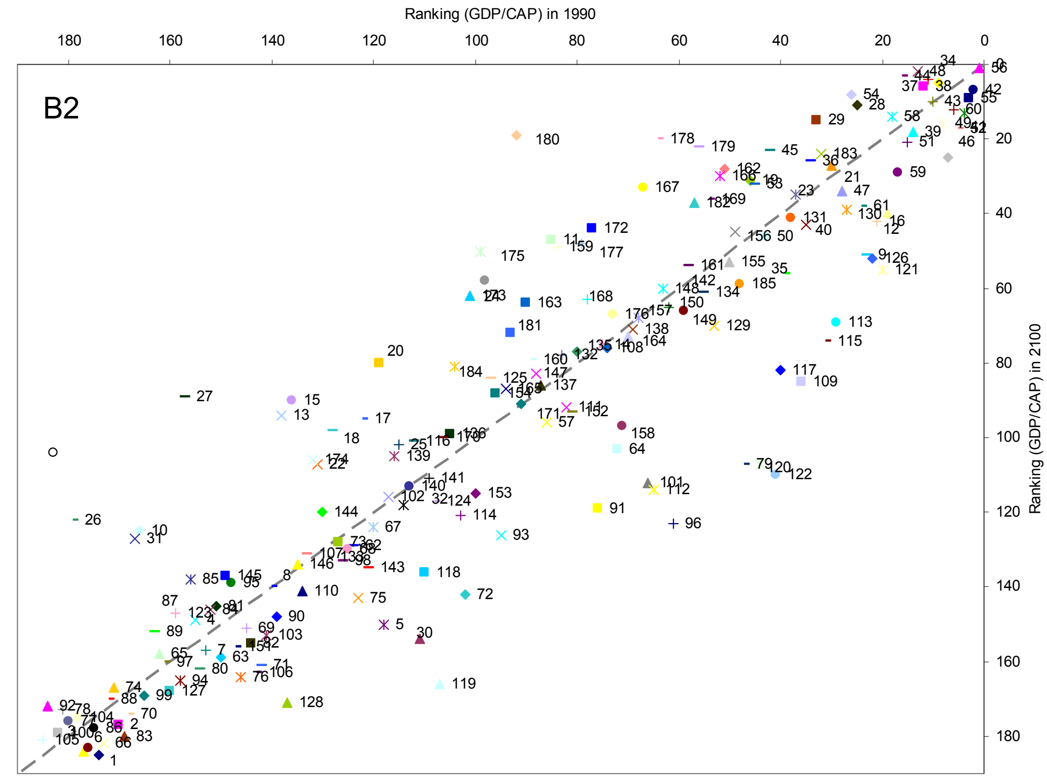

Figure 7b: Relative ranking of GDP per capita in 1990 versus 2100 for the B2 scenario. Numbers represent individual countries (see Appendix 1).

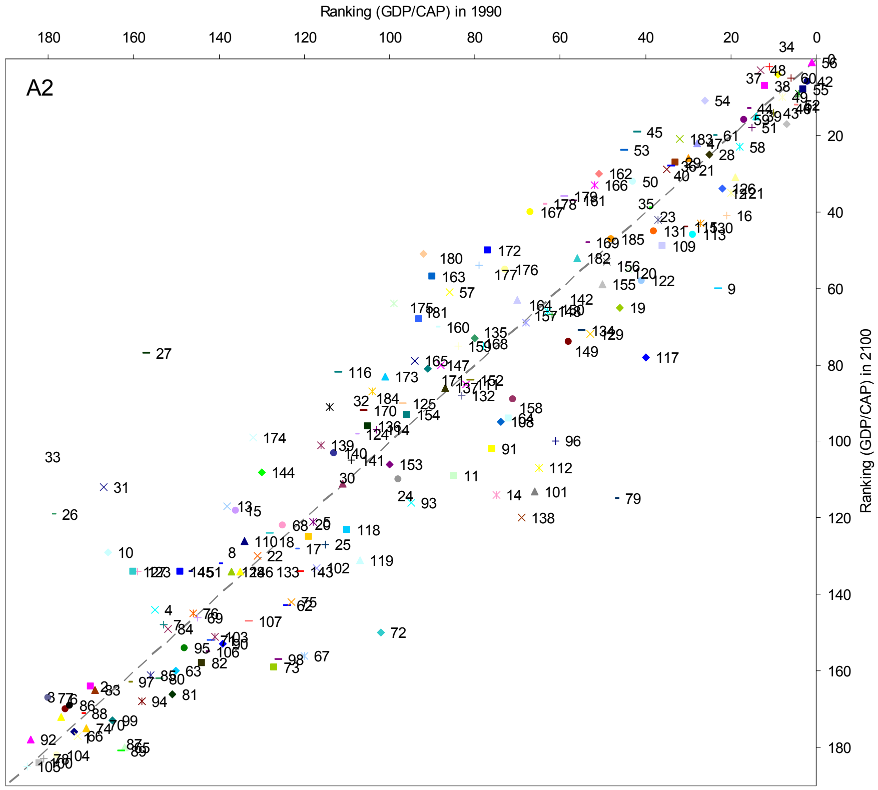

Figure 7c: Relative ranking of GDP per capita in 1990 versus 2100 for the A2 scenario. Numbers represent individual countries (see Appendix 1).

Comparison to Gaffin et al., 2004:

It is important to recall the principal methodological differences between the two downscaling approaches to understand the deviations in results for national GDP. While Gaffin et al. have employed linear downscaling of GDP, or in other words they used uniform growth rates for countries within a region; our downscaling approach uses the development path of the region at a functional scale as a proxy for obtaining the growth paths of individual countries. Clearly, our approach is more elaborate. However, more importantly, it encompasses a number of essential improvements compared to Gaffin et al., in particular concerning internal plausibility and scenario consistency of the national projections. These comprise mainly:

1) *Explicit account for differences between countries at alternative stages of economic development.*
2) *Internal consistency of national GDP and population projections.*
3) *Scenario-dependency of the national economic pathway as well as scenario-consistency of income convergence across countries.*

The difference in methodology is also mirrored by the results for national GDP, summarized in Figure 8. The figure illustrates the cumulative frequency of the deviation between the two studies in all three scenarios. We measure the deviation as the ratio between our GDP estimates and Gaffin et al. for the years 2020, 2050 and 2100. A GDP ratio of 1 denotes identical GDP in both studies.

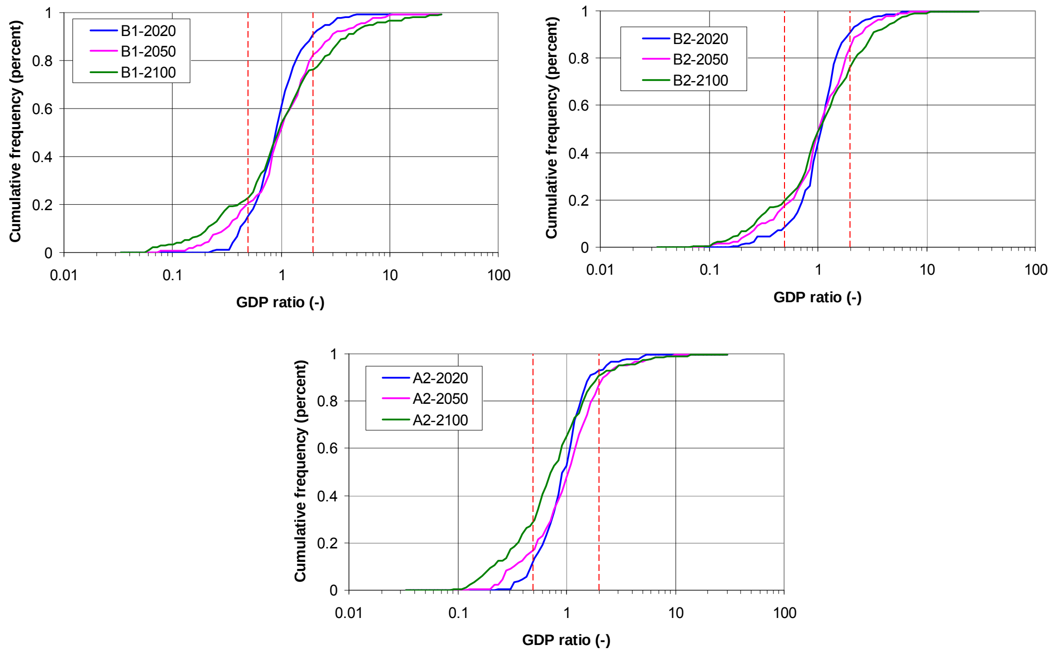

Figure 8: Cumulative frequency distribution of the deviation between national GDP in our downscaling and Gaffin et al., 2004. The deviation is measured as the ratio between our GDP estimates and Gaffin et al. for 182 countries (for the years 2020, 2050, 2100). Each panel illustrates results for a single scenario (B1, B2, and A2).

As illustrated by the frequency distributions of Figure 8, there are significant differences between the GDP projections of the two studies. Note in particular the logarithmic X-axis, which results in a compression of the distribution compared to a linear scale. Observations between the two dashed vertical lines (red) represent countries that deviate less than a factor of two between the two studies. The difference between the two studies increases over time, i.e., while roughly 80 percent of all countries lie within the interval by 2020, more than half of all countries show a difference of more than a factor of two at the end of the century. Some of the difference in the outcomes in the A2 scenario might be due to the revised assumptions on the regional level. But since all three scenarios show the same systematic deviations, we conclude that the differences in outcomes are mainly driven by the alternative methodologies.

This finding is also confirmed by our analysis of the deviation for individual countries. For example, the difference to Gaffin et al. is smallest in those countries where initial GDP per capita in the base year is closest to the regional average. For these countries, the GDP growth rates obtained from linear downscaling are similar to those estimated by our functional relationship. This concerns mainly large countries, which dominate within a specific region because of their size. For example, the total GDP in the two studies for China, India, as well as the United States differ by less than 30 percent across all scenarios by 2100. [7]

By the same token, the linear downscaling leads to significant overestimation of GDP in countries with relatively high per capita income compared to the regional average. E.g., GDP in Reunion, South Africa, and Hong-Kong are seen to be higher in Gaffin et al. by at least a factor of 8 by 2100 (across all scenarios). The systematical upward bias for these countries is also reflected by their per capita incomes, which exceed by far the maximum income across all of our scenarios (87,000 US$). A comparison of per capita income of most problematic countries from Gaffin et al. with the range across the scenarios obtained from our downscaling exercise (IIASA) is given in Table 5. The table focuses on countries that exceed a threshold of 300,000 US$ by 2100 in the Gaffin et al. study, corresponding to an overestimation of a factor of more than three compared to the maximum estimate of per capita GDP in our scenarios.

Table 5: Comparison of GDP per capita (1000 US$) for the year 2100. Selected countries of Gaffin et al. (2004) and the full range across scenarios given by our downscaling approach.

Country	Gaffin et al., 2004		IIASA
	Sceanrio	GDP/CAP	GDP/CAP range (A2, B2, B1)
Botswana	B1	314	15 - 50
Brunei Darussalam	B1	319	24 - 50
Cyprus	B1	335	41 - 66
Gabon	B1	370	11 - 25
China Hong Kong SAR	B1, B2	1075 - 1297	45 - 69
Libyan Arab Jamahiriya	B1	406	19 - 50
China Macao SAR	B1	853	42 - 67
New Caledonia	B2	324	32 - 48
Qatar	B1	364	35 - 63
Réunion	B1, B2	344 - 515	13 - 46
Singapore	B2	331	43 - 59
South Africa	B1	364	11 - 49

5 Conclusions

This report presented national scenarios of economic activity (GDP) for the time period 1990 to 2100 based on three scenarios (A2, B1, and B2) from the IPCC Special Report on Emissions Scenarios (SRES; Nakicenovic et al., 2000). The motivation for the GDP downscaling described here was twofold: first, to provide a break-down of the regional economic projections of SRES to enhance the applicability of the scenarios for national studies and policy making, and secondly to provide the required input for the further downscaling of the scenario's economic projections to grid-cell level (Grübler et al.,

[7] Note that for the comparison of China, we have corrected for the difference in assumptions on the regional level. Also without this correction the deviation to Gaffin et al. is only a factor of 1.6 (i.e., within the range given by the red lines in Figure 8).

2005b), encompassing central information for spatially explicit climate mitigation, vulnerability and impact assessments.

Our downscaling methodology takes into account the heterogeneity of countries due to alternative stages of economic development and structure, as well as persistent disparities concerning their potentials for productivity and economic growth. This also improves scenario plausibility in terms that per capita income levels of individual developing countries do not exceed those of industrialized countries (e.g., the USA), which is the inevitable result of uniform, "proportional" downscaling methods.

Another important feature of our downscaling approach is the scenario dependency, reflecting an attempt to tailor algorithms as well as assumptions in such a way as to best reflect our interpretation of the main features of the original SRES scenario storylines, e.g., in terms of conditional convergence/divergence of national per capita income. Hence, our results show pronounced differences for the national economic development path and income distribution of countries across the three scenarios examined.

Finally, we emphasize that national projections based on the SRES storylines are subject to uncertainty. Our approach and the parameterization that we use is one possible way of obtaining internally consistent national projections. Selecting alternative convergence assumptions, different optimization criteria for matching the residual, alternative mathematical formulation to mimic the regional growth pattern, etc., would lead to changes in the country projections. Thus further systematic sensitivity analysis is necessary in order to better understand plausible ranges for national GDP conditional on the regional trends and storylines given by SRES.

References

Barro, R. J., 1996. Determinants of Economic Growth: A Cross-Country Empirical study, Working Paper No. W5698 for the National Bureau of Economic Research, Cambridge, UK.

Gaffin, S.R., C.R. Rosenzweig, X. Xing, and G. Yetman. 2004. Downscaling and Geo-spatial Gridding of Socio-Economic Projections from the IPCC Special Report on Emissions Scenarios (SRES). *Global Environmental Change*, **14**(2), 105-23.

Grübler, A., Chirkov, V., and Slentoe, E, 2005a. Spatially Explicit Scenarios of Demographic and Economic Change based on SRES. IR-05-064, International Institute for Applied Systems Analysis, Laxenburg, Austria (in prep.).

Grübler, A., Chirkov, V., Goujon, A., Kolp, P., O'Neill, B., Prommer, I., Riahi, K., Scherbov, S., and Slentoe, E, 2005b. Regional, national, and spatially explicit scenarios of demographic and economic change based on SRES. IR-05-001, International Institute for Applied Systems Analysis, Laxenburg, Austria (in prep.).

Heston, A., R. Summers and B. Aten, 2002. Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002. Available at http://pwt.econ.upenn.edu/php_site/pwt_index.php

O'Neill, B., Goujon, A., Prommer, I., Scherbov, S., 2005. Downscaling of SRES population scenarios from regional to national level. IR-05-062, International Institute for Applied Systems Analysis, Laxenburg, Austria (in prep.).

Kuznets, S., 1956. 'Quantitative Aspects of the Economic Growth of Nations. I. Levels and Variability of Rates of Growth', *Economic Development and Cultural Change*, **5**, 1-94.

Lutz, W., W. Sanderson, et al., 2001. 'The end of world population growth', *Nature,* **412**, 543-545.

Nakicenovic, N., J. Alcamo, G. Davis, B. de Vries, J. Fenhann, S. Gaffin, K. Gregory, A. Grübler et al., 2000. Special Report on Emissions Scenarios. Working Group III, Intergovernmental Panel on Climate Change (IPCC), Cambridge University Press, Cambridge. See also http://www.grida.no/climate/ipcc/emission/index.htm.

United Nations, 2004. World Population to 2300. Publication ST/ESA/SER.A/236. United Nations, New York, NY, USA.

Rostow, W.W., 1980. Why the Poor Get Richer and the Rich Slow Down, Macmillan Press, London, UK.

van Vuuren, D. and O'Neill, B.C. The consistency of IPCC's SRES scenarios to 1990-2000 trends and recent projections. *Climatic Change*, in press.

World Bank (WB), 2003. World Development Indicators 2003, World Bank Publications, Washington DC, USA.

Appendix 1: Definition of regions and countries

Table 1: Country codes and regions.

Country	Country Code	11 Regions	4 Regions
Afghanistan	1	SAS	ASIA
Bangladesh	2	SAS	ASIA
Bhutan	3	SAS	ASIA
India	4	SAS	ASIA
Maldives	5	SAS	ASIA
Nepal	6	SAS	ASIA
Pakistan	7	SAS	ASIA
Sri Lanka	8	SAS	ASIA
Brunei Darussalam	9	PAS	ASIA
East Timor	10	PAS	ASIA
Fiji	11	PAS	ASIA
French Polynesia	12	PAS	ASIA
Indonesia	13	PAS	ASIA
Malaysia	14	PAS	ASIA
Myanmar	15	PAS	ASIA
New Caledonia	16	PAS	ASIA
Papua New Guinea	17	PAS	ASIA
Philippines	18	PAS	ASIA
Republic of Korea	19	PAS	ASIA
Samoa	20	PAS	ASIA
Singapore	21	PAS	ASIA
Solomon Islands	22	PAS	ASIA
Taiwan, China	23	PAS	ASIA
Thailand	24	PAS	ASIA
Vanuatu	25	PAS	ASIA
Cambodia	26	CPA	ASIA
China	27	CPA	ASIA
China Hong Kong SAR	28	CPA	ASIA
China Macao SAR	29	CPA	ASIA
Democratic People's Republic of Korea	30	CPA	ASIA
Lao People's Democratic Republic	31	CPA	ASIA
Mongolia	32	CPA	ASIA
Viet Nam	33	CPA	ASIA
Canada	34	NAM	OECD
Guam	35	NAM	OECD
Puerto Rico	36	NAM	OECD
United States of America	37	NAM	OECD
Austria	38	WEU	OECD
Belgium	39	WEU	OECD
Cyprus	40	WEU	OECD
Denmark	41	WEU	OECD
Finland	42	WEU	OECD
France	43	WEU	OECD
Germany	44	WEU	OECD
Greece	45	WEU	OECD
Iceland	46	WEU	OECD
Ireland	47	WEU	OECD
Italy	48	WEU	OECD
Luxembourg	49	WEU	OECD
Malta	50	WEU	OECD

Netherlands	51	WEU	OECD
Norway	52	WEU	OECD
Portugal	53	WEU	OECD
Spain	54	WEU	OECD
Sweden	55	WEU	OECD
Switzerland	56	WEU	OECD
Turkey	57	WEU	OECD
United Kingdom	58	WEU	OECD
Australia	59	PAO	OECD
Japan	60	PAO	OECD
New Zealand	61	PAO	OECD
Burundi	62	AFR	ALM
Cameroon	63	AFR	ALM
Cape Verde	64	AFR	ALM
Central African Republic	65	AFR	ALM
Chad	66	AFR	ALM
Comoros	67	AFR	ALM
Congo	68	AFR	ALM
Côte d'Ivoire	69	AFR	ALM
Democratic Republic of the Congo	70	AFR	ALM
Djibouti	71	AFR	ALM
Equatorial Guinea	72	AFR	ALM
Eritrea	73	AFR	ALM
Ethiopia	74	AFR	ALM
Gabon	75	AFR	ALM
Gambia	76	AFR	ALM
Ghana	77	AFR	ALM
Guinea	78	AFR	ALM
Guinea-Bissau	79	AFR	ALM
Kenya	80	AFR	ALM
Lesotho	81	AFR	ALM
Liberia	82	AFR	ALM
Madagascar	83	AFR	ALM
Malawi	84	AFR	ALM
Mali	85	AFR	ALM
Mauritania	86	AFR	ALM
Mauritius	87	AFR	ALM
Mozambique	88	AFR	ALM
Namibia	89	AFR	ALM
Niger	90	AFR	ALM
Nigeria	91	AFR	ALM
Réunion	92	AFR	ALM
Rwanda	93	AFR	ALM
Senegal	94	AFR	ALM
Sierra Leone	95	AFR	ALM
Somalia	96	AFR	ALM
South Africa	97	AFR	ALM
Swaziland	98	AFR	ALM
Togo	99	AFR	ALM
Uganda	100	AFR	ALM
United Republic of Tanzania	101	AFR	ALM
Zambia	102	AFR	ALM
Zimbabwe	103	AFR	ALM
Angola	104	AFR	ALM
Benin	105	AFR	ALM
Botswana	106	AFR	ALM
Burkina Faso	107	AFR	ALM
Algeria	108	MEA	ALM

Bahrain	109	MEA	ALM
Egypt	110	MEA	ALM
Iran (Islamic Republic of)	111	MEA	ALM
Iraq	112	MEA	ALM
Israel	113	MEA	ALM
Jordan	114	MEA	ALM
Kuwait	115	MEA	ALM
Lebanon	116	MEA	ALM
Libyan Arab Jamahiriya	117	MEA	ALM
Morocco	118	MEA	ALM
Occupied Palestinian Territory	119	MEA	ALM
Oman	120	MEA	ALM
Qatar	121	MEA	ALM
Saudi Arabia	122	MEA	ALM
Sudan	123	MEA	ALM
Syrian Arab Republic	124	MEA	ALM
Tunisia	125	MEA	ALM
United Arab Emirates	126	MEA	ALM
Western Sahara	127	MEA	ALM
Yemen	128	MEA	ALM
Argentina	129	LAM	ALM
Bahamas	130	LAM	ALM
Barbados	131	LAM	ALM
Belize	132	LAM	ALM
Bolivia	133	LAM	ALM
Brazil	134	LAM	ALM
Chile	135	LAM	ALM
Colombia	136	LAM	ALM
Costa Rica	137	LAM	ALM
Cuba	138	LAM	ALM
Dominican Republic	139	LAM	ALM
Ecuador	140	LAM	ALM
El Salvador	141	LAM	ALM
Guadeloupe	142	LAM	ALM
Guatemala	143	LAM	ALM
Guyana	144	LAM	ALM
Haiti	145	LAM	ALM
Honduras	146	LAM	ALM
Jamaica	147	LAM	ALM
Martinique	148	LAM	ALM
Mexico	149	LAM	ALM
Netherlands Antilles	150	LAM	ALM
Nicaragua	151	LAM	ALM
Panama	152	LAM	ALM
Paraguay	153	LAM	ALM
Peru	154	LAM	ALM
Suriname	155	LAM	ALM
Trinidad and Tobago	156	LAM	ALM
Uruguay	157	LAM	ALM
Venezuela	158	LAM	ALM
Armenia	159	FSU	REF
Azerbaijan	160	FSU	REF
Belarus	161	FSU	REF
Estonia	162	FSU	REF
Georgia	163	FSU	REF
Kazakhstan	164	FSU	REF
Kyrgyzstan	165	FSU	REF
Latvia	166	FSU	REF

Lithuania	167	FSU	REF
Republic of Moldova	168	FSU	REF
Russian Federation	169	FSU	REF
Tajikistan	170	FSU	REF
Turkmenistan	171	FSU	REF
Ukraine	172	FSU	REF
Uzbekistan	173	FSU	REF
Albania	174	EEU	REF
Bosnia and Herzegovina	175	EEU	REF
Bulgaria	176	EEU	REF
Croatia	177	EEU	REF
Czech Republic	178	EEU	REF
Hungary	179	EEU	REF
Poland	180	EEU	REF
Romania	181	EEU	REF
Slovakia	182	EEU	REF
Slovenia	183	EEU	REF
TFYR Macedonia	184	EEU	REF
Yugoslavia	185	EEU	REF

Appendix 2: Regional GDP and population projections (scenarios B1, B2, and A2)

Table 1: Scenario B1 - GDP at MER [million US$1990].

Region	1990	2020	2050	2100
AFR	266	871	9089	32625
CPA	477	4321	19467	40393
EEU	290	724	1765	4674
FSU	785	1013	4430	13470
LAM	1083	6109	17238	30595
MEA	596	2210	12448	33338
NAM	6063	13092	21621	39892
PAO	3280	5747	7923	10419
PAS	758	2860	10722	24303
SAS	372	1646	10605	66677
WEU	7006	13547	20336	31963

Table 2: Scenario B2 - GDP at MER [million US$1990].

Region	1990	2020	2050	2100
AFR	266	734	5102	23783
CPA	477	5932	18815	47417
EEU	290	599	1802	4003
FSU	785	1080	4056	8939
LAM	1083	3253	11429	26511
MEA	596	1611	6647	16343
NAM	6063	12539	17269	27759
PAO	3280	4772	5697	8140
PAS	758	4627	11276	23025
SAS	372	1824	9886	26415
WEU	7006	12430	17377	25987

Table 3: Scenario A2 - GDP at MER [million US$1990].

Region	1990	2020	2050	2100
AFR	266	610	2433	7624
CPA	477	3978	18797	35452
EEU	290	670	1462	2839
FSU	785	968	4083	7977
LAM	1083	2933	8841	19649
MEA	596	2019	6462	14094
NAM	6063	13130	21544	37992
PAO	3280	5531	7548	10008
PAS	758	2293	5479	9802
SAS	372	1424	5691	17634
WEU	7006	12212	17785	26154

Appendix 3: National GDP and population projections (scenarios B1, B2, and A2)

Table 1: Scenario B1 - GDP at MER [million US$1990].

Country	1990	2020	2050	2100
AFR - Angola	8	22	455	1670
AFR - Benin	2	8	123	351
AFR - Botswana	3	12	24	37
AFR - Burkina Faso	3	15	404	1424
AFR - Burundi	1	7	120	434
AFR - Cameroon	11	23	316	768
AFR - Cape Verde	0	2	8	17
AFR - Central African Republic	1	6	49	124
AFR - Chad	1	7	169	646
AFR - Comoros	0	2	12	33
AFR - Congo	3	10	88	257
AFR - Côte d'Ivoire	10	21	333	879
AFR - Democratic Republic of the Congo	8	53	814	2920
AFR - Djibouti	0	3	12	30
AFR - Equatorial Guinea	0	1	8	21
AFR - Eritrea	0	3	49	174
AFR - Ethiopia	6	35	841	3279
AFR - Gabon	5	13	30	61
AFR - Gambia	0	2	17	48
AFR - Ghana	6	30	266	718
AFR - Guinea	3	9	181	490
AFR - Guinea-Bissau	0	2	18	70
AFR - Kenya	9	39	328	780
AFR - Lesotho	1	3	14	26
AFR - Liberia	0	3	42	160
AFR - Madagascar	3	13	164	751
AFR - Malawi	2	17	122	378
AFR - Mali	3	16	436	1586
AFR - Mauritania	1	5	51	151
AFR - Mauritius	3	9	22	38
AFR - Mozambique	1	6	88	366
AFR - Namibia	2	10	30	61
AFR - Niger	3	17	474	1998
AFR - Nigeria	35	107	925	5577
AFR - Réunion	2	7	15	27
AFR - Rwanda	2	8	146	395
AFR - Senegal	6	14	253	655
AFR - Sierra Leone	1	4	61	193
AFR - Somalia	1	5	100	565
AFR - South Africa	102	233	584	1021
AFR - Swaziland	1	5	14	24
AFR - Togo	2	7	79	206
AFR - Uganda	3	20	368	1685
AFR - United Republic of Tanzania	2	9	133	803
AFR - Zambia	4	12	162	423
AFR - Zimbabwe	7	16	147	303
CPA - Cambodia	1	24	151	697
CPA - China	370	3887	17813	35650
CPA - China Hong Kong SAR	71	150	258	381
CPA - China Macao SAR	3	8	14	21

CPA - Democratic People's Republic of Korea	21	63	144	341
CPA - Lao People's Democratic Republic	1	10	56	237
CPA - Mongolia	2	8	29	75
CPA - Viet Nam	7	171	1002	2990
EEU - Albania	2	5	25	129
EEU - Bosnia and Herzegovina	6	13	43	120
EEU - Bulgaria	22	37	83	188
EEU - Croatia	10	21	60	163
EEU - Czech Republic	29	82	188	453
EEU - Hungary	33	84	178	408
EEU - Poland	62	246	609	1687
EEU - Romania	38	73	240	744
EEU - Slovakia	16	42	103	257
EEU - Slovenia	17	29	47	84
EEU - TFYR Macedonia	2	5	24	91
EEU - Yugoslavia	53	87	165	350
FSU - Armenia	7	9	27	70
FSU - Azerbaijan	12	13	61	532
FSU - Belarus	32	53	157	386
FSU - Estonia	6	8	19	38
FSU - Georgia	9	6	21	127
FSU - Kazakhstan	42	55	234	763
FSU - Kyrgyzstan	7	11	93	403
FSU - Latvia	9	11	33	77
FSU - Lithuania	10	17	69	191
FSU - Republic of Moldova	10	6	24	132
FSU - Russian Federation	480	653	2636	6344
FSU - Tajikistan	6	5	45	540
FSU - Turkmenistan	6	11	96	434
FSU - Ukraine	121	89	384	1345
FSU - Uzbekistan	28	67	530	2087
LAM - Argentina	106	668	1590	2581
LAM - Bahamas	3	8	13	18
LAM - Barbados	2	5	8	12
LAM - Belize	0	3	10	20
LAM - Bolivia	4	35	194	564
LAM - Brazil	474	2205	6273	10058
LAM - Chile	28	261	638	1027
LAM - Colombia	40	213	712	1594
LAM - Costa Rica	6	40	159	295
LAM - Cuba	27	85	220	349
LAM - Dominican Republic	7	67	211	479
LAM - Ecuador	11	94	304	707
LAM - El Salvador	5	53	168	403
LAM - Guadeloupe	1	6	14	21
LAM - Guatemala	8	67	309	874
LAM - Guyana	0	2	5	11
LAM - Haiti	3	10	94	385
LAM - Honduras	3	18	136	433
LAM - Jamaica	4	28	97	169
LAM - Martinique	1	6	13	19
LAM - Mexico	241	1584	4035	6323
LAM - Netherlands Antilles	1	3	8	11
LAM - Nicaragua	2	4	27	267
LAM - Panama	5	33	127	241
LAM - Paraguay	6	56	187	496
LAM - Peru	33	191	574	1284
LAM - Suriname	2	7	14	20

LAM - Trinidad and Tobago	5	21	39	56
LAM - Uruguay	8	54	126	197
LAM - Venezuela	49	282	932	1685
MEA - Algeria	60	199	1289	2661
MEA - Bahrain	4	14	34	65
MEA - Egypt	35	240	2474	7300
MEA - Iran (Islamic Republic of)	119	493	1933	4208
MEA - Iraq	49	186	1335	3063
MEA - Israel	55	138	300	552
MEA - Jordan	4	28	129	409
MEA - Kuwait	24	52	130	256
MEA - Lebanon	3	20	74	210
MEA - Libyan Arab Jamahiriya	29	75	249	522
MEA - Morocco	26	125	776	2322
MEA - Occupied Palestinian Territory	2	20	111	429
MEA - Oman	11	42	147	355
MEA - Qatar	7	16	30	51
MEA - Saudi Arabia	101	271	1284	2892
MEA - Sudan	8	43	548	2335
MEA - Syrian Arab Republic	14	76	465	1431
MEA - Tunisia	13	51	292	633
MEA - United Arab Emirates	28	63	135	227
MEA - Western Sahara	0	0	1	18
MEA - Yemen	7	58	712	3398
NAM - Canada	567	1122	1882	3280
NAM - Guam	1	3	6	15
NAM - Puerto Rico	31	66	103	165
NAM - United States of America	5465	11902	19630	36433
PAO - Australia	295	643	1121	1914
PAO - Japan	2940	5000	6619	8220
PAO - New Zealand	44	104	183	286
PAS - Brunei Darussalam	4	8	15	29
PAS - East Timor	0	1	7	32
PAS - Fiji	1	6	16	30
PAS - French Polynesia	3	6	9	15
PAS - Indonesia	107	741	3750	9968
PAS - Malaysia	43	186	680	1356
PAS - Myanmar	24	145	675	1997
PAS - New Caledonia	3	5	8	15
PAS - Papua New Guinea	3	20	90	316
PAS - Philippines	44	313	1590	4315
PAS - Republic of Korea	244	674	1469	2221
PAS - Samoa	0	1	3	9
PAS - Singapore	35	72	130	205
PAS - Solomon Islands	0	1	6	27
PAS - Taiwan - China[MEDS data]	165	352	615	939
PAS - Thailand	82	328	1657	2820
PAS - Vanuatu	0	1	3	11
SAS - Afghanistan	3	7	42	1366
SAS - Bangladesh	22	126	1060	5002
SAS - Bhutan	0	1	9	102
SAS - India	296	1288	7727	46209
SAS - Maldives	0	1	3	25
SAS - Nepal	3	14	136	1117
SAS - Pakistan	40	184	1487	12284
SAS - Sri Lanka	8	26	141	572
WEU - Austria	158	270	386	543
WEU - Belgium	192	339	499	758

WEU - Cyprus	5	14	26	46
WEU - Denmark	129	200	276	387
WEU - Finland	138	212	286	390
WEU - France	1192	2371	3432	4985
WEU - Germany	1496	3022	4432	6735
WEU - Greece	66	178	337	595
WEU - Iceland	6	10	14	20
WEU - Ireland	43	130	206	329
WEU - Italy	1095	1794	2265	2943
WEU - Luxembourg	9	22	35	60
WEU - Malta	2	6	11	22
WEU - Netherlands	284	525	789	1207
WEU - Norway	106	170	243	357
WEU - Portugal	57	156	300	558
WEU - Spain	491	936	1461	2150
WEU - Sweden	228	359	489	675
WEU - Switzerland	226	316	403	487
WEU - Turkey	108	404	1184	3297
WEU - United Kingdom	974	2114	3260	5419

Table 2: Scenario B2 - GDP at MER [million US$1990].

Country	1990	2020	2050	2100
AFR - Angola	8	23	245	1309
AFR - Benin	2	8	58	233
AFR - Botswana	3	10	19	40
AFR - Burkina Faso	3	12	155	809
AFR - Burundi	1	3	21	173
AFR - Cameroon	11	25	176	692
AFR - Cape Verde	0	2	6	17
AFR - Central African Republic	1	6	29	98
AFR - Chad	1	6	55	282
AFR - Comoros	0	2	8	27
AFR - Congo	3	5	40	218
AFR - Côte d'Ivoire	10	20	147	582
AFR - Democratic Republic of the Congo	8	34	413	2143
AFR - Djibouti	0	1	6	25
AFR - Equatorial Guinea	0	1	5	17
AFR - Eritrea	0	2	17	95
AFR - Ethiopia	6	26	268	1813
AFR - Gabon	5	12	28	81
AFR - Gambia	0	2	11	41
AFR - Ghana	6	18	163	625
AFR - Guinea	3	9	74	303
AFR - Guinea-Bissau	0	1	9	46
AFR - Kenya	9	35	202	646
AFR - Lesotho	1	3	10	27
AFR - Liberia	0	2	16	93
AFR - Madagascar	3	13	185	898
AFR - Malawi	2	8	67	301
AFR - Mali	3	12	170	912
AFR - Mauritania	1	5	29	133
AFR - Mauritius	3	7	14	33
AFR - Mozambique	1	5	47	301
AFR - Namibia	2	8	23	64
AFR - Niger	3	13	190	1170
AFR - Nigeria	35	109	1072	4749
AFR - Réunion	2	5	10	23
AFR - Rwanda	2	8	63	254
AFR - Senegal	6	15	106	462
AFR - Sierra Leone	1	1	12	102
AFR - Somalia	1	5	51	446
AFR - South Africa	102	188	441	1074
AFR - Swaziland	1	4	10	25
AFR - Togo	2	7	41	149
AFR - Uganda	3	18	194	1233
AFR - United Republic of Tanzania	2	7	45	505
AFR - Zambia	4	12	72	265
AFR - Zimbabwe	7	17	78	248
CPA - Cambodia	1	34	204	787
CPA - China	370	5410	16882	42402
CPA - China Hong Kong SAR	71	181	333	509
CPA - China Macao SAR	3	9	18	29
CPA - Democratic People's Republic of Korea	21	45	81	180
CPA - Lao People's Democratic Republic	1	14	75	272

CPA - Mongolia	2	10	34	84
CPA - Viet Nam	7	228	1187	3153
EEU - Albania	2	4	14	88
EEU - Bosnia and Herzegovina	6	12	45	114
EEU - Bulgaria	22	30	69	141
EEU - Croatia	10	20	65	142
EEU - Czech Republic	29	70	201	397
EEU - Hungary	33	75	191	363
EEU - Poland	62	197	726	1589
EEU - Romania	38	49	173	519
EEU - Slovakia	16	40	106	210
EEU - Slovenia	17	30	46	67
EEU - TFYR Macedonia	2	4	18	62
EEU - Yugoslavia	53	67	147	311
FSU - Armenia	7	15	40	72
FSU - Azerbaijan	12	37	148	357
FSU - Belarus	32	59	133	236
FSU - Estonia	6	9	16	29
FSU - Georgia	9	17	57	108
FSU - Kazakhstan	42	60	193	431
FSU - Kyrgyzstan	7	25	91	219
FSU - Latvia	9	13	29	57
FSU - Lithuania	10	18	55	130
FSU - Republic of Moldova	10	19	55	107
FSU - Russian Federation	480	600	2099	4197
FSU - Tajikistan	6	8	86	266
FSU - Turkmenistan	6	24	92	228
FSU - Ukraine	121	97	470	1097
FSU - Uzbekistan	28	80	490	1405
LAM - Argentina	106	370	946	2028
LAM - Bahamas	3	7	12	21
LAM - Barbados	2	5	8	12
LAM - Belize	0	3	7	15
LAM - Bolivia	4	27	99	320
LAM - Brazil	474	1176	4537	9335
LAM - Chile	28	130	355	802
LAM - Colombia	40	169	741	2152
LAM - Costa Rica	6	24	82	214
LAM - Cuba	27	70	148	325
LAM - Dominican Republic	7	24	98	336
LAM - Ecuador	11	34	140	516
LAM - El Salvador	5	19	80	281
LAM - Guadeloupe	1	4	10	18
LAM - Guatemala	8	43	158	525
LAM - Guyana	0	2	4	9
LAM - Haiti	3	10	58	218
LAM - Honduras	3	18	74	246
LAM - Jamaica	4	15	49	123
LAM - Martinique	1	4	9	17
LAM - Mexico	241	734	2496	5338
LAM - Netherlands Antilles	1	2	5	10
LAM - Nicaragua	2	4	29	158
LAM - Panama	5	20	65	172
LAM - Paraguay	6	27	110	379
LAM - Peru	33	144	528	1377
LAM - Suriname	2	5	11	20
LAM - Trinidad and Tobago	5	16	31	54
LAM - Uruguay	8	30	73	156

LAM - Venezuela	49	116	468	1334
MEA - Algeria	60	122	667	1417
MEA - Bahrain	4	10	23	55
MEA - Egypt	35	144	778	1920
MEA - Iran (Islamic Republic of)	119	322	1272	2772
MEA - Iraq	49	111	632	1446
MEA - Israel	55	100	191	388
MEA - Jordan	4	14	69	228
MEA - Kuwait	24	45	87	181
MEA - Lebanon	3	15	53	127
MEA - Libyan Arab Jamahiriya	29	73	155	311
MEA - Morocco	26	83	348	759
MEA - Occupied Palestinian Territory	2	15	54	163
MEA - Oman	11	39	119	346
MEA - Qatar	7	13	23	41
MEA - Saudi Arabia	101	294	1018	2718
MEA - Sudan	8	29	284	812
MEA - Syrian Arab Republic	14	44	273	777
MEA - Tunisia	13	43	163	368
MEA - United Arab Emirates	28	53	95	176
MEA - Western Sahara	0	0	1	7
MEA - Yemen	7	41	343	1329
NAM - Canada	567	1086	1511	2124
NAM - Guam	1	3	5	10
NAM - Puerto Rico	31	76	123	195
NAM - United States of America	5465	11375	15630	25430
PAO - Australia	295	561	841	1375
PAO - Japan	2940	4125	4719	6537
PAO - New Zealand	44	86	137	228
PAS - Brunei Darussalam	4	8	15	31
PAS - East Timor	0	0	3	17
PAS - Fiji	1	10	21	39
PAS - French Polynesia	3	6	10	18
PAS - Indonesia	107	1183	3855	8556
PAS - Malaysia	43	348	717	1433
PAS - Myanmar	24	261	866	1923
PAS - New Caledonia	3	5	9	17
PAS - Papua New Guinea	3	38	145	371
PAS - Philippines	44	597	1736	3928
PAS - Republic of Korea	244	811	1348	2154
PAS - Samoa	0	2	4	10
PAS - Singapore	35	77	131	212
PAS - Solomon Islands	0	2	11	32
PAS - Taiwan - China[MEDS data]	165	438	758	1299
PAS - Thailand	82	839	1641	2973
PAS - Vanuatu	0	2	5	13
SAS - Afghanistan	3	7	29	347
SAS - Bangladesh	22	110	620	1798
SAS - Bhutan	0	1	7	34
SAS - India	296	1480	7599	18621
SAS - Maldives	0	1	3	13
SAS - Nepal	3	12	77	328
SAS - Pakistan	40	187	1434	4999
SAS - Sri Lanka	8	27	117	274
WEU - Austria	158	246	316	420
WEU - Belgium	192	313	408	563
WEU - Cyprus	5	13	22	37
WEU - Denmark	129	184	234	314

WEU - Finland	138	189	235	308
WEU - France	1192	2041	2747	4036
WEU - Germany	1496	2599	3721	5372
WEU - Greece	66	164	261	397
WEU - Iceland	6	9	12	17
WEU - Ireland	43	136	178	252
WEU - Italy	1095	1684	2060	2619
WEU - Luxembourg	9	23	30	45
WEU - Malta	2	6	9	15
WEU - Netherlands	284	500	659	929
WEU - Norway	106	185	228	300
WEU - Portugal	57	146	239	371
WEU - Spain	491	994	1392	1971
WEU - Sweden	228	326	406	537
WEU - Switzerland	226	289	347	426
WEU - Turkey	108	544	1328	3121
WEU - United Kingdom	974	1840	2542	3937

Table 3: Scenario A2 - GDP at MER [million US$1990].

Country	1990	2020	2050	2100
AFR - Angola	8	21	121	596
AFR - Benin	2	7	32	99
AFR - Botswana	3	9	16	34
AFR - Burkina Faso	3	5	14	73
AFR - Burundi	1	2	7	57
AFR - Cameroon	11	20	74	178
AFR - Cape Verde	0	1	4	13
AFR - Central African Republic	1	5	21	68
AFR - Chad	1	5	25	102
AFR - Comoros	0	1	5	16
AFR - Congo	3	4	22	113
AFR - Côte d'Ivoire	10	18	70	175
AFR - Democratic Republic of the Congo	8	26	169	556
AFR - Djibouti	0	1	4	17
AFR - Equatorial Guinea	0	1	4	14
AFR - Eritrea	0	2	10	52
AFR - Ethiopia	6	14	60	224
AFR - Gabon	5	10	18	43
AFR - Gambia	0	1	5	17
AFR - Ghana	6	13	72	182
AFR - Guinea	3	9	44	132
AFR - Guinea-Bissau	0	1	6	29
AFR - Kenya	9	33	140	400
AFR - Lesotho	1	2	4	10
AFR - Liberia	0	2	10	51
AFR - Madagascar	3	6	16	79
AFR - Malawi	2	6	34	115
AFR - Mali	3	5	15	79
AFR - Mauritania	1	4	17	69
AFR - Mauritius	3	6	12	27
AFR - Mozambique	1	3	6	45
AFR - Namibia	2	7	17	45
AFR - Niger	3	13	79	352
AFR - Nigeria	35	102	653	1911
AFR - Réunion	2	4	8	18
AFR - Rwanda	2	5	29	100
AFR - Senegal	6	14	55	149
AFR - Sierra Leone	1	1	3	33
AFR - Somalia	1	3	7	62
AFR - South Africa	102	170	331	679
AFR - Swaziland	1	2	5	11
AFR - Togo	2	7	28	90
AFR - Uganda	3	11	53	175
AFR - United Republic of Tanzania	2	5	11	78
AFR - Zambia	4	11	50	139
AFR - Zimbabwe	7	14	46	115
CPA - Cambodia	1	18	99	506
CPA - China	370	3640	17741	31963
CPA - China Hong Kong SAR	71	137	227	360
CPA - China Macao SAR	3	7	12	21
CPA - Democratic People's Republic of Korea	21	63	150	362
CPA - Lao People's Democratic Republic	1	9	44	204

CPA - Mongolia	2	8	26	76
CPA - Viet Nam	7	97	497	1960
EEU - Albania	2	4	15	57
EEU - Bosnia and Herzegovina	6	13	37	81
EEU - Bulgaria	22	35	71	129
EEU - Croatia	10	19	46	110
EEU - Czech Republic	29	78	160	298
EEU - Hungary	33	79	156	283
EEU - Poland	62	222	515	964
EEU - Romania	38	66	189	397
EEU - Slovakia	16	39	76	144
EEU - Slovenia	17	26	36	61
EEU - TFYR Macedonia	2	5	16	43
EEU - Yugoslavia	53	83	145	271
FSU - Armenia	7	9	21	47
FSU - Azerbaijan	12	12	60	274
FSU - Belarus	32	45	131	281
FSU - Estonia	6	8	18	30
FSU - Georgia	9	5	21	83
FSU - Kazakhstan	42	53	244	530
FSU - Kyrgyzstan	7	10	69	271
FSU - Latvia	9	10	28	55
FSU - Lithuania	10	17	50	111
FSU - Republic of Moldova	10	6	23	80
FSU - Russian Federation	480	621	2460	3364
FSU - Tajikistan	6	5	41	342
FSU - Turkmenistan	6	11	72	280
FSU - Ukraine	121	87	377	828
FSU - Uzbekistan	28	67	469	1401
LAM - Argentina	106	278	767	1531
LAM - Bahamas	3	6	9	17
LAM - Barbados	2	4	6	10
LAM - Belize	0	3	5	11
LAM - Bolivia	4	18	64	185
LAM - Brazil	474	1112	3323	6736
LAM - Chile	28	106	278	610
LAM - Colombia	40	173	620	1523
LAM - Costa Rica	6	21	64	175
LAM - Cuba	27	54	89	149
LAM - Dominican Republic	7	25	87	278
LAM - Ecuador	11	36	128	423
LAM - El Salvador	5	20	71	235
LAM - Guadeloupe	1	4	7	15
LAM - Guatemala	8	30	108	323
LAM - Guyana	0	2	4	7
LAM - Haiti	3	9	42	137
LAM - Honduras	3	12	48	149
LAM - Jamaica	4	13	37	99
LAM - Martinique	1	3	7	14
LAM - Mexico	241	653	1921	4105
LAM - Netherlands Antilles	1	2	4	8
LAM - Nicaragua	2	4	23	136
LAM - Panama	5	17	50	135
LAM - Paraguay	6	28	96	300
LAM - Peru	33	153	493	1120
LAM - Suriname	2	4	9	17
LAM - Trinidad and Tobago	5	13	24	43
LAM - Uruguay	8	24	55	120

LAM - Venezuela	49	107	402	1040
MEA - Algeria	60	176	603	1057
MEA - Bahrain	4	9	20	46
MEA - Egypt	35	211	806	1769
MEA - Iran (Islamic Republic of)	119	491	1329	2422
MEA - Iraq	49	176	632	1107
MEA - Israel	55	107	209	406
MEA - Jordan	4	17	71	205
MEA - Kuwait	24	47	93	191
MEA - Lebanon	3	16	49	113
MEA - Libyan Arab Jamahiriya	29	63	124	256
MEA - Morocco	26	119	357	692
MEA - Occupied Palestinian Territory	2	14	53	161
MEA - Oman	11	33	93	280
MEA - Qatar	7	13	23	42
MEA - Saudi Arabia	101	264	786	2073
MEA - Sudan	8	39	284	699
MEA - Syrian Arab Republic	14	63	286	648
MEA - Tunisia	13	50	147	315
MEA - United Arab Emirates	28	55	100	180
MEA - Western Sahara	0	0	1	8
MEA - Yemen	7	55	395	1424
NAM - Canada	567	1114	1837	2939
NAM - Guam	1	2	4	8
NAM - Puerto Rico	31	68	103	149
NAM - United States of America	5465	11945	19600	34896
PAO - Australia	295	575	965	1668
PAO - Japan	2940	4865	6427	8069
PAO - New Zealand	44	91	156	270
PAS - Brunei Darussalam	4	6	9	21
PAS - East Timor	0	1	4	14
PAS - Fiji	1	4	8	14
PAS - French Polynesia	3	5	8	17
PAS - Indonesia	107	758	2216	3657
PAS - Malaysia	43	131	287	523
PAS - Myanmar	24	145	411	776
PAS - New Caledonia	3	4	7	14
PAS - Papua New Guinea	3	16	47	125
PAS - Philippines	44	257	767	1514
PAS - Republic of Korea	244	345	522	1023
PAS - Samoa	0	1	1	3
PAS - Singapore	35	57	94	179
PAS - Solomon Islands	0	1	4	11
PAS - Taiwan - China[MEDS data]	165	255	412	827
PAS - Thailand	82	307	680	1078
PAS - Vanuatu	0	1	2	5
SAS - Afghanistan	3	7	20	165
SAS - Bangladesh	22	75	313	1123
SAS - Bhutan	0	1	3	18
SAS - India	296	1145	4487	13157
SAS - Maldives	0	1	3	11
SAS - Nepal	3	9	35	184
SAS - Pakistan	40	160	748	2789
SAS - Sri Lanka	8	27	82	188
WEU - Austria	158	247	337	480
WEU - Belgium	192	308	428	631
WEU - Cyprus	5	14	23	40
WEU - Denmark	129	188	250	357

WEU - Finland	138	195	255	357
WEU - France	1192	2121	3006	4111
WEU - Germany	1496	2714	3901	5192
WEU - Greece	66	171	286	460
WEU - Iceland	6	9	13	19
WEU - Ireland	43	116	169	267
WEU - Italy	1095	1607	2001	2746
WEU - Luxembourg	9	20	30	53
WEU - Malta	2	5	10	18
WEU - Netherlands	284	469	669	1000
WEU - Norway	106	155	210	309
WEU - Portugal	57	151	257	421
WEU - Spain	491	887	1383	2018
WEU - Sweden	228	328	432	609
WEU - Switzerland	226	301	378	495
WEU - Turkey	108	318	991	2675
WEU - United Kingdom	974	1889	2757	3895

Table 4: Scenario B1 - Population [million]. Source: O’Neill et al., 2005

Country	1990	2020	2050	2100
AFR - Angola	10	24	41	44
AFR - Benin	5	11	15	12
AFR - Botswana	1	2	1	1
AFR - Burkina Faso	9	23	40	46
AFR - Burundi	6	12	19	19
AFR - Cameroon	12	22	24	17
AFR - Cape Verde	0	1	1	0
AFR - Central African Republic	3	5	6	5
AFR - Chad	6	15	24	24
AFR - Comoros	1	1	2	1
AFR - Congo	2	6	10	10
AFR - Côte d'Ivoire	13	23	27	19
AFR - Democratic Republic of the Congo	38	92	145	138
AFR - Djibouti	1	1	1	1
AFR - Equatorial Guinea	0	1	1	1
AFR - Eritrea	3	7	10	8
AFR - Ethiopia	49	115	166	152
AFR - Gabon	1	2	2	2
AFR - Gambia	1	2	3	2
AFR - Ghana	15	31	39	28
AFR - Guinea	6	14	19	16
AFR - Guinea-Bissau	1	3	5	5
AFR - Kenya	24	41	41	28
AFR - Lesotho	2	2	1	1
AFR - Liberia	2	6	9	9
AFR - Madagascar	12	30	45	41
AFR - Malawi	10	18	24	21
AFR - Mali	9	24	44	48
AFR - Mauritania	2	5	7	7
AFR - Mauritius	1	2	2	1
AFR - Mozambique	14	26	30	22
AFR - Namibia	1	2	2	2
AFR - Niger	8	24	51	73
AFR - Nigeria	88	193	251	199
AFR - Réunion	1	1	1	1
AFR - Rwanda	7	13	16	14
AFR - Senegal	7	16	21	16
AFR - Sierra Leone	4	8	10	7
AFR - Somalia	7	20	38	47
AFR - South Africa	37	47	38	21
AFR - Swaziland	1	1	1	1
AFR - Togo	4	8	10	7
AFR - Uganda	18	51	98	117
AFR - United Republic of Tanzania	27	54	67	49
AFR - Zambia	8	15	17	14
AFR - Zimbabwe	10	14	11	7
CPA - Cambodia	9	20	28	26
CPA - China	1137	1366	1244	716
CPA - China Hong Kong SAR	6	8	8	6
CPA - China Macao SAR	0	1	1	0
CPA - Democratic People's Republic of Korea	20	24	23	14
CPA - Lao People's Democratic Republic	4	8	11	10

CPA - Mongolia	2	3	3	2
CPA - Viet Nam	65	97	108	73
EEU - Albania	3	4	4	3
EEU - Bosnia and Herzegovina	4	4	4	3
EEU - Bulgaria	9	7	6	4
EEU - Croatia	5	5	4	4
EEU - Czech Republic	10	11	10	8
EEU - Hungary	10	10	9	7
EEU - Poland	38	41	38	28
EEU - Romania	23	23	21	17
EEU - Slovakia	5	6	6	4
EEU - Slovenia	2	2	2	1
EEU - TFYR Macedonia	2	2	2	2
EEU - Yugoslavia	10	11	10	8
FSU - Armenia	4	3	3	1
FSU - Azerbaijan	7	11	13	12
FSU - Belarus	10	10	9	7
FSU - Estonia	2	1	1	1
FSU - Georgia	5	5	4	3
FSU - Kazakhstan	17	18	18	16
FSU - Kyrgyzstan	4	7	10	9
FSU - Latvia	3	2	2	1
FSU - Lithuania	4	3	3	3
FSU - Republic of Moldova	4	4	4	3
FSU - Russian Federation	148	143	128	100
FSU - Tajikistan	5	9	13	12
FSU - Turkmenistan	4	7	10	10
FSU - Ukraine	52	46	39	28
FSU - Uzbekistan	21	38	50	46
LAM - Argentina	32	45	52	43
LAM - Bahamas	0	0	0	0
LAM - Barbados	0	0	0	0
LAM - Belize	0	0	0	0
LAM - Bolivia	7	12	16	16
LAM - Brazil	147	210	230	173
LAM - Chile	13	19	22	18
LAM - Colombia	35	55	67	58
LAM - Costa Rica	3	5	6	5
LAM - Cuba	11	12	10	6
LAM - Dominican Republic	7	11	12	9
LAM - Ecuador	10	16	19	15
LAM - El Salvador	5	8	10	8
LAM - Guadeloupe	0	0	0	0
LAM - Guatemala	9	18	27	28
LAM - Guyana	1	1	0	0
LAM - Haiti	7	10	13	12
LAM - Honduras	5	10	13	12
LAM - Jamaica	2	3	4	3
LAM - Martinique	0	0	0	0
LAM - Mexico	83	125	136	102
LAM - Netherlands Antilles	0	0	0	0
LAM - Nicaragua	4	8	11	11
LAM - Panama	2	4	5	4
LAM - Paraguay	4	9	13	13
LAM - Peru	21	34	41	34
LAM - Suriname	0	0	0	0
LAM - Trinidad and Tobago	1	1	1	1
LAM - Uruguay	3	4	4	3

LAM - Venezuela	19	33	41	34
MEA - Algeria	25	44	56	50
MEA - Bahrain	0	1	1	1
MEA - Egypt	56	108	150	150
MEA - Iran (Islamic Republic of)	59	91	108	84
MEA - Iraq	17	43	63	66
MEA - Israel	5	9	11	10
MEA - Jordan	3	8	11	10
MEA - Kuwait	2	4	5	5
MEA - Lebanon	3	5	5	4
MEA - Libyan Arab Jamahiriya	4	8	11	11
MEA - Morocco	25	42	55	53
MEA - Occupied Palestinian Territory	2	7	12	15
MEA - Oman	2	5	8	8
MEA - Qatar	0	1	1	1
MEA - Saudi Arabia	15	40	60	62
MEA - Sudan	25	51	75	82
MEA - Syrian Arab Republic	12	27	36	32
MEA - Tunisia	8	12	14	12
MEA - United Arab Emirates	2	4	4	3
MEA - Western Sahara	0	0	1	1
MEA - Yemen	12	43	99	152
NAM - Canada	28	34	39	43
NAM - Guam	0	0	0	0
NAM - Puerto Rico	4	4	3	2
NAM - United States of America	254	325	384	466
PAO - Australia	17	23	28	28
PAO - Japan	124	131	124	106
PAO - New Zealand	3	4	5	4
PAS - Brunei Darussalam	0	0	1	1
PAS - East Timor	1	1	1	1
PAS - Fiji	1	1	1	1
PAS - French Polynesia	0	0	0	0
PAS - Indonesia	183	260	289	202
PAS - Malaysia	18	32	40	33
PAS - Myanmar	41	58	65	47
PAS - New Caledonia	0	0	0	0
PAS - Papua New Guinea	4	8	11	11
PAS - Philippines	61	103	127	104
PAS - Republic of Korea	43	52	52	35
PAS - Samoa	0	0	0	0
PAS - Singapore	3	5	5	3
PAS - Solomon Islands	0	1	1	1
PAS - Taiwan - China[MEDS data]	22	24	23	15
PAS - Thailand	55	71	77	52
PAS - Vanuatu	0	0	0	0
SAS - Afghanistan	14	41	70	72
SAS - Bangladesh	112	190	231	167
SAS - Bhutan	2	3	5	5
SAS - India	858	1275	1390	924
SAS - Maldives	0	1	1	1
SAS - Nepal	18	34	47	41
SAS - Pakistan	111	228	334	307
SAS - Sri Lanka	17	20	19	11
WEU - Austria	8	8	8	7
WEU - Belgium	10	11	11	11
WEU - Cyprus	1	1	1	1
WEU - Denmark	5	6	6	6

WEU - Finland	5	5	5	5
WEU - France	57	63	65	63
WEU - Germany	80	84	86	86
WEU - Greece	10	11	11	8
WEU - Iceland	0	0	0	0
WEU - Ireland	4	4	5	4
WEU - Italy	57	55	49	39
WEU - Luxembourg	0	1	1	1
WEU - Malta	0	0	0	0
WEU - Netherlands	15	17	18	17
WEU - Norway	4	5	5	5
WEU - Portugal	10	10	10	8
WEU - Spain	39	41	39	30
WEU - Sweden	9	9	9	9
WEU - Switzerland	7	7	6	6
WEU - Turkey	56	83	91	78
WEU - United Kingdom	58	63	70	73

Table 5: Scenario B2 - Population [million]. Source: O'Neill et al., 2005

Country	1990	2020	2050	2100
AFR - Angola	10	24	48	74
AFR - Benin	5	11	18	22
AFR - Botswana	1	2	2	2
AFR - Burkina Faso	9	24	47	76
AFR - Burundi	6	12	22	32
AFR - Cameroon	12	23	31	35
AFR - Cape Verde	0	1	1	1
AFR - Central African Republic	3	5	7	9
AFR - Chad	6	15	29	41
AFR - Comoros	1	1	2	3
AFR - Congo	2	7	12	17
AFR - Côte d'Ivoire	13	22	28	32
AFR - Democratic Republic of the Congo	38	93	170	239
AFR - Djibouti	1	1	2	2
AFR - Equatorial Guinea	0	1	1	2
AFR - Eritrea	3	7	12	15
AFR - Ethiopia	49	116	193	261
AFR - Gabon	1	2	3	3
AFR - Gambia	1	2	3	4
AFR - Ghana	15	32	45	52
AFR - Guinea	6	14	22	28
AFR - Guinea-Bissau	1	3	5	8
AFR - Kenya	24	43	50	54
AFR - Lesotho	2	2	2	2
AFR - Liberia	2	6	11	16
AFR - Madagascar	12	30	52	72
AFR - Malawi	10	18	29	38
AFR - Mali	9	24	51	83
AFR - Mauritania	2	5	9	11
AFR - Mauritius	1	2	2	2
AFR - Mozambique	14	27	35	40
AFR - Namibia	1	3	3	3
AFR - Niger	8	24	59	115
AFR - Nigeria	88	196	294	355
AFR - Réunion	1	1	1	1
AFR - Rwanda	7	13	19	24
AFR - Senegal	7	16	25	30
AFR - Sierra Leone	4	8	12	13
AFR - Somalia	7	20	44	77
AFR - South Africa	37	49	46	45
AFR - Swaziland	1	1	1	1
AFR - Togo	4	8	11	14
AFR - Uganda	18	52	115	196
AFR - United Republic of Tanzania	27	55	79	90
AFR - Zambia	8	15	21	26
AFR - Zimbabwe	10	14	14	15
CPA - Cambodia	9	21	31	39
CPA - China	1137	1413	1476	1502
CPA - China Hong Kong SAR	6	8	9	8
CPA - China Macao SAR	0	1	1	0
CPA - Democratic People's Republic of Korea	20	25	26	26
CPA - Lao People's Democratic Republic	4	8	12	15

CPA - Mongolia	2	3	4	4
CPA - Viet Nam	65	103	123	125
EEU - Albania	3	4	4	4
EEU - Bosnia and Herzegovina	4	4	4	3
EEU - Bulgaria	9	7	5	4
EEU - Croatia	5	4	4	4
EEU - Czech Republic	10	10	9	7
EEU - Hungary	10	9	8	7
EEU - Poland	38	38	33	28
EEU - Romania	23	21	18	16
EEU - Slovakia	5	5	5	4
EEU - Slovenia	2	2	2	1
EEU - TFYR Macedonia	2	2	2	2
EEU - Yugoslavia	10	10	9	8
FSU - Armenia	4	3	2	2
FSU - Azerbaijan	7	10	11	12
FSU - Belarus	10	9	8	6
FSU - Estonia	2	1	1	1
FSU - Georgia	5	5	4	3
FSU - Kazakhstan	17	16	15	13
FSU - Kyrgyzstan	4	6	8	8
FSU - Latvia	3	2	1	1
FSU - Lithuania	4	3	3	3
FSU - Republic of Moldova	4	4	4	3
FSU - Russian Federation	148	130	102	86
FSU - Tajikistan	5	8	10	10
FSU - Turkmenistan	4	6	8	8
FSU - Ukraine	52	43	32	26
FSU - Uzbekistan	21	33	40	39
LAM - Argentina	32	45	56	62
LAM - Bahamas	0	0	0	0
LAM - Barbados	0	0	0	0
LAM - Belize	0	0	0	1
LAM - Bolivia	7	12	17	21
LAM - Brazil	147	210	246	258
LAM - Chile	13	19	23	26
LAM - Colombia	35	55	71	82
LAM - Costa Rica	3	5	7	7
LAM - Cuba	11	11	11	10
LAM - Dominican Republic	7	11	13	13
LAM - Ecuador	10	16	20	22
LAM - El Salvador	5	8	10	12
LAM - Guadeloupe	0	0	0	0
LAM - Guatemala	9	18	28	36
LAM - Guyana	1	1	1	0
LAM - Haiti	7	10	13	16
LAM - Honduras	5	9	13	16
LAM - Jamaica	2	3	4	4
LAM - Martinique	0	0	0	0
LAM - Mexico	83	125	148	155
LAM - Netherlands Antilles	0	0	0	0
LAM - Nicaragua	4	8	12	15
LAM - Panama	2	4	5	6
LAM - Paraguay	4	8	13	17
LAM - Peru	21	34	43	48
LAM - Suriname	0	0	0	1
LAM - Trinidad and Tobago	1	1	1	1
LAM - Uruguay	3	4	4	5

LAM - Venezuela	19	33	44	49
MEA - Algeria	25	45	57	54
MEA - Bahrain	0	1	1	1
MEA - Egypt	56	108	148	155
MEA - Iran (Islamic Republic of)	59	89	110	112
MEA - Iraq	17	39	61	77
MEA - Israel	5	8	10	11
MEA - Jordan	3	8	11	12
MEA - Kuwait	2	4	5	5
MEA - Lebanon	3	5	5	5
MEA - Libyan Arab Jamahiriya	4	8	11	11
MEA - Morocco	25	43	55	55
MEA - Occupied Palestinian Territory	2	6	12	17
MEA - Oman	2	4	7	9
MEA - Qatar	0	1	1	1
MEA - Saudi Arabia	15	37	57	70
MEA - Sudan	25	49	69	77
MEA - Syrian Arab Republic	12	26	36	40
MEA - Tunisia	8	13	15	13
MEA - United Arab Emirates	2	4	4	4
MEA - Western Sahara	0	0	1	1
MEA - Yemen	12	38	89	166
NAM - Canada	28	33	34	31
NAM - Guam	0	0	0	0
NAM - Puerto Rico	4	4	4	4
NAM - United States of America	254	325	350	370
PAO - Australia	17	23	26	27
PAO - Japan	124	128	114	102
PAO - New Zealand	3	4	5	5
PAS - Brunei Darussalam	0	1	1	1
PAS - East Timor	1	1	2	2
PAS - Fiji	1	1	1	1
PAS - French Polynesia	0	0	0	0
PAS - Indonesia	183	268	307	311
PAS - Malaysia	18	32	41	45
PAS - Myanmar	41	60	68	68
PAS - New Caledonia	0	0	0	0
PAS - Papua New Guinea	4	8	11	14
PAS - Philippines	61	106	133	146
PAS - Republic of Korea	43	51	48	42
PAS - Samoa	0	0	0	0
PAS - Singapore	3	5	5	4
PAS - Solomon Islands	0	1	1	1
PAS - Taiwan - China[MEDS data]	22	27	31	26
PAS - Thailand	55	74	80	80
PAS - Vanuatu	0	0	0	1
SAS - Afghanistan	14	41	73	103
SAS - Bangladesh	112	201	267	296
SAS - Bhutan	2	3	6	7
SAS - India	858	1272	1533	1618
SAS - Maldives	0	1	1	1
SAS - Nepal	18	36	53	67
SAS - Pakistan	111	234	366	465
SAS - Sri Lanka	17	22	22	21
WEU - Austria	8	8	7	7
WEU - Belgium	10	11	10	10
WEU - Cyprus	1	1	1	1
WEU - Denmark	5	5	5	5

WEU - Finland	5	5	5	5
WEU - France	57	64	65	65
WEU - Germany	80	83	80	79
WEU - Greece	10	11	10	8
WEU - Iceland	0	0	0	0
WEU - Ireland	4	5	5	5
WEU - Italy	57	54	45	36
WEU - Luxembourg	0	1	1	1
WEU - Malta	0	0	0	0
WEU - Netherlands	15	17	17	17
WEU - Norway	4	5	5	5
WEU - Portugal	10	10	9	8
WEU - Spain	39	41	37	31
WEU - Sweden	9	9	9	9
WEU - Switzerland	7	7	6	5
WEU - Turkey	56	88	102	103
WEU - United Kingdom	58	63	67	69

Table 6: Scenario A2 - Population [million]. Source: O'Neill et al., 2005

Country	1990	2020	2050	2100
AFR - Angola	10	23	51	84
AFR - Benin	5	11	19	27
AFR - Botswana	1	2	2	2
AFR - Burkina Faso	9	23	50	87
AFR - Burundi	6	12	23	38
AFR - Cameroon	12	21	31	40
AFR - Cape Verde	0	1	1	1
AFR - Central African Republic	3	5	8	11
AFR - Chad	6	15	30	47
AFR - Comoros	1	1	2	3
AFR - Congo	2	6	13	20
AFR - Côte d'Ivoire	13	22	33	44
AFR - Democratic Republic of the Congo	38	89	181	279
AFR - Djibouti	1	1	2	2
AFR - Equatorial Guinea	0	1	1	2
AFR - Eritrea	3	7	13	18
AFR - Ethiopia	49	110	203	303
AFR - Gabon	1	2	3	4
AFR - Gambia	1	2	3	5
AFR - Ghana	15	30	47	64
AFR - Guinea	6	13	23	34
AFR - Guinea-Bissau	1	3	6	9
AFR - Kenya	24	41	55	70
AFR - Lesotho	2	2	2	3
AFR - Liberia	2	6	12	19
AFR - Madagascar	12	28	55	88
AFR - Malawi	10	18	32	47
AFR - Mali	9	23	55	95
AFR - Mauritania	2	5	9	13
AFR - Mauritius	1	1	2	2
AFR - Mozambique	14	25	38	50
AFR - Namibia	1	2	3	4
AFR - Niger	8	23	62	125
AFR - Nigeria	88	186	309	431
AFR - Réunion	1	1	1	1
AFR - Rwanda	7	12	20	29
AFR - Senegal	7	15	26	37
AFR - Sierra Leone	4	7	12	15
AFR - Somalia	7	19	47	87
AFR - South Africa	37	46	51	62
AFR - Swaziland	1	1	1	1
AFR - Togo	4	7	12	17
AFR - Uganda	18	49	122	222
AFR - United Republic of Tanzania	27	52	83	112
AFR - Zambia	8	14	23	31
AFR - Zimbabwe	10	14	16	19
CPA - Cambodia	9	20	33	50
CPA - China	1137	1398	1468	1689
CPA - China Hong Kong SAR	6	8	9	8
CPA - China Macao SAR	0	1	1	0
CPA - Democratic People's Republic of Korea	20	24	27	33
CPA - Lao People's Democratic Republic	4	8	13	19

CPA - Mongolia	2	3	4	5
CPA - Viet Nam	65	100	128	161
EEU - Albania	3	4	4	4
EEU - Bosnia and Herzegovina	4	4	4	4
EEU - Bulgaria	9	7	6	5
EEU - Croatia	5	4	4	4
EEU - Czech Republic	10	10	9	9
EEU - Hungary	10	9	8	8
EEU - Poland	38	39	36	34
EEU - Romania	23	22	20	19
EEU - Slovakia	5	6	5	5
EEU - Slovenia	2	2	2	2
EEU - TFYR Macedonia	2	2	2	2
EEU - Yugoslavia	10	11	10	10
FSU - Armenia	4	3	3	2
FSU - Azerbaijan	7	11	14	15
FSU - Belarus	10	10	9	8
FSU - Estonia	2	1	1	1
FSU - Georgia	5	5	4	4
FSU - Kazakhstan	17	18	20	24
FSU - Kyrgyzstan	4	7	11	14
FSU - Latvia	3	2	2	2
FSU - Lithuania	4	3	3	3
FSU - Republic of Moldova	4	5	4	4
FSU - Russian Federation	148	140	123	116
FSU - Tajikistan	5	9	14	18
FSU - Turkmenistan	4	7	11	15
FSU - Ukraine	52	46	38	35
FSU - Uzbekistan	21	39	58	73
LAM - Argentina	32	47	62	78
LAM - Bahamas	0	0	0	1
LAM - Barbados	0	0	0	0
LAM - Belize	0	0	1	1
LAM - Bolivia	7	12	19	25
LAM - Brazil	147	221	279	339
LAM - Chile	13	20	25	31
LAM - Colombia	35	58	78	98
LAM - Costa Rica	3	6	8	10
LAM - Cuba	11	12	12	15
LAM - Dominican Republic	7	11	14	17
LAM - Ecuador	10	17	23	28
LAM - El Salvador	5	9	12	15
LAM - Guadeloupe	0	1	1	1
LAM - Guatemala	9	19	31	43
LAM - Guyana	1	1	1	1
LAM - Haiti	7	11	15	18
LAM - Honduras	5	10	15	20
LAM - Jamaica	2	3	4	5
LAM - Martinique	0	0	0	1
LAM - Mexico	83	134	172	210
LAM - Netherlands Antilles	0	0	0	0
LAM - Nicaragua	4	8	13	18
LAM - Panama	2	4	6	8
LAM - Paraguay	4	9	14	20
LAM - Peru	21	36	49	61
LAM - Suriname	0	1	1	1
LAM - Trinidad and Tobago	1	1	1	2
LAM - Uruguay	3	4	5	6

LAM - Venezuela	19	35	50	64
MEA - Algeria	25	43	59	72
MEA - Bahrain	0	1	1	2
MEA - Egypt	56	104	155	202
MEA - Iran (Islamic Republic of)	59	93	122	136
MEA - Iraq	17	42	69	93
MEA - Israel	5	9	12	14
MEA - Jordan	3	8	12	15
MEA - Kuwait	2	4	6	6
MEA - Lebanon	3	5	6	6
MEA - Libyan Arab Jamahiriya	4	8	11	14
MEA - Morocco	25	41	57	71
MEA - Occupied Palestinian Territory	2	7	13	20
MEA - Oman	2	5	8	11
MEA - Qatar	0	1	1	1
MEA - Saudi Arabia	15	40	65	85
MEA - Sudan	25	47	72	93
MEA - Syrian Arab Republic	12	27	40	48
MEA - Tunisia	8	12	16	18
MEA - United Arab Emirates	2	4	5	5
MEA - Western Sahara	0	0	1	1
MEA - Yemen	12	42	103	190
NAM - Canada	28	34	38	39
NAM - Guam	0	0	0	0
NAM - Puerto Rico	4	4	4	3
NAM - United States of America	254	330	398	469
PAO - Australia	17	24	30	34
PAO - Japan	124	128	125	127
PAO - New Zealand	3	4	5	6
PAS - Brunei Darussalam	0	1	1	1
PAS - East Timor	1	1	2	2
PAS - Fiji	1	1	1	1
PAS - French Polynesia	0	0	0	0
PAS - Indonesia	183	271	335	358
PAS - Malaysia	18	33	44	49
PAS - Myanmar	41	60	73	76
PAS - New Caledonia	0	0	0	0
PAS - Papua New Guinea	4	8	12	15
PAS - Philippines	61	106	143	163
PAS - Republic of Korea	43	51	49	45
PAS - Samoa	0	0	0	0
PAS - Singapore	3	5	5	4
PAS - Solomon Islands	0	1	1	1
PAS - Taiwan - China[MEDS data]	22	27	31	26
PAS - Thailand	55	75	89	95
PAS - Vanuatu	0	0	0	1
SAS - Afghanistan	14	42	77	98
SAS - Bangladesh	112	209	304	339
SAS - Bhutan	2	4	6	7
SAS - India	858	1397	1829	1945
SAS - Maldives	0	1	1	1
SAS - Nepal	18	37	60	72
SAS - Pakistan	111	240	400	484
SAS - Sri Lanka	17	23	25	26
WEU - Austria	8	8	8	8
WEU - Belgium	10	10	11	12
WEU - Cyprus	1	1	1	1
WEU - Denmark	5	5	6	6

WEU - Finland	5	5	5	6
WEU - France	57	63	68	76
WEU - Germany	80	81	84	92
WEU - Greece	10	11	10	9
WEU - Iceland	0	0	0	0
WEU - Ireland	4	5	5	6
WEU - Italy	57	54	48	43
WEU - Luxembourg	0	1	1	1
WEU - Malta	0	0	0	0
WEU - Netherlands	15	17	18	20
WEU - Norway	4	5	5	6
WEU - Portugal	10	10	10	9
WEU - Spain	39	40	40	37
WEU - Sweden	9	9	9	10
WEU - Switzerland	7	7	6	6
WEU - Turkey	56	85	103	112
WEU - United Kingdom	58	62	70	81