Inclusive Wealth Report 2014

Measuring progress toward sustainability

UNEP

UNU–IHDP

Secretariat of the

International Human Dimensions Programme on Global Environmental Change

CAMBRIDGE

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The *Inclusive Wealth Report 2014* is a joint initiative of the UN University – International Human Dimensions Programme (UNU-IHDP) and the UN Environment Programme (UNEP), in collaboration with the UNESCO-Mahatma Gandhi Institute of Education for Peace and Sustainable Development (UNESCO-MGIEP), ASCENT Africa Sustainability Centre, the Malaysian Industry-Government Group for High Technology (MIGHT), Science to Action (S2A), the Ministry of Environment – Government of Japan, the UN University – Institute for the Advanced Study of Sustainability (UNU-IAS), and endorsed by the Science and Technology Alliance for Global Sustainability.

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Review Board

Foreword

National accounts are descriptors. They describe the state of an economy and form the raw material for both assessing performance and prescribing policy. National accounts are meant to contain the kinds of information that are essential for economic evaluation.The system of national accounts currently in use throughout the world, however, suffers from extreme narrowness. Vast quantities of information relevant for economic evaluation do not appear in them. Some don't because the appropriate data are hard, even impossible, to collect; but others don't because until recently the theory and practice of economic evaluation didn't ask for them. The demand for "green national accounts" has arisen because of a growing recognition that contemporary national accounts are an unsatisfactory basis for economic evaluation. The qualifier, "green", signals that we should be especially concerned about the absence of information on society's use of the natural environment.

The IWR 2012

The inaugural publication on inclusive wealth (the IWR 2012), issued jointly by UNU-IHDP and UNEP, provided an account of what would ideally be needed for a comprehensive set of national accounts. The procedures recommended there were put to work in estimating changes in inclusive wealth per capita during 1990-2008 in 20 countries that represent various stages of economic development. The publication revealed that national governments and international agencies ought to go beyond even green national accounts, by reclassifying certain classes of goods and services and adding others that are currently missing. For the present, the ideal can be approximated at best crudely, which is what the IWR 2012 achieved. Data on many items that ought to be included will of necessity appear only in physical terms for some time yet, while many other items of significance (ecosystems other than forests, for example) will continue to be missing even in physical terms. Economic evaluation inevitably involves cutting corners. But it is essential for good practice to know where the corners that are being cut happen to be. That is why the authors of the IWR 2012 went extensively into the conceptual foundations of economic evaluation.

The IWR 2012 offered a set of capital accounts for each of the 20 countries on its list, akin to balance sheets of private firms. Inclusive wealth is the social value of an economy's capital assets. The assets comprise (i) manufactured capital (roads, buildings, machines, and equipment), (ii) human capital (skills, education, health), and (iii) natural capital (sub-soil resources, ecosystems, the atmosphere). Such other durable assets as knowledge, institutions, culture, religion – more broadly, social capital – were taken to be enabling assets; that is, assets that enable the production and allocation of assets in categories (i)-(iii). The effectiveness of enabling assets in a country gets reflected in the shadow prices of assets in categories (i)-(iii). For example, the shadow price of a price of farming equipment would be low in a country racked by civil conflict, whereas it would be high elsewhere, other things being equal.

The system of national accounts (SNA) that are still being developed by the United Nations and their affiliated international agencies do not yet contain several of the additions and reclassifications that were made in the IWR 2012. That is why the empirical estimates reported in the IWR 2012 were of significance. Being a first attempt, the estimates were conducted mainly with natural capital in mind. Even within that category, attention was paid to forests, land, sub-soil resources, and the atmosphere as a sink for carbon. Estimates of human capital were restricted to education, whose measurement has a long history in economics.

The present publication extends the IWR 2012 in three ways: (a) the coverage is 140 countries; (b) the basis for the estimates of education as a capital asset is the more sophisticated approach developed by Dale Jorgenson and his collaborators; and (c) health as a form of capital asset receives attention in the main body of work. Health poses special problems of estimation, so it is worth explaining why.

Health capital

Health is a capital asset and should be seen as a component of a person's human capital. In order to compare the relative significance of an economy's various capital assets with one another, they have to be expressed in a common currency. That common currency is typically monetary, say, dollars. But the currency could have been any chosen commodity, or a basket of commodities, for example, a basket of consumption goods. Health capital is health status expressed in that common currency.

Good health brings three benefits to a person:

1. It adds directly to the person's well-being (she feels good);
2. It enables the person to be productive (a healthy person works better and can work for longer hours than an unhealthy person);
3. It contributes to her longevity (a healthy person can be expected to live longer than an unhealthy person).

Items (1) and (3) are direct benefits (they constitute aspects of a good life), while item (2) is an indirect benefit (a means to a better life). It is humanity's good fortune that good health offers the three benefits jointly (they are not in competition!). Economists have developed elaborate methods for estimating the value of each type of benefit. Some involve asking people to report their willingness to pay for the benefits ("reported preference"), while others estimate the value of the benefits to people by observing their behavior ("revealed preference"). One way to estimate the combined benefit of improved health is by recording people's willingness to pay for better health (e.g., observing how much people spend on health). Some studies estimate the benefits enjoyed from item (2) by the output lost when workers are absent owing to illness (the costs of air pollution are often estimated on the basis of lost days of work owing to bronchial congestion).

Unfortunately, there are no systematic studies of items (1) and (2) that could be used to cover the 140 countries in question. The present study confines itself to item (3), by using tables that have been prepared by economists reporting the value of a statistical life in various countries. The approach is not without its weaknesses, but a first step had to be taken, and the authors of the IWR 2014 are to be applauded for inaugurating in an official publication what is likely to be a long process of evaluation of health as a form of capital asset.

That said, I do not believe that a central finding of the publication will be overturned, no matter how refined the valuation exercise becomes in future. It is that health is the most significant component of the wealth of nations. The authors show that it swamps the value of all other forms of capital assets by an order of magnitude and more. This will come as a surprise to all of us who have thought that in a reasonably well-ordered society the various forms of capital assets are on a par with one another; after all that is what the theory of economic development tells us to expect. The estimates in the IWR 2014 tell us otherwise.

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Chair of the IWR science advisory group and
Frank Ramsey Professor Emeritus of Economics
at the University of Cambridge

Preface

There can be no doubt that, over the past two decades, many countries have done much to improve their citizens' well-being. Of course, some have a better record than others, but overall the trend has been positive. Gross domestic product (GDP), although stagnant in some highly advanced economies, has risen steadily across most of the world. Human Development Index (HDI) scores have also improved for a substantial number of countries over the same time period. A cursory glance at these two trends might suggest that we are on the right track; that we should continue with business as usual.

> Countries have spent decades chasing production, consumption, and employment at all costs as the ticket to well-being.

That first glance would be misleading. Over the past twenty years we have seen, it is true, enormous gains in economic activity and output, and indeed as well in many of the quality of life indicators comprising the HDI.

On the other hand, serious questions have arisen as to the equitability and – more importantly – the sustainability of those gains. As Thomas Piketty demonstrated in his groundbreaking Capital in the Twenty-First Century, inequality is steadily growing, and will continue to as long as returns on capital exceed the rate of overall growth. In the era of globalization and instant communication, such levels of inequality, both within and across nations, are unsustainable.

Meanwhile, these gains have, as they have since the onset of Industrialization, come at a massive cost to ecosystem health, biodiversity, air quality, and climate resiliency.

One of the welcome key outcomes of the Rio+20 Conference on Sustainable Development was the agreement by countries to focus explicitly on sustainability in crafting the post-2015 development agenda. It is thus that the successors to the Millennium Development Goals will be known as the Sustainable Development Goals.

But how will we know when we are developing sustainably?

GDP growth still dominates policy planning, implementation, and evaluation for countries of all levels of development. Yet we have no way of knowing whether that growth is sustainable and inclusive – whether the activities that generate that growth will be possible in five years or fifty; whether they enrich the few at the expense of the many. Countries have spent decades chasing production, consumption, and employment at all costs as the ticket to well-being. But there is more to well-being than GDP, and it is time countries have approached policy planning strategically, and over the long term.

We hope that policy-makers will see the IWR 2014 as a useful tool, and as encouragement …

We have seen, since the seminal Brundtland Report in 1987, successive efforts call for audacity and ambition in tackling sustainability, but with only limited success. We will continue to see only limited success so long as our definitions of economic success and socioeconomic well-being continue to be based on GDP.

The case against GDP as a metric for economic success and socioeconomic well-being can be distilled into three main points: The first relates to the extent to which income alone is conflated with well-being. Although it is undoubtedly a necessary condition for well-being, it is not a sufficient one. As the World Bank's Voices of the Poor study found, poor people themselves define well-being not only in terms of income, but as "peace of mind, … belonging to a community, … safety, … [and] good health", among others.

Second, GDP measures gains in production and output at market prices, but ignores the environmental externalities produced through the production process. Nor does GDP reflect scarcity arising from dwindling natural resources, which are often public goods with no market prices.

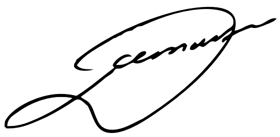
Third, GDP represents flows only for a specified, generally short, time period. It does not provide information on the state of those capital stocks necessary to generate the income measured. Equally important, it provides no insight into whether those capital stocks – what we call inclusive wealth – are sufficient to generate consumption flows for future generations.

The Sustainable Development Goals are thus destined for only limited success as long as we are missing an adequate framework to measure progress, and do so in an integrated and holistic manner.

The Inclusive Wealth Report (IWR) aims to provide a comprehensive overview of the status of capital stocks of three key assets for nations. These assets are tracked over the past 21 years, and the sustainability implications of trends and changes in these assets are appraised. The report does not attempt to provide a comprehensive overview of human well-being. Instead, it provides guidance and insight for policy-makers on how their economies are generating income, how depreciation and reinvestment are affecting capital stocks, and whether system trajectories are sustainable.

The IWR 2014, while still suffering from incomplete data in some areas, is a significant improvement over the IWR 2012 in both breadth and depth, particularly in the areas of education and health capital stocks. We hope that policy-makers at the international, national, and state level will see the IWR 2014 as a useful tool, and as encouragement to take the steps necessary to close gaps in data and to utilize the inclusive wealth accounts presented in the report as guidance.

We acknowledge that it may be early to use the report for practical policy-making; however, this was also the case 60 years ago, when nations began designing economic policies based on an incomplete set of GDP accounts. We are confident that countries will recognize the need for a comprehensive and integrated picture of the three pillars of sustainability, and the benefit of a tool to monitor and assess it. The report, however, should not only be useful for policy-makers but also our education systems, educators, and students – providing an understanding of the productive base available to societies and how it has to be managed to ensure sustainability of human well-being. We hope countries find the IWR 2014 useful as they gather in 2015 to finalize the post-2015 development agenda and the Sustainable Development Goals. It is time to plan – and measure – the future we want holistically, and inclusively.



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Science Advisory Board

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Reviewers

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IWR Team

As an initiative hosted by UNU-IHDP Secretariat, the IWR has involved many people that devoted much time and energy. Anantha Duraiappah, Executive Director of IHDP, who conceived of the idea for an IWR as early as 2008, took the lead as the IWR Director. Pablo Muñoz, Academic Officer at IHDP, who coordinated and oversaw scientific inputs to the report, is the IWR's Science Director. Elorm Darkey, Cecilia Fernandes, and Kira Petters provided analytical and quantitative support. We are equally grateful to our interns who devoted their time to this project, including Sergio de Marco and Muzaffar Yunusov. Special thanks to Katja Cloud and Louise Schenk, art and layout designers, as well as our consultants John Tkacik and Carmen Scherkenbach. We are also grateful to Sabrina Zwick for her technical and logistical support. And we would like to thank Terry Collins for helping disseminate the report through press releases and other media forums.

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Publisher

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Abbreviations

BAU .... business as usual
BMI........ body mass index
CGE .... computable general equilibrium
CLA .... physical amount of total cropland area of country
CO2 .... carbon dioxide
DSB .... Dispute Settlement Body
ECE .... estuarine and coastal ecosystems
EDF .... expected damage function
EGP .... Egyptian Pound
EIA .... Energy Information Administration
EPA .... United States Environmental Protection Agency
ESVD...... Ecosystem Service Valuation Database
ESW....... ecosystem service wealth
EU......... European Union
EU KLEMS. . EU level analysis of capital (K), labour (L), energy (E), materials (M) and service (S) inputs on a detailed activity level: statistical and analytical research project to analyse productivity and growth across Europe
FAO .... Food and Agricultural Organization of the United Nations
GBM ...... geometric Brownian motion
GDP .... gross domestic product
GHG....... greenhouse gas
GIS .... geographical information systems
GTAP ...... Global Trade Analysis Project
GTAP ...... Global Timber and Forestry Data Project
HAD .... High Aswan Dam
HC .... human capital
HDI........ Human Development Index
HS .... crop classification
HTA .... health technology assessment
IALS .... International Adult Literacy Survey
IEA .... International Energy Agency
IW......... inclusive wealth
IWI .... Inclusive Wealth Index
IWIadj ..... Adjusted Inclusive Wealth Index
IWR .... Inclusive Wealth Report
KPMG ..... Klynveld Peat Marwick Goerdeler
MA .... Millennium Ecosystem Assessment
MW .... megawatt
NAFSA .... Association of International Educators
NC .... natural capital
NCC....... Natural Capital Committee
NDP....... net domestic product
NIA........ national income account
NPV .... net present value
NRC....... National Research Council
NTFB...... value of non-timber forest benefits
NTFP...... non-timber forest products
OECD ..... Organisation for Economic Co-operation and Development
ONS....... Office of National Statistics
PC......... produced capital
PCE .... personal consumption expenditure
PIAAC ..... Programme for International Assessment of Adult Competencies
PIM........ perpetual inventory method
PISA....... Programme for International Student Assessment
PLA........ physical amount of pastureland area available
PPI .... per capita income, adjusted by a private consumption
PPP .... purchasing power parity
REDD...... Reducing Emissions for Deforestation and Degradation
RICE....... Regional Integrated Climate-Economy
RPA .... rental price per hectare
SEEA ...... System of Environmental and Economic Accounts

SEPA . . . . . . State Environmental Protection Administration
SNA . . . . System of National Accounts
STEM . . . . . science, technology, engineering, and mathematics
TEEB . . . . . . The Economics of Ecosystems and Biodiversity
TFP. . . . . total factor productivity
UN . . . . United Nations
UN–DESA. . United Nations Department of Economic and Social Affairs
UNDP . . . . . United Nations Development Programme
UNECE . . . . United Nations Economic Commission for Europe
UNECE CES United Nations Economic Commission for Europe - Conference of European Statisticians
UNEP. . . . . . United Nations Environment Programme
UNESCO . . United Nations Educational, Scientific and Cultural Organization
UN–OWG . . United Nations - Open Working Group
UNU–IAS . . United Nations University – Institute for the Advanced Study of Sustainability
UNU–IHDP United Nations University – International Human Dimensions Programme on Global Environmental Change
USSR. . . . . . Union of Soviet Socialist Republics
VARG. . . . . . The Value at Risk or Gain
VLS. . . . . value of a statistical life
VLSY . . . . . . value of a statistical life year
WAVES . . . . Wealth Accounting for Valuation of Ecosystem Services
WCL. . . . . . . wealth in cropland
WDR . . . . . . World Development Report
Wha . . . . wealth per hectare
WPL . . . . wealth in pastureland
WTO . . . . . . World Trade Organization
WTP. . . . . . . willingness to pay

Executive summary

The goals of the IWR 2014

The primary objective of the 2014 Inclusive Wealth Report (IWR 2014) is to provide quantitative information and analysis on long-term trends in global inclusive wealth (IW), and in doing so paint a picture of how nations are performing in their efforts to sustainably improve the well-being of their citizens.

Another objective of the report is to further drive global efforts toward improving conceptual understanding – and quantitative evaluation – of the components of inclusive wealth that remain all-too poorly understood: natural capital and human capital.

The IWR 2014 strives to cement the role of the Inclusive Wealth Index (IWI) as the leading comprehensive indicator for measuring nations' progress on building and maintaining inclusive wealth – a central pillar of the sustainability agenda – and gauging global sustainability as part of the post-2015 development agenda as outlined in the Sustainable Development Goals.

Structure and content of the IWR 2014

The IWR 2014 is presented in three parts and eight chapters, each beginning with key messages.

Part I comprises two chapters. Chapter 1 presents the empirical computations of inclusive wealth for 140 countries over the period of 1990 to 2010. Particular attention is paid to changes and trends in inclusive wealth, and respective changes across human, natural, and produced capital, as well as a comparative analysis with those of GDP and HDI. Chapter 1 provides an analysis of per capita trends, demonstrating the role population growth plays in sustainability.

Chapter 2 provides basic policy guidance for improving the inclusive wealth of a country, and offers initial ideas on how the IWR can be utilized to address typical policy challenges, such as energy and agricultural policy. The chapter also discusses some of the pitfalls of present health investment policies, and suggests gaps that the

IWR might address. The chapter concludes with suggestions on how to revise national accounts to include wealth accounts.

Part II of the report provides a detailed analysis of human capital wealth accounts. Chapters 3 and 4 offer in-depth reviews, as well as recommendations, on methodologies for generating education wealth accounts, and suggest using the lifetime income approach to measure human capital, which uses information on gender, demography, and age, among other categories, to compute the contribution of education to sustainable development.

Chapter 5 focuses on the theoretical model for computing health wealth accounts. The chapter gives insights into the contribution of health to human well-being, and the ways in which health is valued as a capital asset. There is considerable controversy involved in using valuation methods to value human health, some of which are discussed in the chapter. The authors suggest using the Value of a Statistical Life (VSL) for health wealth accounts, and provide some initial estimates for a small number of selected countries (not included in final IW country calculations).

Part III contains three chapters. Chapters 6 and 7 cover advances made in computing natural capital, while Chapter 8 describes how inclusive wealth can be used for project evaluation utilizing scenario analysis. Chapter 6 focuses especially on forest accounts, and explains improvements in calculations based on updated values for non-timber forest goods and services. These values were compiled from The Economics of Ecosystems and Biodiversity (TEEB) and Ecosystem Service Valuation Database (ESVD). Chapter 6 also recommends further research on generating a more complete computation of ecosystem services provided by forests, particularly with regard to carbon sequestration. For instance, countries could use the marginal contribution from a unit of forest maintained to inclusive wealth as a price for maintaining the forest for carbon sequestration.

Chapter 7 discusses several contentious issues involved in developing valuation estimates for ecosystem services, including methodologies for assuming benefit transfer across specific areas, or scaling up values to generate national-level figures. The final chapter of Part III provides an illustrative example for using the IW framework in project evaluation. The authors describe a model whereby a social cost-benefit analysis is computed for a project relating to investment in produced capital. The analysis makes an important contribution to existing project evaluation techniques by explicitly addressing the inter-linkages that occur across the various capital stocks. The chapter offers two case study examples, focusing on how infrastructure investments impact natural capital and health capital, respectively. Although the model looks retroactively at past projects, it offers insights into use for future scenario building that can inform investment decisions, in particular investments in produced capital.

Key messages

PART I

CHAPTER 1

Accounting for the inclusive wealth of nations: Key findings of the IWR 2014

- Chapter 1 utilizes the Inclusive Wealth Index per capita as an indicator of inter-temporal human well-being to assess nations' economic progress within the context of sustainable development. The chapter covers 140 countries over the time period between 1990 and 2010.
- Empirical evidence shows average positive growth in per capita inclusive wealth – and thus progress toward sustainable development – in 85 of the 140 countries evaluated (approximately 60 percent). Gains in inclusive wealth were in general lesser than those in GDP and HDI: 124 of 140 nations (89 percent) experienced gains in GDP, while 135 of 140 (96 percent) showed improvement in HDI over the same period.
- Human capital is the foremost contributor to growth rates in inclusive wealth in 100 out of 140 countries. In 28 countries produced capital was the primary contributor. On average, human capital contributed 54 percent of overall gains in inclusive wealth, while produced capital contributed 33 percent and natural capital 13 percent.
- Population growth and natural capital depreciation constitute the main driving forces of declining wealth per capita in the majority of countries. Population increased in 127 of 140 countries, while natural capital declined in 127 of 140 countries. Although both factors each negatively affect growth in wealth, changes in population were responsible for greater declines.
- Produced capital, the capital type for which by far the most exhaustive (and reliable) data exists, represents only about 18 percent of the total wealth of nations. The remaining capital types, which together constitute 82 percent of wealth (54 percent in human capital and 28 percent in natural capital), are currently treated as, at best, satellite accounts in the System of National Accounts.
- After adjusting for carbon damage, oil capital gains, and total factor productivity, the number of overall progressing countries drops from 85 to 58 of 140 counties (41 percent). Results show that all three factors negatively affected inclusive wealth in most of countries; of the three, total factor productivity adjustments had the greatest negative effect.

CHAPTER 2

The IWR and policy lessons

- Chapter 2 provides basic policy guidance for improving the inclusive wealth of a country based on the findings and lessons of the Inclusive Wealth Report.
- Countries striving to improve their citizens' well-being – and do so sustainably – should reorient economic policy planning and evaluation away from targeting GDP growth as a primary objective toward incorporating inclusive wealth accounting as part of a sustainable development agenda.
- Investments in human capital – in particular education – would generate higher returns for IW growth, as compared to investments in other capital asset groups, in countries with high rates of population growth.
- Investments in natural capital, in particular agricultural land and forest, can produce a twofold dividend: First, they can increase IW directly; second, they can improve agricultural resiliency and food security to accommodate anticipated population growth.
- Investments in renewable energy can produce a triple dividend: First, they can

increase IW directly by adding to natural and produced capital stocks; second, they improve energy security and reduce risk due to price fluctuations for oil-importing countries; third, they reduce global carbon emissions and thus carbon-related damages.

- Investments in research and development to increase total factor productivity, which decreased in 65 precent of countries, can immediately contribute to growth in inclusive wealth in nearly every country.
- Countries should expand the asset boundary of the present System of National Accounts (SNA), which currently captures only 18 percent of a country's productive base, to include human and natural capital, which are now measured only through satellite accounts, if at all.

PART II

CHAPTER 3

Human capital measurement: a bird's eye view

- Chapter 3 explores concepts and methodologies of measuring human capital for the purposes of inclusive wealth accounting.
- Measuring human capital can serve many purposes: it can help one better understand what drives economic growth; assess the long-term sustainability of a country's development path; measure the output and productivity of the educational sector; and facilitate informed discussions on social progress and well-being. In spite of this, human capital has not yet been included within the asset boundary of the SNA.
- The multifaceted nature of the concept of human capital creates substantial challenges for its measurement. By focusing on formal education and economic returns for individuals – rather than on human capital in general and all the benefits due to human capital investment – we can begin from an empirically manageable and practical point of departure.
- All existing approaches to measuring human capital have both advantages and disadvantages. However, the monetary measures generated from the cost-based and the income-based approaches should arguably be designated a "core" status. One reason for this is to enable direct comparison of figures with those for traditional produced capital covered by the SNA, the construction of which is a primary task of national statistical offices.
- Drawing on country experiences and international initiatives in the field of human capital measurement, one may conclude that an international trend is emerging toward an income-based approach, specifically the lifetime income approach. Estimates based on this approach can be used to assess the relative contribution of a range of factors (demographic, education, and labor market) to the evolution of human capital, and facilitate corresponding policy interventions.
- Despite significant progress having been made, there remain considerable challenges regarding data availability, and detailed methodological choices inherent in applying monetary measures. Further research should therefore be encouraged, including toward the compilation of quality data for use in international and inter-temporal comparisons; the construction of experimental satellite accounts, in order to better understand and reconcile the discrepancies between estimates based on the cost-based and the income-based approaches; and, eventually, toward incorporating human capital measures into the SNA in the future.

CHAPTER 4

Human capital: country estimates using alternative approaches

- Chapter 4 reviews and analyzes data on human wealth accounts from the IWR 2014 country sample.
- Human capital is critical to individual and societal well-being.
- The educational attainment of a country's younger cohort is frequently higher than the educational attainment of the older cohort; high levels of youth educational attainment correlate to high potential for improved well-being and economic growth in the future.
- Human capital indicators which depend solely on educational attainment information fail to capture the full potential of a country's population.
- Human capital measures including information on present and future demographic trends, education, and wage or income components are essential for appropriate policy formulation and analysis.

CHAPTER 5

Health capital

- Chapter 5 discusses the importance of health to human well-being and the concept of health capital.
- Health is an essential characteristic of human well-being.
- Health capital is an important part of inclusive wealth.
- The economic model of health capital presented in this chapter allows health to affect human well-being through three distinct channels: direct well-being, productivity, and longevity.
- Most health capital services influence human well-being directly rather than through the production of goods and services that are counted in GDP.
- In the absence of better estimates of the direct and productivity effects, gains in life expectancy should be used as the primary measure of health capital.
- Annual gains in health capital in the United States are worth approximately US$10,000 per person in monetary terms.

PART III

CHAPTER 6

Forest wealth of nations

- Chapter 6 focuses on forest ecosystems as a key component of natural capital, and looks at current efforts to internalize benefits from forest ecosystem services to well-being.
- Forest ecosystems provide a huge range of tangible and intangible benefits for human well-being. These are of immense value and represent an important component of national and global wealth.
- Demographic trends and economic growth are exerting increasing pressure on forest capital. Accounting more fully for this wealth, and how it is changing as a result of economic and social activity, is urgently required. The estimates in this chapter provide a tentative first step in this direction.
- From a global perspective, in 2010 for the selected countries, forest wealth amounted to more than US$273 trillion. On the face of it this wealth, in absolute terms, seems concentrated in relatively few countries. However, for many other countries, forest capital remains an important component of national wealth. Many of these countries (although not all) have experienced alarming losses in forest capital over the past 20 years.
- From an accounting perspective, these losses are frequently hidden from view. It is thus essential that nations pursue better

accounting to understand quantity, quality, and distribution of forest wealth. Indeed, keeping forest wealth intact – and, moreover, investing in forests to reverse past losses – is an important pre-condition for sustaining development.

CHAPTER 7

Challenges to ecosystem service valuation for wealth accounting

- Chapter 7 reviews the use of ecosystem service valuation for wealth accounting.
- In recent years, substantial progress has been made by economists working with ecologists and other natural scientists in valuing some ecosystem goods and services.
- However, difficulties in measurement, data availability, and other limitations still preclude the valuation of certain ecosystem services.
- There is often uncertainty associated with estimated ecosystem service values, and even more so with scaling up of local values to regional or national levels or updating these values annually, which poses problems for their use in wealth accounts.
- In the absence of reliable estimates, the temptation is to use "second-best" estimates, or to transfer values from other locations; however, such methods should be used with caution and only under specific circumstances, at the risk of generating unrealistic values.
- Progress in incorporating ecological capital in wealth accounts therefore requires developing more accurate methods of valuing ecosystem goods and services and applying them to a wider range of ecosystems.

CHAPTER 8

Using inclusive wealth for policy evaluation: the case of infrastructure capital

- Chapter 8 explores strategies and methods for using inclusive wealth in project evaluation.
- Wealth accounting to date has focused primarily on the assessment of past performance in economies, by measuring changes to produced, natural, and human capital.
- In order to use inclusive wealth for policy evaluation, we must estimate the impacts of a given policy on the trajectories of the capital stocks that comprise wealth.
- Infrastructure is an important policy domain because proposed changes to current systems affect many, if not all, capital stocks, which results in capital stock interactions and trade-offs.
- A systems view of policy evaluation is necessary in order to map and quantify these impacts and trade-offs; this can be managed using conceptual and mathematical models that capture integrated physical and economic processes.
- To illustrate how one might conduct wealth-based policy evaluation, we use two infrastructure case studies – coal-fired power generation in China and the High Aswan Dam in Egypt. The case studies rely on integrated physical and economic models to quantify capital stock impacts of past infrastructure decisions.
- Such models can be used to evaluate prospective infrastructure systems as well, although doing so requires careful consideration of future uncertainty. Scenario analysis is a useful and flexible method for incorporating uncertainty into wealth-based policy evaluation.

Inclusive wealth: an overview

Anantha Duraiappah and Nabila Jamshed

Context

For more than half a century we have appraised our progress as nations on the basis of how much we produce, consume, and invest; we have measured that progress in U.S. dollars and aggregated into an easy-to-compare metric: gross domestic product (GDP). We have been working under the implicit underlying assumption that the resource base upon which this growth depends is infinite. But what if it is not – what if this growth is not sustainable? And further, what if the reality of human well-being is not being accurately reflected in our computations of GDP; or if our GDP growth rates are not resulting in improvements in human well-being?

The dialogue surrounding what is to become the post-2015 global development agenda has recognized the shortcomings of the present development agenda, as well as the limitations inherent in using GDP as a yardstick for progress (UNITED NATIONS 2012, UNU-IHDP AND UNEP 2012). The outcome document from the 2012 global summit, the Rio+20 United Nations Conference on Sustainable Development, calls for a paradigm shift in the way we view development and growth, and for a set of Sustainable Development Goals (SDGs) that reflect that paradigm shift. At the same time, there is growing recognition that conventional national accounting frameworks have overlooked some of the most important assets a country possesses, treating them as peripheral, rather than central to human well-being.

We require a more comprehensive framework for measuring our future progress – not necessarily to replace, but rather complement, GDP – and to reveal the full extent of a country's assets, or productive base. The shift toward sustainability as a core development pillar demands an index that can quantify, measure, and track sustainability. The concept of inclusive wealth, and an inclusive wealth indicator, is a response to these deliberations and demand.

The Inclusive Wealth Report (IWR) is a biennial effort to evaluate the capacities of nations around the world to improve their citizens' well-being, and do so sustainably for the benefit of present and future generations. The report provides a more comprehensive and accurate measure of human wealth, development, and progress. The IWR validates our suspicions that GDP is an inadequate measure for assessing long-term prosperity, and reveals education, health, and the environment as investments that will truly unleash the potential of young and interconnected populations around the world for development. The Inclusive Wealth Index (IWI) will be crucial to measuring progress toward the Sustainable Development Goals, and in the planning and evaluation of sustainable development as a policy paradigm.

Inclusive Wealth Index: beyond GDP and HDI

Inclusive Wealth is a tool, rather than a prescription. In the first IWR in 2012, we demonstrated that the principal pillars of the wealth of nations, human capital and natural capital, have remained largely hidden to policy-makers due to the limitations of traditional economic indices. It was discovered that the biggest returns were coming from factors not accounted by our systems of national accounts, nor, by extension, reflected in GDP.

GDP is a useful and practical tool for measuring economic production, but it does not impart any information on the state of the resource base upon which production relies. The 2010 Report of the French Government's Commission on Measurement of Economic Performance and Social Progress, also known as the Stiglitz-Sen-Fitoussi Commission, pointed to a number of ways in which nations were "mis-measuring" development through using GDP (STIGLITZ ET AL. 2010). These range from measurement errors and exclusion of key variables, to incomplete and misleading data. The commission echoed the warnings of Simon Kuznets – the father of GDP – of using GDP to measure societal progress (KUZNETS 1934).

The underlying framework used to compute GDP are the systems of national accounts. These national accounts have in recent years made some progress toward capturing a broader picture of the economic system, in particular by extending accounting to include the environmental system (see SEEA 2013). However, the accounts measured are still flow accounts – they measure only financial and material flows over a given time period – and thus do not reflect the sustainability dimensions of the economy. It is for this reason that recent attempts to internalize environmental externalities into national accounts, such as Green GDP, still fall short of providing an indicator to understand and track sustainability.

Another effort, the Human Development Index (HDI), was created in the 1990's as an initiative to provide an alternative to GDP in measuring human development progress in terms of life expectancy, education, and income (United Nations Development Programme 1990-2014). Although certainly illuminating, HDI still has significant – in sustainability terms – shortcomings. A primary drawback of HDI is its inability to adequately incorporate the ecological dimensions of sustainable development, and that it does not integrate social goods in capital accounts to complement GDP.

"… a better way to size up wealth"
– *The Economist*

The IW does not reject GDP. It acknowledges GDP's practicality for tracking efficiency of resource use for production, and for providing an overview of interdependencies among economic sectors held within the system of national accounts. Neither does the IW aim to modify GDP to accommodate missing elements, as Green GDP initiatives attempt. The IW starts from the premise that all development is conditional on the existence of several key assets, and that the total value of these assets should not be allowed to decline if human well-being is to be furthered sustainably.

The inclusive wealth framework takes a different approach to that of earlier efforts to capture a broader sense of human well-being and progress. Inclusive wealth directs its focus not on the constituents of well-being – measuring as does the HDI specific outcomes that reflect well-being – but rather the determinants of well-being, the set of "ingredients" necessary for nations to bring about those outcomes. These determinants can be found in several pools of national capital assets, or the productive base of economies.

Inclusive wealth and the post-2015 Sustainable Development Goals:

The outcome document of the Rio+20 UN Conference on Sustainable Development, The Future We Want, set out to establish a broader development agenda for the Millennium Development Goals (MDGs) after their evaluation in 2015 (UNITED NATIONS 2012). The international policy dialogue on the Sustainable Development Goals (SDGs) that followed is clear on the need for long-term planning to ensure achievements are not merely temporary, but strive to improve the lives of both present and future generations. The SDGs also take sustainable development from the environmental realm to include social and economic aspects. In doing so, the SDGs offer a unique and much-needed catalyst to converge economic aspirations with the social and environmental goals, and not consider them independently, as is currently the case.

> "... if governments could agree to use the IWI as part of their overall economic accounting, it would be a substantial step towards true sustainable development."
>
> – *The Huffington Post*

Sustainable development will be about transformative shifts (UNITED NATIONS 2013), and should include, according to an Open Working Group charged with developing the draft goals, the following arenas: poverty alleviation, food security, inclusive and quality education, gender equality, water and sanitation, sustainable energy for all, inclusive and sustainable economic growth for all, decent work, innovation, inclusive and sustainable industrialization, reduced inequality, inclusive human settlements, sustainable consumption and production, sustainable use of oceans and terrestrial ecosystems, and inclusive societies and institutions (UNITED NATIONS 2013).

The Open Working Group of the SDGs has rightly identified key issues and priorities to guide nations' and the global community's sustainable development agenda over the coming decade. The next step will be to develop a set of indicators for each of the goals and targets included in the final ratified list. In doing so, however, they must keep in mind what the predecessors of the SDGs – the MDGs – did not: that indicators should capture the interdependencies among various goals. That is, indicators must provide information pertaining to trade-offs and synergies among the goals in an integrated and holistic manner. This will allow policy-makers to understand the trade-offs and knock-on effects of prioritizing some goals over others, and the areas in which synergies can be leveraged to achieve a multiplicity of positive outcomes across several goals.

The SDGs call for "measurements of progress on sustainable development that complement GDP". The IWI might offer such a tool. The IWI helps countries measure sustainable development within the framework of growth and prosperity, and will facilitate integration of the SDGs into the rationale of national economic growth strategies.

The IWI premises development on opportunity. The underlying axiom of the inclusive wealth concept is simple and elegant: changes in the overall value of all assets in a country over time must be positive if the economy is to be considered on a sustainable trajectory (see Annex 1 for a description of the model and the underlying prepositions and theorems). The value of the change in each asset stock is computed using the social price – commonly called by economists the shadow price – of each asset, multiplied by the change in the physical stock of that particular asset. These prices in effect reflect the weighting preference of individuals across the various capital assets.

The IWR 2012

The Inclusive Wealth Index was launched with the first IWR at Rio+20 in 2012, and represented the first attempt by the international scientific and policy communities to develop a framework for quantifying and tracking sustainable development, inclusive of produced, human, and natural capital. It drew upon two decades of data for 20 countries covering three types of capital to quantify and demonstrate the impact and returns of investing in them. The report, subtitled Measuring progress toward sustainability, focused on natural wealth, and offered valuable insights for development policy. The report was experimental in nature but, as Time Magazine noted, was the first serious effort to measure the true total wealth of nations.

The results from the IWR 2012 were both promising and sobering. Promising was that 19 of the 20 countries evaluated experienced positive changes in overall wealth. Still, after factoring in population, inclusive wealth growth rates per capita level turned negative for five countries. It was clear that population growth in these five countries had outpaced growth of inclusive wealth, highlighting the oft underplayed role of population growth in determining the sustainability trajectory of countries.

The sobering factor that emerged from the IWR 2012 was the status of natural capital. The IWR found that 19 of 20 countries were depleting natural capital while failing to adequately invest in rebuilding this category, despite evidence that returns on investment in natural capital far outweighed investing in produced capital – infrastructure, buildings, roads, etc. – for a majority of countries. Although 14 out of the 20 countries witnessed positive per capita growth rates on their overall asset base, growth rates were marginal and could easily turn negative should declines in natural capital continue apace. Moreover, the costs of natural capital declines in the IWR 2012 were conservative estimates; actual growth rates might indeed have become negative had the IWR 2012 used less cautious estimates. These results reinforced our contention that the prevailing understanding of economic development must change to meet the needs of the 21st Century.

The IWR 2014: what is new

The IWR 2014 has been expanded from 20 to 140 countries, and the time horizon has been updated to include data from 2009 and 2010 in addition to the original 1990 to 2008 periods. While the IWR 2012 included a special focus on natural capital, the IWR 2014 does the same for human capital.

Spending on human capital has traditionally been considered as expenditure in core national accounts. The IWR 2014 makes a powerful case for treating education and other spending in human capital as investments, rather than expenditures. Education has long been considered a social good, and one that is crucial for future growth; however the IWR 2014 demonstrates it is also an engine of wealth today, and puts numbers to this value. In increasingly knowledge-based economies, education's role as driver of production has become more important than ever. That role is two-pronged: education is positively correlated to produced capital, as well as enhancing opportunity, which is at the core of human well-being.

"… this impressive research project … is the first serious attempt to measure the total wealth of the planet's richest countries."
– *TIME*

The two main components of human capital are education and health. However, while health is a key component of human capital, we have left it out of the main human capital wealth accounts as we did for the IWR 2012. This was done for a number of reasons: First, because of the relatively high value of health capital, it dominates and skews overall inclusive wealth figures. While we are convinced that health capital is indeed valuable, the methodology used for computing health values is still under debate; until there is consensus among health economists on these methodologies, it would be inappropriate to integrate as such into overall wealth accounts.

We have, however, included in the IWR 2014 a chapter in Part II which delves into the subject, providing a detailed analysis of health capital and the challenges and opportunities it poses for the national accounts and the computation of inclusive wealth. Sample coverage for a selected number of countries is represented in Part II of this report for health capital. Our goal is to integrate health capital in the 2016 report, given continuing progress on methodologies and database construction on health.

The education component in the main inclusive wealth accounts is unchanged in 2014. This is due to a lack of available data necessary to undertake a more detailed analysis as prescribed in the chapters addressing education in Part II of the report. However, the education wealth accounts have been expanded to account for new methodologies, and in Part II calculated for a selected number of countries in which necessary data was available. The lessons learned from this exposition will help guide in the revision and updating of education accounts for the broader set of countries for the IWR 2016.

The natural capital wealth accounts have been revised with new estimates for forest accounts, which included improved estimates for forest physical accounts and updated values for non-timber forest product goods and services taken from The Economics of Ecosystems and Biodiversity (TEEB) and Ecosystem Service Valuation Database (van der ploeg and de groot 2014). In addition, Part III discusses recent advances in using new typologies for forest accounts, with special attention paid to the challenges and opportunities involved in using social prices from economic valuation methods for ecosystem services.

Total factor productivity (TFP) was treated as a residual in the IWR 2012. The estimates were taken from the Total Economy Database (conference board 2012). In the IWR 2014, TFP is still treated as a residual, but is now generated by including natural capital as an explicit factor input to the production process. This approach allows us to extract directly the contribution of natural capital toward production, and not have it be reflected implicitly in the TFP, as was the case in 2012. We were therefore able to isolate to a closer approximation the real role technological innovation and creativity played in production, as well as other implicit capital types not yet accounted in building the inclusive wealth of the country.

The final addition for 2014 is policy. We present some first attempts at interpreting the findings of the IWR 2014 into implications for national and intergovernmental policy-makers. The report also takes a first stab at using scenario analysis for specific areas, applying inclusive wealth methodology and results to guide policy-making at the project level. The inclusive wealth framework allows using a social cost-benefit approach to project design and implementation (dasgupta et al. 1972). The first attempt focuses on produced capital, but the lessons learned can be easily transferable to the other capitals.

Audience and structure of the IWR 2014

The primary audience of the Inclusive Wealth Report 2014 will be researchers and policy-makers. The inclusion of environmental damage in the accounts – such as damages caused by global environmental and climate change – can be useful in determining transnational compensations, and as a guide for international negotiations on trans-boundary assets.

The report will also be useful for national economic planning agencies when considering macroeconomic fiscal policies. Changes in the various capital assets and their contributions toward inclusive wealth can provide key information as to where future investments should be targeted to generate optimal returns for increasing the overall productive base of a country.

The IWR is also targeted toward the research community. The 2014 edition identifies and elaborates on a large number of areas within the framework still in need of theoretical refinement and empirical data. For instance, the IWR 2014 does not address the issue of inequality within and among nations; yet the significance of wealth as a common denominator for measuring inequalities is becoming more evident, as recently demonstrated by Thomas Piketty in Capital in the 21st Century (PIKETTY 2014). Using inclusive wealth rather than income alone can provide a more complete picture of inequality in contemporary societies across the world.

The IWR 2014 is presented in three parts. Part I comprises two chapters. Chapter 1 presents the empirical computations of inclusive wealth for 140 countries over the period of 1990 to 2010. Particular attention is paid to the changes in inclusive wealth, and respective changes across human, natural, and produced capital. Chapter 1 also compares IWR trends with those of GDP and HDI. Importantly, Chapter 1 also provides an analysis of per capita trends, demonstrating the role population growth plays in sustainability.

Chapter 2 provides basic policy guidance on investment strategies to improve the inclusive wealth of a country. The chapter offers some initial ideas on how the IWR can be used to address typical policy issues such as energy or agricultural policy. The chapter also discusses some of the pitfalls of present health investment policies, and suggests gaps that the IWR might address. The chapter concludes with suggestions on how to revise national accounts to include wealth accounts.

Part II of the report provides a detailed analysis of human capital wealth accounts. Chapter 3 and 4 offer in-depth reviews as well as recommendations on methodologies for generating education wealth accounts, eventually suggesting a specific approach (the lifetime income approach) to measure human capital, which uses information on gender, demography, and age, among other categories, to compute the contribution of education to sustainable development.

Chapter 5 focuses on the theoretical model for computing health wealth accounts. The chapter gives insights into the contribution of health to human well-being, and the ways in which health is valued as a capital asset. There is considerable controversy involved in using valuation methods to value human health, some of which are discussed in the chapter. The authors go on to suggest using the Value of a Statistical Life (VSL) for health wealth accounts, and provide some initial estimates for a small number of selected countries.

Part III of the report contains three chapters. Chapters 6 and 7 cover advances made in computing natural capital, while Chapter 8 describes how inclusive wealth can be used for project evaluation using scenario analysis. Chapter 6 focuses especially on forest accounts, and explains improvements in calculations based on updated values for non-timber forest goods and services. These values were compiled from The Economics of Ecosystems and Biodiversity (TEEB) and Ecosystem Service Valuation Database (van der Ploeg and de Groot 2014). Chapter 6 also recommends further research on generating a more complete computation of ecosystem services provided by forests, particularly with regard to carbon sequestration. It is a component that might be useful in the Reducing Emissions from Deforestation and Degradation (REDD) initiative. Countries might, for instance, use the marginal contribution to inclusive wealth from a unit of forest maintained as a price for maintaining the forest for carbon sequestration. Although the wealth accounts are still experimental, the potential of using the inclusive wealth accounts for this purpose is promising.

Chapter 7 discusses several contentious issues involved in developing valuation estimates for ecosystem services, including methodologies for assuming benefit transfer across specific areas, or scaling up values to generate national-level figures. The final chapter of Part III provides an illustrative example for using the inclusive wealth framework in project evaluation. The authors describe a model whereby a social cost-benefit analysis is computed for a project relating to investment in produced capital. The analysis makes an important contribution to existing project evaluation techniques by explicitly addressing the inter-linkages that occur across the various capital stocks. The chapter offers two case study examples, focusing on how infrastructure investments impact natural capital and health capital, respectively. Although the model looks retroactively at past projects, it offers insights into use for future scenario building that can inform investment decisions, in particular investments in produced capital.

The reader is encouraged to review the data and technical notes annexed at the end of the report for a more detailed discussion of the specific methods used in the IWR 2014. A brief description of the inclusive wealth framework is provided as well, giving those unfamiliar with inclusive wealth an understanding of the concepts and definitions that make up the inclusive wealth theorem for sustainability.

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Part I:

What does the data say?

CHAPTER 1

Accounting for the inclusive wealth of nations: key findings of the IWR 2014

Pablo Muñoz, Kira Petters, Shunsuke Managi, and Elorm Darkey

KEY MESSAGES

This chapter utilizes the Inclusive Wealth Index per capita as an indicator of inter-temporal human well-being to assess nations' economic progress within the context of sustainable development. The chapter covers 140 countries over the time period between 1990 and 2010.

Empirical evidence shows positive average growth in per capita inclusive wealth – and thus progress toward sustainable development – in 85 of the 140 countries evaluated (approximately 60 percent). Gains in inclusive wealth among the countries analyzed were in general lesser than those in GDP and HDI; 124 of 140 nations experienced gains in GDP, while 135 of 140 showed improvement in HDI over the same period.

Human capital is the foremost contributor to growth rates in inclusive wealth in 101 out of 140 countries. In 27 countries produced capital was the primary contributor. On average, human capital contributed 55 percent of overall gains in inclusive wealth, while produced capital contributed 32 percent and natural capital 13 percent.

Population growth and the depreciation of natural capital constitute the main driving forces of declining wealth per capita in the majority of countries. Population increased in 127 of 140 countries, while natural capital declined in 116 of 140 countries. Although both factors each negatively affect growth in wealth, changes in population were responsible for greater declines.

Produced capital, the capital type for which by far the most exhaustive (and reliable) data exists, represents only about 18 percent of the total wealth of nations; while the remaining capital types, which together constitute 82 percent of wealth (54 percent in human capital and 28 percent in natural capital), are at best treated as satellite accounts in the System of National Accounts.

After adjusting for carbon damage, oil capital gains, and total factor productivity, the number of overall progressing countries drops from 85 to 58 of 140 counties. Results show that all three factors negatively affected inclusive wealth in most of countries; of the three, total factor productivity adjustments had the greatest negative effect.

1. Introduction[1]

For those interested in understanding a nation's short term progress in increasing gross economic output, there is a veritable flood of raw data, macro trend research, comparative analysis, and prescriptive advice available from which to choose. For those interested in understanding a nation's progress in improving its citizens' well-being from a long term perspective, there is significantly less information available.

For many years economists and policymakers have relied primarily on gross domestic product (GDP) as a proxy indicator for gauging countries' welfare[2]. But the pursuit of GDP growth has, in many instances, failed to deliver the gains in overall human welfare for which many had hoped (STIGLITZ ET AL. 2009). There is growing consensus (discussed in the introduction and throughout this report) that GDP is falling short in this regard (BARTELMUS 2014). This should not be surprising. GDP is a limited, unidimensional measure of market activity.

Well-being is, on the other hand, a complex, multidimensional concept that goes far beyond material living conditions, for which GDP might in certain cases be reasonably enlisted as a valid metric. Well-being encompasses not only income but also dimensions such as educational opportunity, health and quality of life, natural landscapes and ecosystems, and social networks and relationships, among others.

This multidimensional nature introduces significant challenges for those attempting to articulate the notion into a quantitative indicator within a consistent theoretical framework. Despite the challenges, a number of efforts have attempted to fill the gaps left by GDP, and measure, evaluate, and track meaningful progress of nations in improving well-being.

Some reactions on this issue are reflected in a resolution adopted by the UN General Assembly in 2012 and enshrined in "The Future We Want" outcome document of the Rio+20 summit, which explicitly recognizes the need for broader measures of progress to complement GDP (UNITED NATIONS 2012). The report "Resilient People, Resilient Planet", published in 2012 by the United Nations Secretary-General´s High Level Panel on Global Sustainability, called for the development of an indicator for sustainable development.

The United Nations has not been the only supporter of change on this front. In 2007, the European Union launched the Beyond GDP initiative, which aims to develop indicators that integrate environmental and social aspects of progress. In 2011, the OECD launched the Better Life initiative to better track progress in improving human well-being (OECD 2014). Other contributions to the debate have come from the Beyond Economic Growth initiative at the World Bank (SOUBBOTINA 2004).

At the same time, national level programs have also made headway in pushing indicators beyond GDP. Perhaps the most famous example is Bhutan's Gross Domestic Happiness indicator. India too has delved into the issue with its Report on Green National Accounts (DASGUPTA ET AL. 2013); as has the United Kingdom with the Measuring National Well-Being initiative (OFFICE FOR NATIONAL STATISTICS 2014). France has also been at the forefront of *beyond GDP,* and the output of its 2008 "Commission on the measurement of economic performance and social progress", the so called Stiglitz-Sen-Fitoussi Report (STIGLITZ ET AL. 2009), has provided the philosophical and theoretical underpinnings for much of the concrete progress over the past several years.

There are now a number of proposed *beyond GDP* indicators available, including (but not exclusive of): the Human Development Index (UNITED NATIONS DEVELOPMENT PROGRAMME 1990-2013); the Happiness Index (HELLIWELL ET AL. 2012, EASTERLIN 2003, KAHNEMAN ET AL. 2006, LAYARD 2005, AND OTHERS); the Genuine Progress Indicator (KUBISZEWSKI ET AL. 2013); indicators derived from the System of National

1 We gratefully acknowledge comments and suggestions provided by Matthew Agarwala, Giles Atkinson, and Nick Hanley.

2 We use "welfare" and "well-being" interchangeably.

Accounts 2008 (UNITED NATIONS 2009) and the System of Integrated Economics and Environmental Accounts 2013 (UNITED NATIONS ET AL. 2012); and the Better Life Index[3] (OECD 2014).

It is unlikely that a single indicator can provide the information needed for understanding well-being and informing long-term policy planning in the area of sustainable development. Instead, several indicators, incorporating multiple dimensions, will be necessary.

In this context, the Inclusive Wealth Report (IWR) project proposes wealth accounting as a complementary indicator of social progress and human well-being.

Wealth accounting at one level aims to fill gaps left by traditional economic indicators, some of which are derived from the System of National Accounts (SNA). For instance, GDP largely ignores biophysical changes to environmental systems caused by economic production, yet those changes often drastically affect human well-being, both directly and indirectly.

Wealth accounting also internalizes sustainability by tracking the changes in the value of a nation's capital asset stocks – its productive base – so as to understand how a its activities and policies now will impact its future opportunity to generate well-being. This concept of opportunity is central to inclusive wealth. Rather than measure the constituents of well-being – the specific outcomes and circumstances that make up quality of life for us now – inclusive wealth measures the determinants of well-being – the capital stocks upon which nations rely to bring about those outcomes. This is a key pillar of intergenerational sustainability, and should be included in any assessment of a nation's economic performance.

Inclusive wealth accounting also allows for analysis and understanding of trade-offs and other relationships among the various capital stock trajectories as an economy evolves, linking macroeconomic variables such as consumption and investment in several assets, including environmental capital stocks.

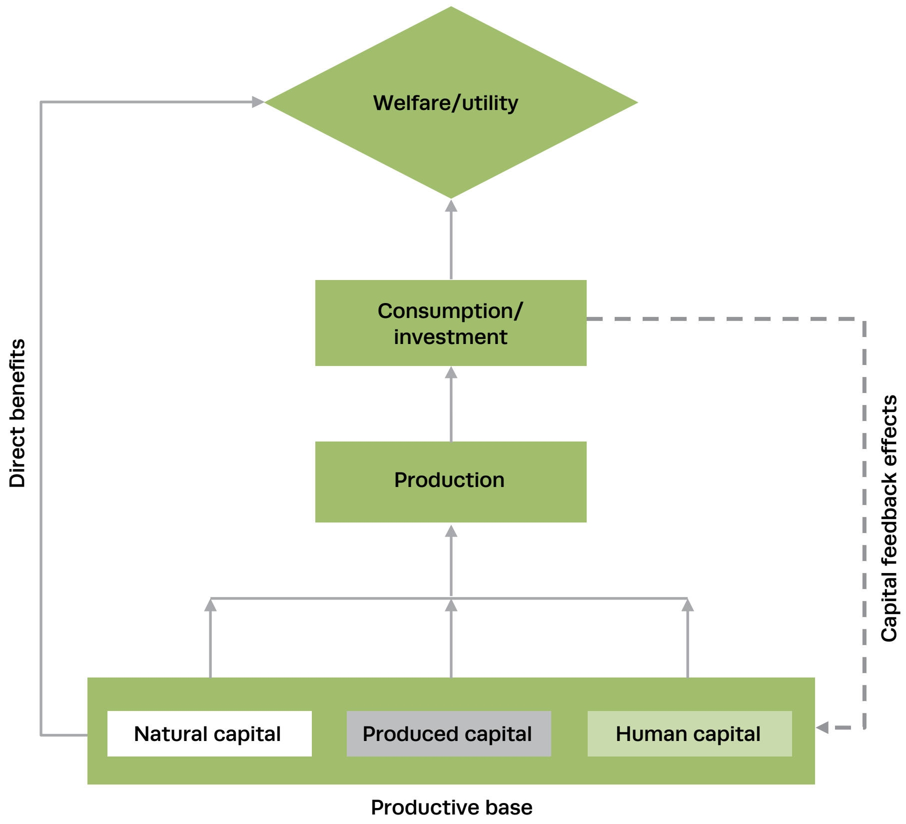
The IWR tracks changes in three categories of capital assets: human capital, produced capital, and natural capital. While some of the components of these capital stocks, such as manufactured capital, are extensively accounted for within the SNA, other important assets, including natural capital, human capital, and health capital, have been poorly or not at all assessed and reflected. To be sure, the SNA recognizes the importance of these capital assets, and recommends accounting not only for produced capital but also for some aspects of natural capital, such as fossil fuel and mineral deposits and forest cover. The SNA also considers the quantification of human capital of relevance; its measurement, however, falls outside the boundaries of analysis (UNITED NATIONS 2009), and is therefore excluded from nations' balance sheets.

In this chapter, we present the key findings from the wealth accounts of 140 countries in 2014. While the overall methodology for computing the Inclusive Wealth Index (IWI) is largely the same as it was in 2012, it has been expanded and improved in several ways worth noting: First, the country sample has been expanded from 20 countries – representing 72 percent of world GDP and 56 percent of the global population – to 140 countries, together representing 99 percent of GDP and 95 percent of the global population. Second, the time period reviewed has been extended by two years, stretching now from 1990 to 2010. Third, the methodologies for calculating several components of natural capital have been updated and improved, particularly with regard to calculating contributions of forest ecosystem services toward human well-being. Fourth, proxy variables used to represent contributions of inputs for which data is lacking, total factor productivity (TFP) estimates, have been improved by adding in the

3 The index focuses on eleven key aspects of life, including not only income and jobs, but also housing, environment, social network, work–life balance, personal security, education, health, whether citizens feel part of the democratic process, and their level of satisfaction with life in general.

FIGURE 1

A three-capital model of wealth creation



production function natural capital along with produced and human capital.

The chapter is organized into four sections, in addition to the introduction: Section 2 presents a brief overview of the theory and methodology behind the Inclusive Wealth Index. Further details regarding the architecture of the index can be found in the conceptual and methodological annexes (Annex 1 and 2) at the end of the report. Section 3 provides some of the key results and upshots stemming from the inclusive wealth calculations. Further details on the data inputs presented in this section are located in Annex 3, while the full data set is available at www.inclusivewealthindex.org. Section 4 discusses some of the challenges and limitations of the study. Section 5 contains concluding remarks.

2. Methods

The Inclusive Wealth Index is premised on a body of work[4] (e.g., DASGUPTA 2009, ARROW ET AL. 2012, HULTEN 1992, HEAL AND KRISTRÖM 2005) for linking the discounted present value of all future consumption possibilities to the total worth of the capital assets (or wealth) in an economy.

This implies that present decisions involving countries' asset portfolio management have consequences for a population's future consumption opportunities. In wealth accounting, capital assets are both the inter-temporal means of production, as well as a direct source of human well-being by filling the current population's consumption needs (see Figure 1). Because wealth accounting is concerned with sustaining well-being over time, the approach is especially relevant for studying sustainability issues.

The wealth accounting framework can be thought as a supply-driven accounting system, in

4 See also the conceptual framework in Annex 1.

which wealth is the constraint of inter-temporal consumption; it follows thereby that changes (positive or negative) in the total worth of capital assets will increase (or decrease) inter-temporal welfare. For the IWR we group capital assets into the following three categories: human capital (HC), produced capital (PC), and natural capital (NC). These three capital asset groups can all be broken down into various subcomponents; for the IWR 2014 we look especially closely at human capital (see Figure 2). For the IWR 2014, as in 2012, we have excluded health capital from the human capital asset group as this asset, according to existing methodologies, so dominates wealth capital that any changes, even modest, would disproportionately influence overall trends in capital asset stocks. Human capital accounts thus reflect only the education component of a population.

The basket of assets comprising the resource base is calculated by using the marginal contribution of each asset type to social welfare, which is represented by the social (or shadow) price of the assets under evaluation. Such prices act as a weight in the metric, resulting in the measure of wealth, or Inclusive Wealth Index (IW):

EQUATION 1

$$Wealth = P_{pc}\ x\ PC\ + P_{hc}\ x\ HC\ + P_{nc}\ x\ NC$$

while the changes in wealth, also called inclusive investment, are captured by assessing changes in capital assets over time:

EQUATION 2

$$\Delta Wealth = Inclusive\ Investment = P_{pc}\ x\ \Delta\ PC\ + P_{hc}\ x\ \Delta\ HC\ + P_{nc}\ x\ \Delta NC$$

It is worth highlighting that changes in IW are driven solely by changes in the productive base (the entirety of capital assets) of the economy, as prices (the weights in the index) are assumed to be constant and represented in most of cases by the average price of the time span under evaluation in this study. In this way, changes in wealth are induced only by real changes in the physical amount of the various capital forms, and not simply by price fluctuations, which may be subject to contingent situations. Over the long run, however, price fluctuation may nonetheless be important for building other capital types. We therefore suggest accounting separately for those capital gains (or losses) due to price changes.

We represent this by, for instance, accounting oil capital gains (and losses) due to fluctuations in oil prices separately from physical changes in the resource base. As we see in Sections 3.4, this is particularly relevant for oil-extractive economies such as Saudi Arabia, Kuwait, or Iraq, as they are positively affected by the changes in oil prices. Conversely, net oil importing countries tend to see welfare negatively affected from rises in oil prices, as their basket of consumed goods and services diminishes.

In addition to oil capital gains, there are two other items in our accounts that we keep separate from IW: carbon damage, and total factor productivity.

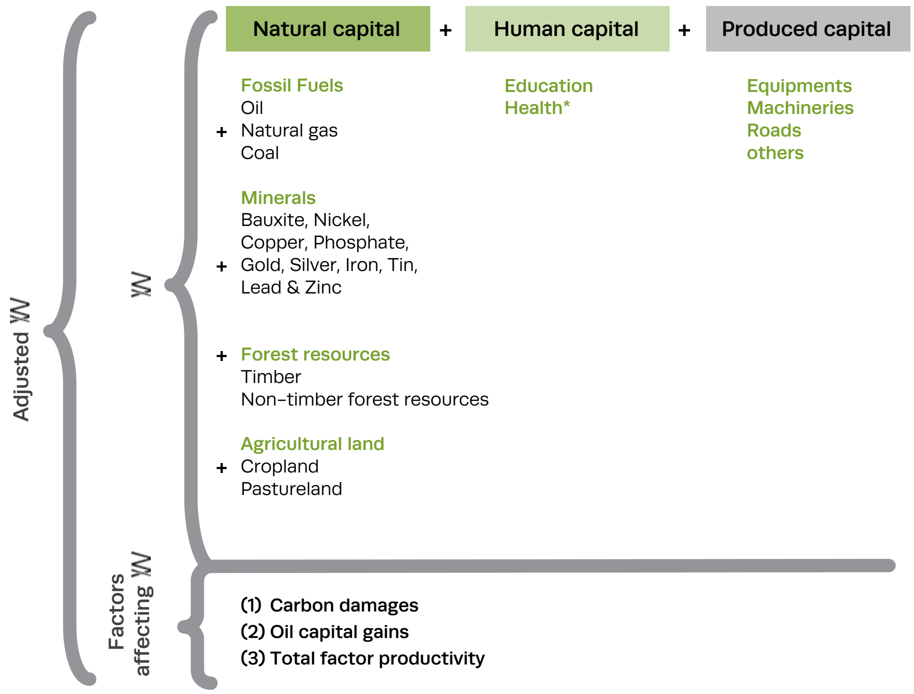
The decision to exclude damage experienced by nations as a result of increased CO2 concentrations in the atmosphere was made because those effects do not themselves constitute an asset of a particular country under analysis. Rather, these damages are negative externalities stemming from total global fossil fuel combustion. While such damages could be counted for as a component of the shadow price of burnt fossil fuel, there are complications inherent in this route, such as the reality that the countries responsible for the majority of carbon discharge are usually not experiencing proportional damages to well-being. Instead, we account for the externalities on the basis of how the damages are distributed across nations once the emissions are concentrated in the atmosphere. For further explanations as to how the calculations of these damages are allocated to different countries, refer to Annex 2 as well as Arrow et al. (2012).

Total factor productivity (TFP) is the third component accounted for separately from the resource base and IW. This is because TFP does not explicitly capture the contribution of one particular asset, but instead captures the contributions of several "missing" assets – assets

FIGURE 2

Schematic representation of the Inclusive Wealth Index (IW) and the Adjusted Inclusive Wealth Index (IWadj).

Note: assets are added by evaluating their changes at their social (shadow) price.



*Not included in the Inclusive Wealth Index Calculations

not explicitly accounted for in our wealth calculations. TFP measures changes in aggregated output (GDP) that cannot be explained by the growth rate of observable inputs or capital assets.

In the IWR 2014 accounts we estimate TFP growth rates, isolating not only the contribution of produced and human capital to economic outputs – as is done in, for instance, the Penn World Tables (FEENSTRA ET AL. 2013) or the Total Economy Database (CONFERENCE BOARD 2014) – but also taking into consideration the contribution of natural capital to economic growth.

Thus, our TFP growth measures represent the contribution of residual production factors to GDP growth after the three capital asset groups (human, produced, and natural capital) are accounted for. In other words, the same productive base of a country can lead to an increase (decrease) in aggregate output over time due to productivity changes in the use of resources. These TFP estimates, including the contribution of natural capital, represent new developments in our wealth accounts; the IWR 2012 estimates were taken from the Total Economy Database (CONFERENCE BOARD 2012).

Combining the last three factors (oil capital gains, carbon damage, and TFP) with our three capital asset groups leads us to our second measure of wealth: the Adjusted Inclusive Wealth Index (IWadj). Figure 2 illustrates the full array of capital assets accounted for within the Inclusive Wealth Index, as well as the three items integrated into the Adjusted Inclusive Wealth Index. As reflected by Equation (1), the sum of all capital assets and factors of the indices outlined in Figure 2 is found by evaluating the changes of the capital assets at the marginal shadow price.

For the IWR 2014 we have also introduced updates to the forest accounts, which affect estimates of timber and non-timber forest resource benefits. The main change is to the boundary utilized to define forest resources: specifically, we excluded cultivated forest from the forest measures. The main reason for this is that the activity of cultivating a forest – for which labor is required – is considered a production activity in the System of National Accounts (UNITED NATIONS 2009). Further, such cultivated forest, and the corresponding changes in stock over time, are part of produced capital, as well as gross capital formation, respectively. Cultivated forest is therefore accounted for under produced capital, while our revised forest accounts reflect naturally regenerated forest.

The second update in the forest accounts refers to estimates of non-timber forest benefits. In the IWR 2012, calculations were primarily based on work carried out by Lampietty and Dixon (1995), which reflected the monetary value of several ecosystem services stemming from studies carried out in the early 1990s. Since then, there has been a considerable amount of work devoted to calculating monetary values of ecosystem services. An exhaustive summary of work conducted over the past two decades can be found in the Ecosystem Service Valuation Database (van der Ploeg and de Groot 2010). For the IWR 2014, we make use of this database to update our figures for economic benefits of provisioning (excluding timber[5]), regulating, and recreational services resulting from forest area. Additional details are presented in Annex 2.

3. The inclusive wealth of nations

3.1 Measuring performances based on changes in wealth

This subsection explores one of the key questions of this report: have nations been expanding or depleting their inclusive wealth over the past several decades? The direction of such changes in wealth correlates positively with the movements of inter-temporal welfare, and therefore its relevance. In the following analysis, we show changes in wealth for the 140 nations under examination. In addition, we illustrate how these changes in wealth vary when resources are measured on a per capita basis.

As we will show for several countries, the aggregated accumulation of wealth moves at a slower pace than population growth, leading to negative per capita growth rates in wealth for a considerable number of countries, including some which otherwise experienced absolute gains in wealth.

We estimated changes in wealth by calculating annual average growth rates in wealth and population. In some instances, which are explicitly pointed out, the information is presented in terms of the changes with respect to a base year of analysis that in our case refers to 1990.

Our estimates show that 128 of the 140 countries assessed (91 percent) experienced a positive annual average growth rate in wealth, while the remaining 12 countries exhibited negative growth (see Figure 3-a). On a per capita basis, the number of countries showing positive growth rates in wealth fell from 128 to 85 (60 percent). Per capita, 55 countries experienced negative growth rates in IW (40 percent) (see Figure 3-b). Figure 3 also shows changes in per capita wealth after adjusting by TFP, damages from climate change, and oil capital gains (see Figure 3-c). Only 58 of the 140 counties experienced an increase in Adjusted Inclusive Wealth. For further details on the results of IWadj, refer to Sections 3.4.

In Figure 4 the above trends in wealth and wealth per capita are further investigated by identifying those countries, and their region of precedence, that turn into negative wealth growth.

Of the twelve countries with negative IW growth rates (Figure 4: quadrants II and III), ten are negative both in absolute terms as well as per capita (quadrant III). In two of twelve countries – Russia and Ukraine – figures improve when population is factored in (quadrant II), due to both countries having experienced negative population growth over the time period. As the population decreases in these countries, there are relatively more resources available per person in relation to the base period. Moldova experienced negative growth in per capita IW despite having also had a declining population.

Ten nations (Albania, Armenia, Bulgaria, Croatia, Estonia, Hungary, Kazakhstan, Latvia, Lithuania, and Romania) had negative population growth but positive changes in wealth;

5 Benefits resulting from timber are measured separately by using a different methodology – see Annex 2 for further details.

FIGURE 3

Annual average growth rates in IW, IW per capita and IWadj for the 140 countries assessed in the IWR 2014 during the time period between 1990 and 2010

FIGURE 3 a: Growth in Inclusive Wealth Index

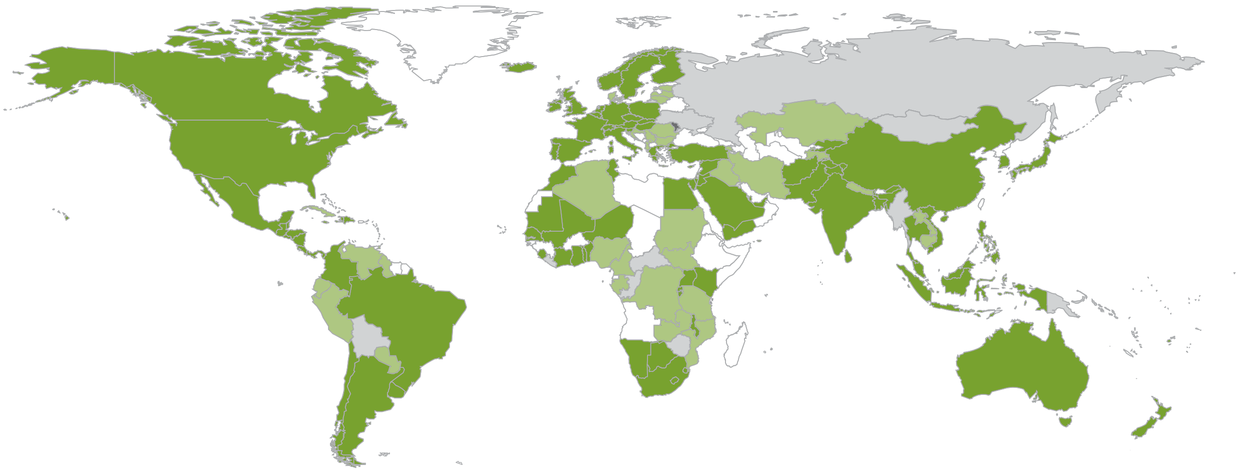


FIGURE 3 b: Growth in Inclusive Wealth Index per capita

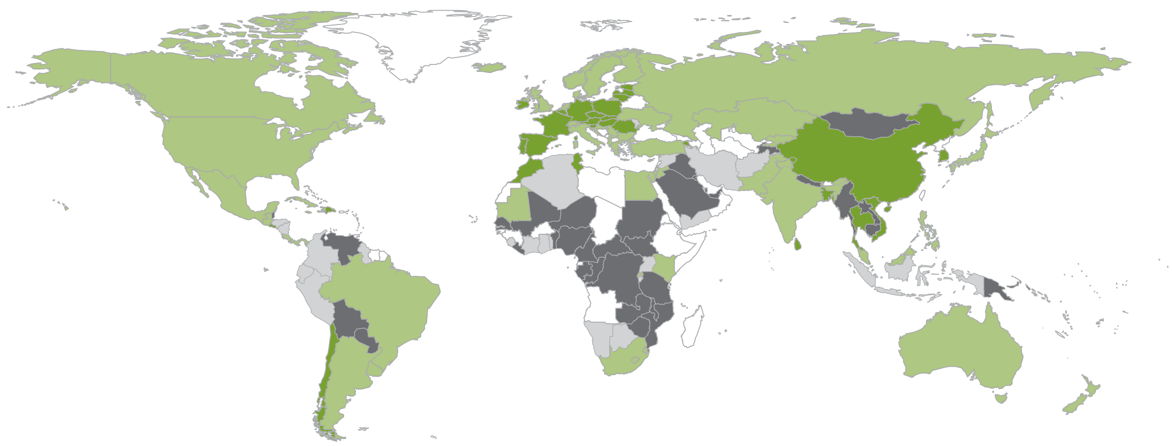
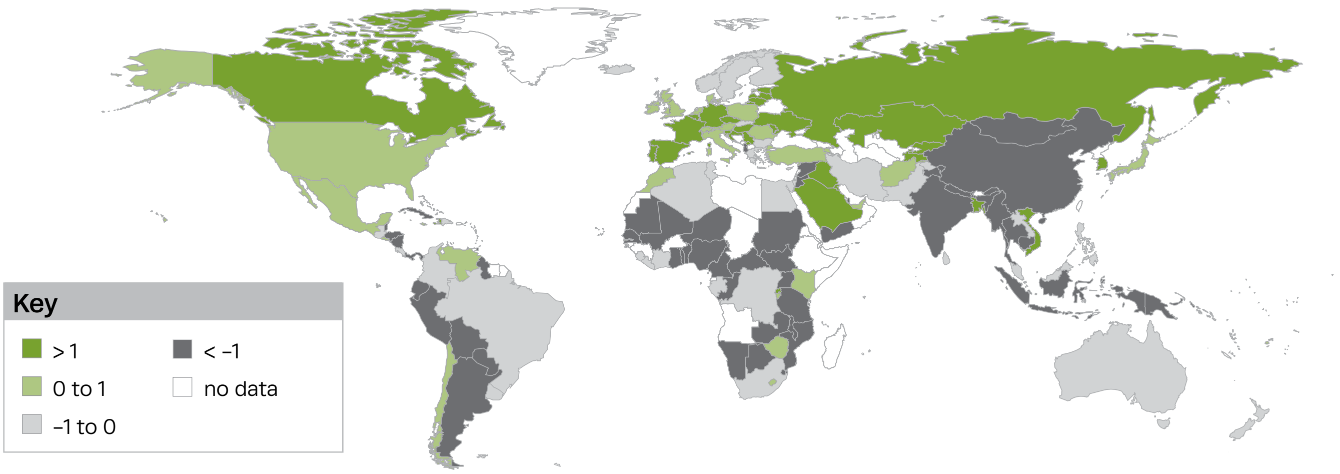


FIGURE 3 c: Growth in Adjusted Inclusive Wealth Index



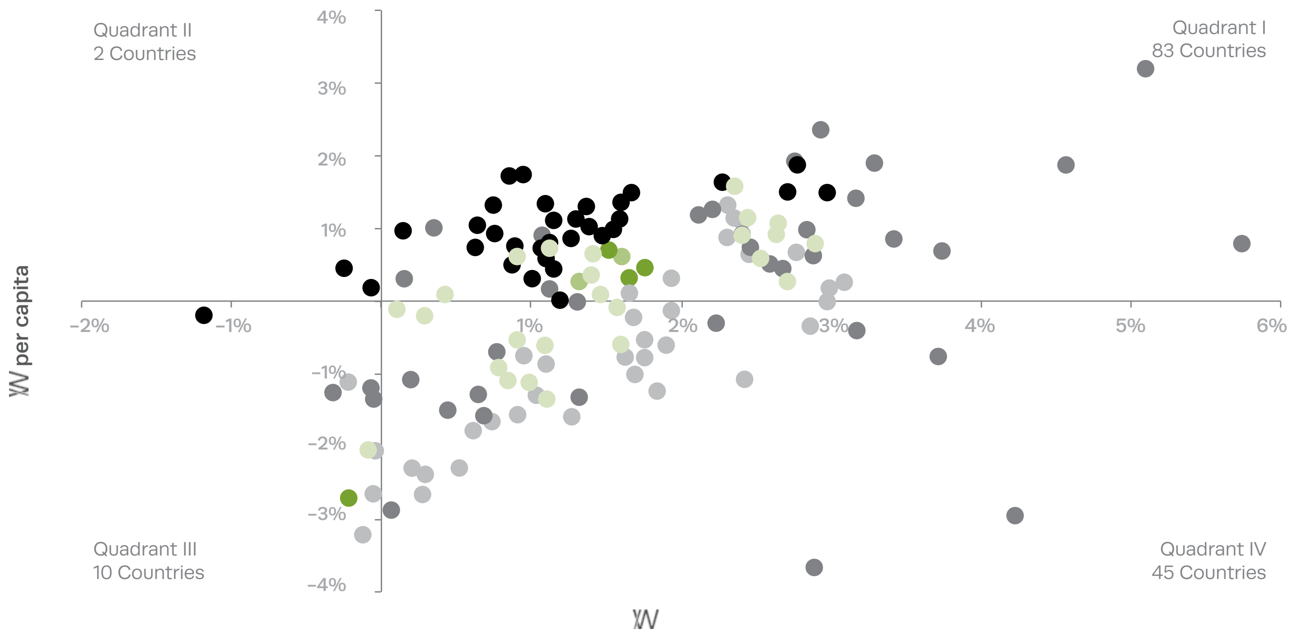


FIGURE 4

Annual average growth rate in IW and IW per capita

hence, growth in wealth remained positive in per capita terms.

Out of the 128 countries with positive absolute growth in wealth (quadrant I and IV in Figure 4), 83 also experienced per capita growth in wealth (quadrant I in Figure 4). The remaining 45 countries experienced declining wealth on a per capita basis (see quadrant IV in Figure 4).

3.2 On the contribution of human, produced, and natural capital to IW[6]

This subsection breaks down the contributions of each capital asset group to the total inclusive wealth average growth rates (see Figure 5). In particular we look at trajectories of the individual capital asset groups, which do not always reflect the trajectories of total inclusive wealth.

In 137 nations, human capital experienced positive growth during the period of 1990 to 2010. In the case of produced capital, 132 of 140 experienced positive growth. Natural capital accounts experienced positive growth in only 24 countries[7] (see Figure 5).

Per capita, 138 of the 140 countries assessed experienced positive contribution in human capital to inclusive wealth; 117 of 140 exhibit a positive contribution in produced capital; whilst the contribution of natural capital is positive for only 13 nations (see Appendix 1).

Regarding the magnitude of the average country[8] contribution of each capital category to the growth rates in inclusive wealth, the general trend shows that human capital has been the major contributor (55 percent), followed by produced capital (32 percent), and natural capital (13 percent). This pattern can also be seen at regional and sub-regional levels, with Europe being the only exception. In particular in Eastern and Northern

6 In the analysis we still use the average annual growth rates in inclusive wealth per capital as our reference indicator to investigate the changes in wealth.

7 There are two countries with zero growth rates included in this group.

8 This is an average across countries, where every nation is equally weighted.

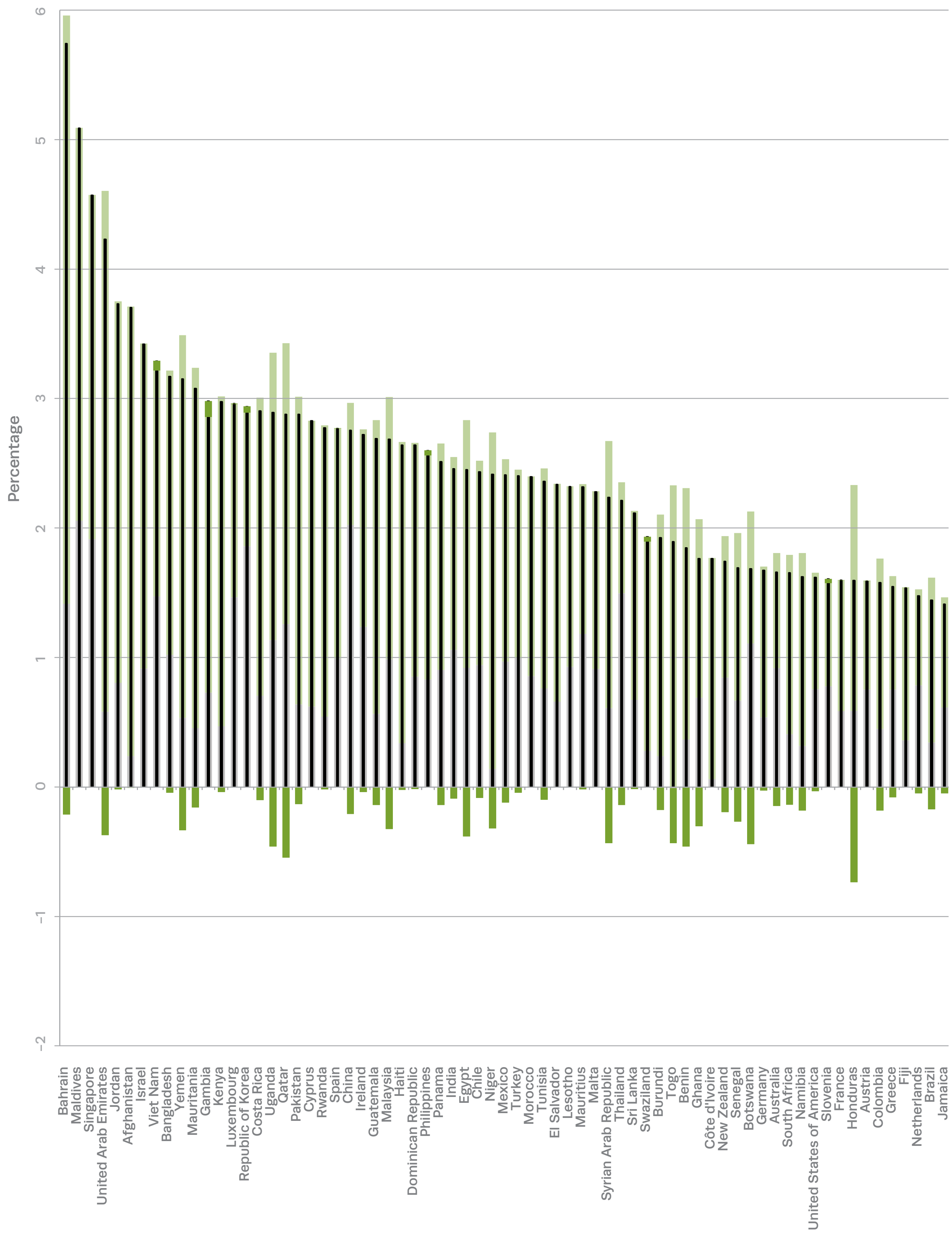

Percentage
6
5
4
3
2
1
0
−1
−2
Bahrain
Maldives
Singapore
United Arab Emirates
Jordan
Afghanistan
Israel
Viet Nam
Bangladesh
Yemen
Mauritania
Gambia
Kenya
Luxembourg
Republic of Korea
Costa Rica
Uganda
Qatar
Pakistan
Cyprus
Rwanda
Spain
China
Ireland
Guatemala
Malaysia
Haiti
Dominican Republic
Philippines
Panama
India
Egypt
Chile
Niger
Mexico
Turkey
Morocco
Tunisia
El Salvador
Lesotho
Mauritius
Malta
Syrian Arab Republic
Thailand
Sri Lanka
Swaziland
Burundi
Togo
Benin
Ghana
Côte d'Ivoire
New Zealand
Senegal
Botswana
Germany
Australia
South Africa
Namibia
United States of America
Slovenia
France
Honduras
Austria
Colombia
Greece
Fiji
Netherlands
Brazil
Jamaica

FIGURE 5

IW growth rates before per capita adjustment disaggregated by capital form, annual average for 1990–2010.

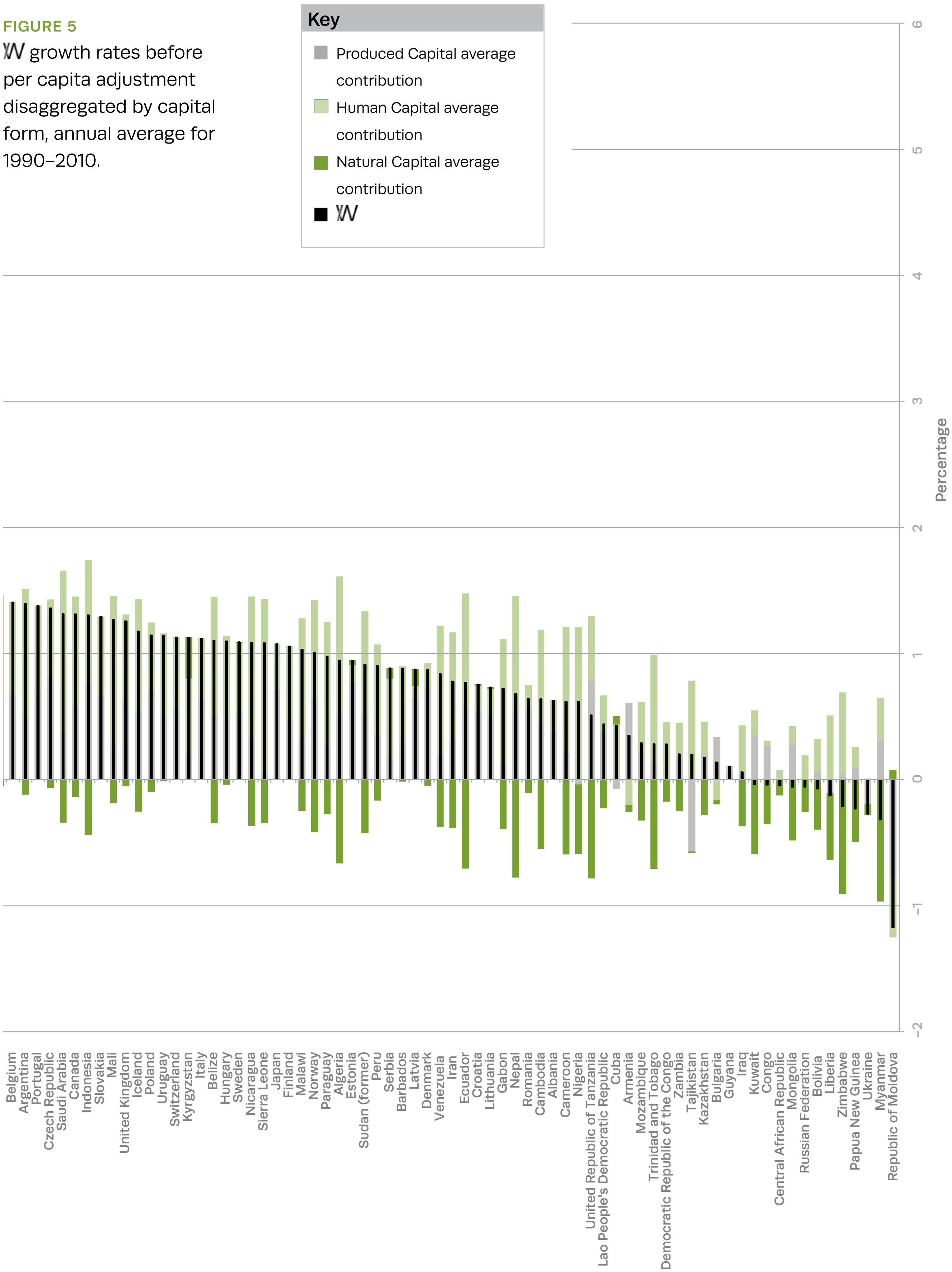


TABLE 1

Relative contribution (in percentage) of human, produced, and natural capital to IW growth by sub-regions, regions, and total world average

Note: The figures represent the average relative contribution by asset category of those countries comprising the (sub-) region to growth in IW. Contributions with negative sign as in the case of natural capital are taken in absolute numbers.

	Human Capital	Produced Capital	Natural Capital
Africa	**62**	**20**	**19**
Eastern Africa	56	24	20
Middle Africa	47	13	40
Northern Africa	57	29	14
Southern Africa	66	27	7
Western Africa	72	12	15
Asia	**54**	**32**	**14**
Eastern Asia	29	56	15
South-Central Asia	60	27	12
South-Eastern Asia	46	37	17
Western Asia	61	26	13
Europe	**44**	**50**	**6**
Eastern Europe	36	51	14
Northern Europe	38	55	7
Southern Europe	50	48	2
Western Europe	55	45	1
Latin America and the Caribbean	**61**	**26**	**13**
Caribbean	67	23	10
Central America	64	26	10
South America	56	28	16
Northern America	**54**	**41**	**5**
Northern America	54	41	5
Oceania	**49**	**31**	**21**
Australia/New Zealand	48	43	8
Melanesia	49	18	33
Total World Average	**55**	**32**	**13**

Europe, produced capital has been the major contributor to overall growth in inclusive wealth. There are possible explanations for this: some of these countries had already achieved high levels of education across their populations, thus leaving them with less room to improve from already high levels of human capital. In some areas, high rates of migration likely resulted in low growth in human capital. In other areas, natural capital makes up a relatively small part of growth in total wealth. See Table 1 for further information.

Patterns on the capital type contribution to inclusive wealth at an individual country level show that human capital is the major contributor to the growth rates in wealth for 101 out of 140 countries. In 27 of 140 countries produced capital is the greatest contributor to inclusive wealth. In only 12 of 140 countries did natural capital make up the largest contributor affecting the changes in wealth (negatively). See Figure 5 and Appendix 1 for additional details.

BOX 1

Changes in worldwide aggregate inclusive wealth

In order to see how the global economy is performing in terms of inter-temporal welfare, we carried out experimental wealth accounts worldwide. We did so by converting countries' wealth into international dollars (or Geary-Khamis dollars) using purchasing power parity (PPP) exchange rates[9], and aggregating the wealth across all countries for the time period[10] of 1992 to 2010. Finally, we calculated changes of global inclusive wealth on the per capita basis. The results are illustrated in Figure 6.

Changes in global wealth per capita were largely stagnant throughout the 1990s, and increasingly positive changes in the period from 2000 to 2010. By 2010, the performance of the global economy from a wealth perspective had shown an increase of only 6 percent with respect to 1992. The major positive changes can be observed for produced capital (56 percent growth from 1992 levels), followed by human capital (8 percent growth). Natural capital experienced a decline of about 30 percent from 1992 levels.

On average, human capital is the main source of wealth, making up 57 percent of total global inclusive wealth. Natural capital is responsible for 23 percent of total inclusive wealth, while produced capital makes up the remaining 20 percent.

Relatively low increases in human capital, combined with vast losses in natural capital, largely explain the anemic overall growth in inclusive wealth worldwide, despite enormous gains in produced capital.

From an economic production perspective, the outlook is much rosier: worldwide GDP per capita grew, albeit with some fluctuations around 2008, by over 50 percent in the past two decades – a trajectory similar to that of produced capital (as would be expected). These differences in progress as measured by IW and GDP underscore the need for integrating sustainability into economic evaluation and policy planning.

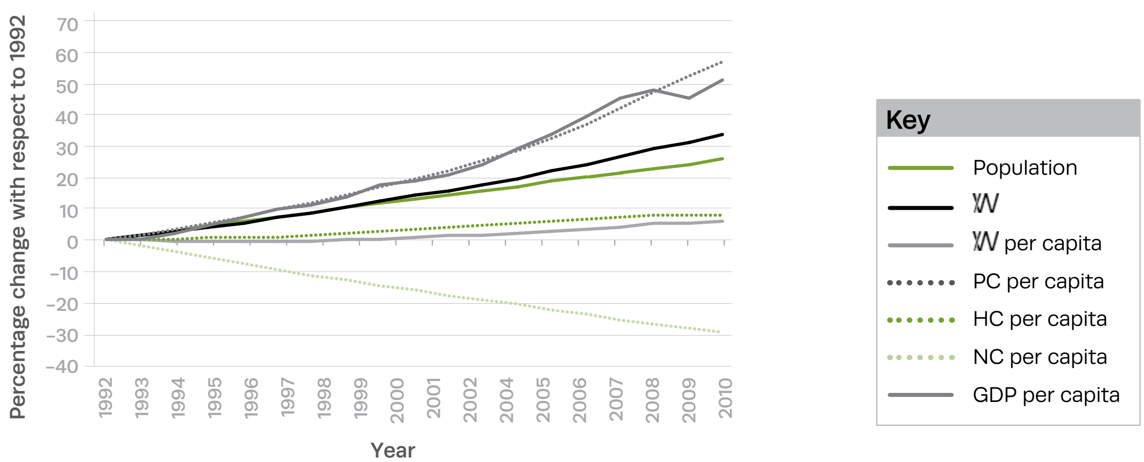
Regional trends are shown in Appendix 2, using the same variables plotted in Figure 6.

9 We assume PPP to be a proxy variable for adjusting in the right direction the price differences of inter-temporal consumption of goods and services between countries.

10 Because data was unavailable for some countries in 1990 and 1991, we used 1992 as a baseline to maintain consistency.

FIGURE 6

Changes in worldwide inclusive wealth per capita and other indicators for 1992–2010



Note: HC = human capital; PC = produced capital; NC = natural capital; and GDP= gross domestic product

3.3 Wealth compositions

In this subsection we explore the sources of nations' wealth by looking at the composition of individual countries' productive bases valued at their shadow price. Composition is shown for our three capital asset stock groups at a country, sub-regional, regional, and global level. Country-level results are shown in Figure 7, which depicts the relative importance of each capital type in total wealth.

In addition to the overview of the countries' capital portfolio presented in Figure 7, we further explore how the overall capital portfolio is composed for an average nation on a global level. When analyzing the mean composition across the country sample for each capital type, the shares of the average country over the period of study clearly demonstrate the importance of human capital wealth, with a representation of 54 percent (see Figure 8-a).Developments over time show that, while for the average country the contribution of human capital and produced capital to the total wealth increased, the share of natural capital has declined (see Figure 8-b).

The dominance of human capital over the other two capital types tends to be a fair representation of the sample, as this trend holds true for 100 out of the 140 countries evaluated. What is more, in 89 of these 101 countries the percentage of human capital in total wealth is 50 percent or higher. For those countries in which human capital is not the most important relative source of wealth (40 of 140), natural capital is the most important asset category in all but one. The only country obtaining the majority of its wealth from produced capital (with 49 percent) is the Republic of Moldova.

Of those nations with a high proportion of natural capital in comparison to the other asset categories, 13 countries had 80 percent or more of their total wealth held in natural capital[11]. Interestingly, 11 of 13 generate wealth from renewable resources such as forest and agricultural land. Only Iraq and Kuwait had fossil fuel-based natural capital wealth. In the overall average for our complete country sample, 75 percent of a country's natural capital is attained from renewable resources, while 25 percent is based on non-renewable resources such as fossil fuels and minerals.

A more specific analysis is presented in Table 2, which includes a disaggregation of average capital type at the regional and sub-regional level. These breakdowns show that European countries in general, and Western European countries in particular, have a very low share of natural capital in relation to that of human capital, which tends to be high. In fact, the only regions in which natural capital is the most important source of wealth are: Middle Africa, South America, and Melanesia. The wealth portfolios of the sub-regions of Latin America and the Caribbean are also interesting since each of them reveals a different trend, contrary to common understanding of regional economic similarities (see Table 2).

An interesting observation can be seen in the correlations between the composition of human and natural capital (see Figure 9): countries with a high share of human capital are generally likely to have a low share of natural capital, and vice versa. This is particularly true in the case of high-income[12] countries, which have relatively high wealth held in human capital, and relatively low wealth in natural capital (see also Table 3). This is largely explained by the relative stability of produced capital's proportion in total wealth. Produced capital's share tends toward around 18 percent in most nations; for 70 percent of the countries

11 The following countries are part of the group of 13 countries presenting a high level of natural capital in total wealth: Bolivia, Central Africa, Congo, Democratic Republic of the Congo, Guyana, Iraq, Kuwait, Lao People's Democratic Republic, Liberia, Mongolia, Mozambique, Papua New Guinea, and Zambia.

12 In total there are 42 high-income economies, 35 upper middle-income economies, 37 lower middle-income economies, and 26 low-income economies.

FIGURE 7

Percentage of human, produced, and natural capital in total wealth, annual average for 1990–2010.

FIGURE 7 a: Percentage of natural capital in total wealth

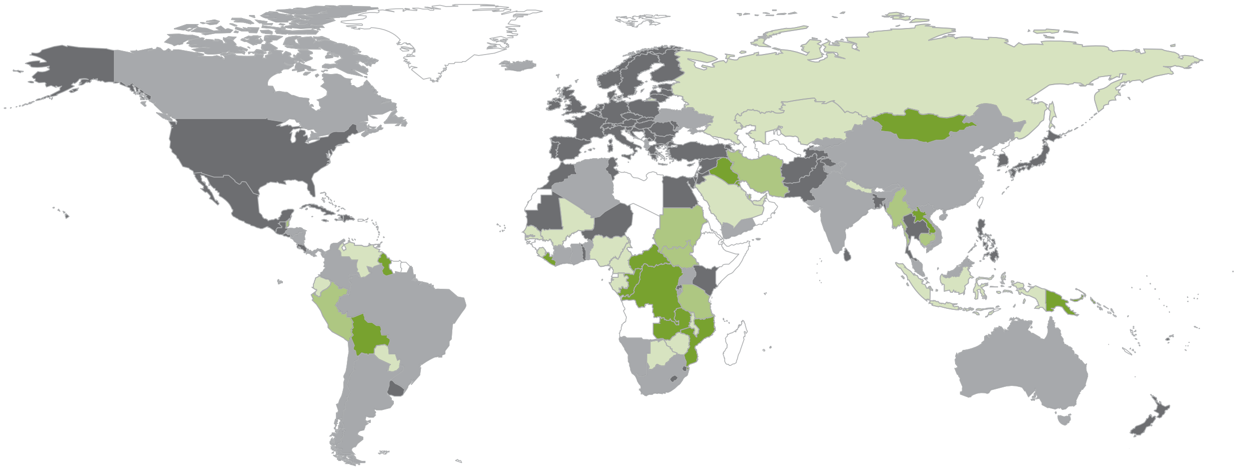


FIGURE 7 b: Percentage of produced capital in total wealth

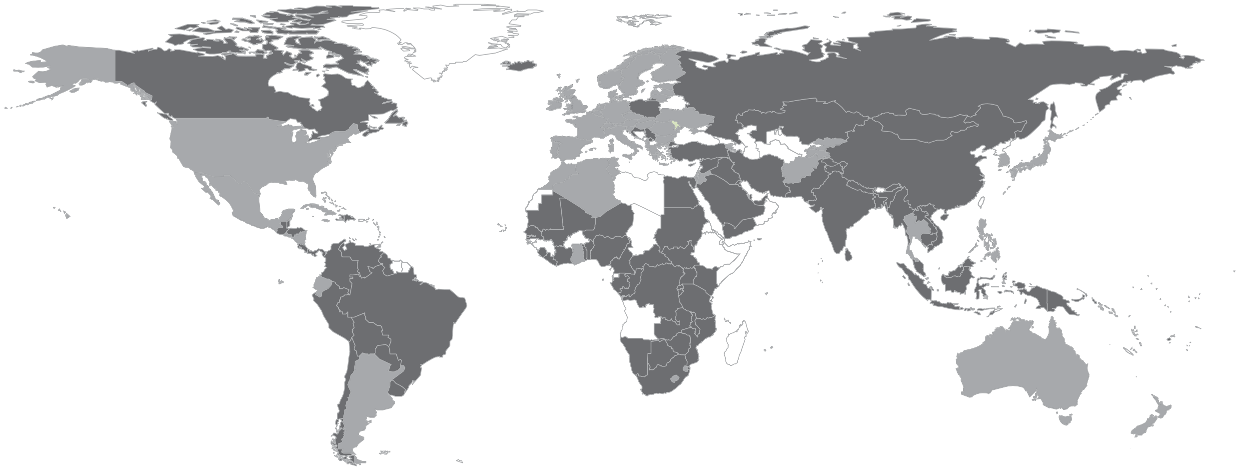
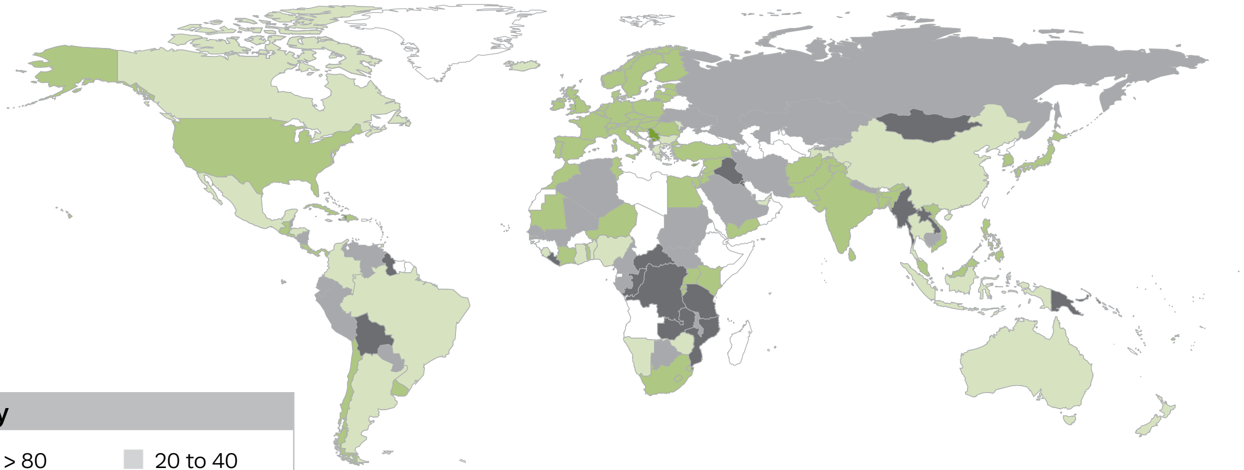


FIGURE 7 c: Percentage of human capital in total wealth



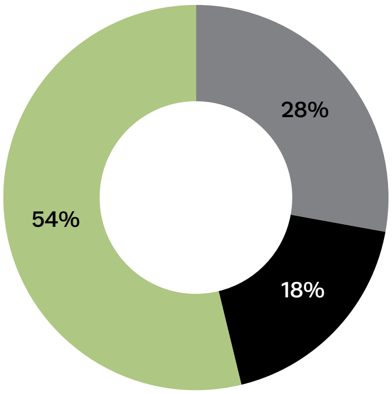
Key

> 80
60 to 80
40 to 60
20 to 40
< 20
no data

Note: It is worth remarking that the maps do not aim at describing where natural capital is in the world, but rather to measure the relative importance of each capital asset in the total wealth for every country.

FIGURE 8

Developments in the composition of wealth by capital form, 1992–2010



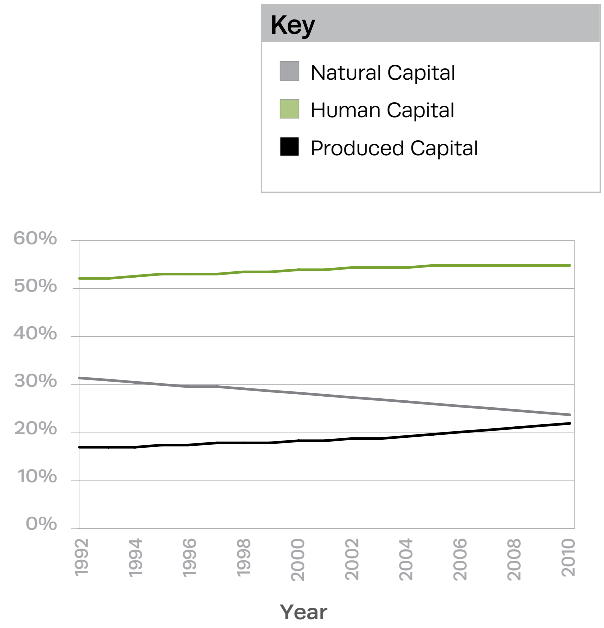


FIGURE 8 a

Average wealth composition across countries, mean 1992–2010

FIGURE 8 b

Developments in the country average wealth composition

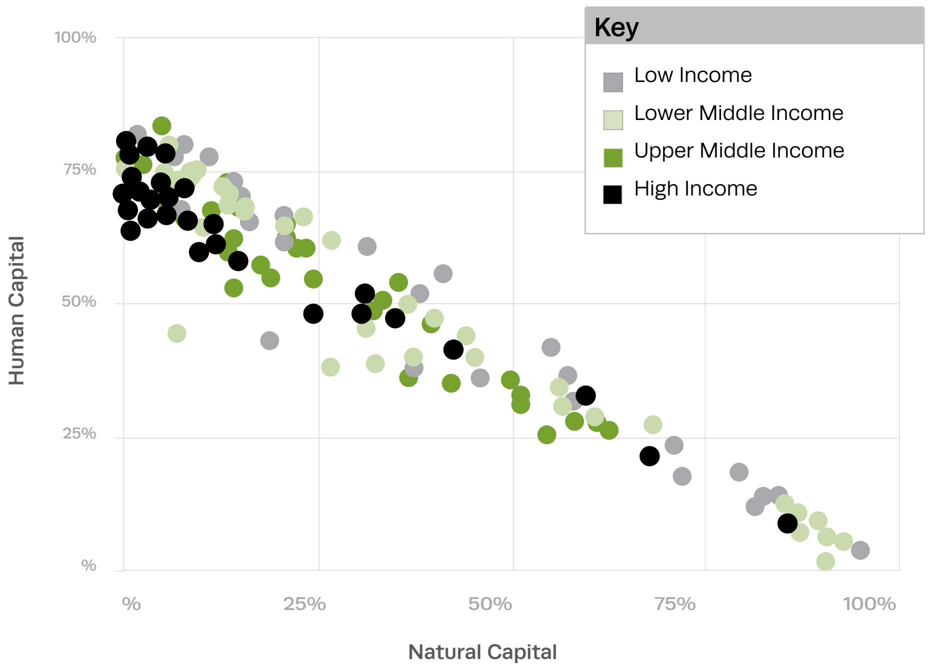


FIGURE 9

Percentage shares of human capital and natural capital in total wealth, average 1990–2010

measured, produced capital made up between 12 and 28 percent of total wealth.

These shares should be interpreted with caution. They show the worth of one capital form in relation to the total wealth of a country, but they do not provide information about the absolute wealth of the different capital types. Norway, for example, has a high level of total wealth in natural capital; however, its share still only amounts to 12 percent due to Norway's high level of human capital wealth.

TABLE 2
Regional and subregional composition (in percentage) of wealth by capital form, average 1990–2010

	Human Capital	Produced Capital	Natural Capital
Africa	**47**	**13**	**40**
Eastern Africa	47	12	41
Middle Africa	16	7	77
Northern Africa	56	18	26
Southern Africa	59	18	23
Western Africa	52	12	37
Asia	**51**	**18**	**31**
Eastern Asia	47	22	31
South-Central Asia	54	19	26
South-Eastern Asia	46	16	39
Western Asia	53	16	31
Europe	**66**	**26**	**8**
Eastern Europe	57	28	15
Northern Europe	67	24	9
Southern Europe	70	24	6
Western Europe	70	28	2
Latin America and the Caribbean	**52**	**17**	**31**
Caribbean	68	22	10
Central America	58	18	25
South America	39	13	48
Northern America	**62**	**19**	**19**
Northern America	62	19	19
Oceania	**45**	**17**	**38**
Australia/New Zealand	53	24	23
Melanesia	37	9	53
Total World Average	**54**	**18**	**28**

TABLE 3
Wealth composition (in percentage) based on income-based country classification, average 1990–2010

	Human Capital	Produced Capital	Natural Capital
High Income	64	24	12
Low income	47	12	41
Lower Middle Income	46	15	39
Upper Middle Income	55	19	25
Total World Average	**54**	**18**	**28**

3.4 Adjusted Inclusive Wealth Index

This subsection investigates how countries' performances based on IW are impacted after taking into account the following three factors: 1) climate change, accounting particularly for those damages that nations have suffered as a result of increased carbon concentration in the atmosphere; 2) total factor productivity changes, capturing exogenous contributions of multiple missing factors to economic growth 3) oil capital gains, reflecting how changes in oil prices may increase or decrease the value of a country's productive base. Similarly to the IWR 2012, we refer to this adjusted figure as "Adjusted Inclusive Wealth Index" (IWadj) (see Annex 2 for further explanations).

A nation's wealth could in principle be either positively or negatively affected by each of the three adjustment factors. For instance, Nordhaus and Boyer (2000) predict that some countries will benefit from the changes in climate, while others will be negatively impacted by those perturbations. In the case of change in oil prices, countries that are net oil producers would observe positive changes in wealth, while countries that are dependent upon oil imports will be negatively impacted. Total factor productivity adjustments can also go either way, as less efficient use of capital results in reduced productivity from the previous year.

An overview of the estimates is illustrated in Figure 10, which shows how each of the three adjustments contributes to IW. In addition, Figure 10 displays the final adjusted measure of wealth, IWadj.

Out of 55 countries for which we had reported negative growth in IW per capita, 10 moved to positive growth rate after wealth adjustments. The remaining 45 countries still experienced negative growth in inclusive wealth after adjustments.

Remarkably, of the 85 countries that had shown positive IW per capita in section 3.1, 37 moved into the negative bracket after adjustments. Considering this, the global outlook becomes far less optimistic. We have now identified 82 countries – or over half our sample – that are facing long-term issues in sustaining current consumption patterns. As the remaining 48 countries of the pre-adjusted positive bracket remained positive after adjustments, there are in total 58 countries exhibiting a positive trend.

When we drill down into specific adjustment impacts, TFP shows negative growth in 91 out of the 140 studied countries. The average growth rates in TFP range from ± 6 percent, and thus had a considerable impact on results in several countries, such as China, which moved into a negative position in IWadj due to negative changes in TFP.

In the case of climate change, results confirm that most of the countries (134 of 140) would experience negative economic consequences from this phenomenon. The six remaining countries would exhibit improvements in the productive base. Regarding the magnitude of the climate change damages in relation to the inclusive wealth of the countries, it is estimated that such effects, at less than 0.25 percent, are still relatively low.

Trends for oil capital gains illustrate that most of the nations (119 of 140) suffer from increases in the price of oil. The remaining 21 countries[13] show positive changes (essentially a positive economic re-evaluation of oil reserves). Three countries, for example, enjoy high oil capital gains at a rate of at least 3 percent: Kuwait (7.0 percent), Iraq (5.9 percent), and Saudi Arabia (3.5 percent). These magnitudes offset unadjusted negative trends shown in IW for these nations, and in some cases even the negative impacts caused by climate change and TFP. A key reason why we prefer to keep oil capital gains separate from the initial IW estimates is that the positive changes in wealth for

13 This group is comprised by the following oil-extractive economies: Kuwait, Iraq, Saudi Arabia, Iran, Kazakhstan, Venezuela, Canada, Norway, Nigeria, Russia, Algeria, Ecuador, Trinidad and Tobago, United Arab Emirates, Qatar, Yemen, Gabon, Cameroon, and Congo.

the above three countries were not the result of improved management of the countries' asset portfolios, but rather by the rises in oil prices that resulted primarily from changes in oil supply, demand, and geo-political trends.

3.5 Measuring economic performance: a comparison of inclusive wealth, GDP, and HDI

As we discussed at the beginning of the chapter, there exists a number of indicators to evaluate nations' economic performance and progress. Two of the most commonly used are gross domestic product (GDP) and the Human Development Index (HDI). GDP measures the market monetary value of all final goods and services produced in a given economy over a period of time (generally one calendar year). HDI measures a nation's performance as pertains to a selection of outcomes seen as critical to human well-being, such as life expectancy and educational attainment, in addition to income.

In this section, we provide an overview of country trends as measured by GDP and HDI alongside inclusive wealth. In doing so, we can identify how these measures of progress converge or diverge in the assessing of nations' performance. Figure 11 presents these measures in terms of the average percentage growth rates in IW per capita, GDP per capita, and HDI over the period[14] of 1990 to 2010.

Figure 12 shows that IW growth rates are in general more moderate than those of GDP and HDI. In most cases this can be explained by the additional factor included in the IW, natural capital. As most countries experienced declines in natural capital, total IW growth is decelerated as compared to GDP and HDI.

From this section, we identified a positive growth rate for 86 out of 140 countries[15] (61 percent); while in the case of the HDI 135 out of 140 countries (96 percent) show positive progress. The five countries with negative HDI growth are Lesotho, Swaziland, Tajikistan, United Arab Emirates, and Zimbabwe. In terms of GDP, 124 of 140 countries[16] (89 percent) show an overall increase in GDP growth over the past 21 years. Most of the countries with negative growth rates are located in Africa (9 countries) and Asia (3 countries). When looking at the three measures simultaneously for every country, we see consistent signs of progress in 80 of the 140 countries assessed (57 percent) across the three indicators. Signs of regress in all three indices are found only in Tajikistan, the United Arab Emirates, and Zimbabwe.

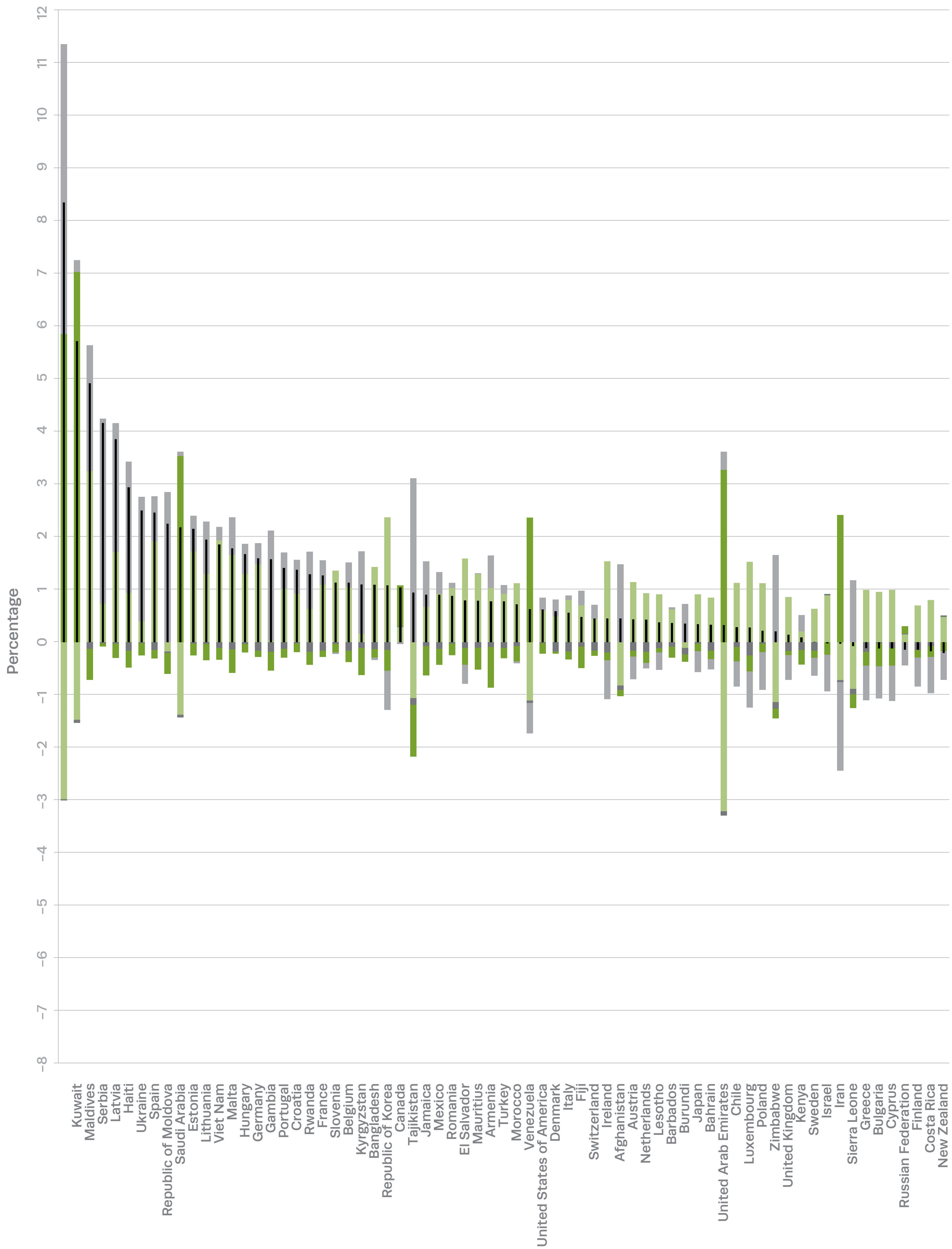
As the three measurements capture mostly different aspects of a system, the evaluation obtained about a country's performance is not always consistent in terms of progress or regress. Indeed, 42 out of 140 countries reveal, for example, a negative trend in average IW growth rate, but positive growth rates in GDP and HDI.

When nations are grouped according to income level, it is conspicuous that for all three measurements high-income economies mostly show a positive development. There are, however, a few high-income economies that show a negative development from the IW perspective: United Arab Emirates, Kuwait, Qatar, Saudi Arabia, and Trinidad and Tobago. These are all countries which the extraction of fossil fuels plays an important role, and the depletion in

14 Due to missing data, Afghanistan, Cambodia, Czech Republic, and Estonia are compared for the period of 2000 to 2010, and Iraq, Nigeria, and United Arab Emirates for 2005 to 2010.

15 For the whole period of study 55 countries with a negative IW growth rate can be identified, but for this comparison the period for some countries had to be changed to the period of 2000 to 2010, thus the average growth rate for Afghanistan switched from negative to positive.

16 Negative in HDI: Lesotho, Swaziland, Tajikistan, United Arab Emirates, Zimbabwe. Negative in GDP: Burundi, Central Africa, Côte d'Ivoire, Democratic Republic of Congo, Gabon, Haiti, Kyrgyzstan, Nigeria, Republic of Moldova, Serbia, Sierra Leone, Tajikistan, Togo, Ukraine, United Arab Emirates, Zimbabwe.


Percentage
12
11
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7
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5
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−6
−7
−8
Kuwait
Maldives
Serbia
Latvia
Haiti
Ukraine
Spain
Republic of Moldova
Saudi Arabia
Estonia
Lithuania
Viet Nam
Malta
Hungary
Germany
Gambia
Portugal
Croatia
Rwanda
France
Slovenia
Belgium
Kyrgyzstan
Bangladesh
Republic of Korea
Canada
Tajikistan
Jamaica
Mexico
Romania
El Salvador
Mauritius
Armenia
Turkey
Morocco
Venezuela
United States of America
Denmark
Italy
Fiji
Switzerland
Ireland
Afghanistan
Austria
Netherlands
Lesotho
Barbados
Burundi
Japan
Bahrain
United Arab Emirates
Chile
Luxembourg
Poland
Zimbabwe
United Kingdom
Kenya
Sweden
Israel
Iran
Sierra Leone
Greece
Bulgaria
Cyprus
Russian Federation
Finland
Costa Rica
New Zealand

FIGURE 10

Average annual growth rates of IWadj disaggregated by the three adjustments

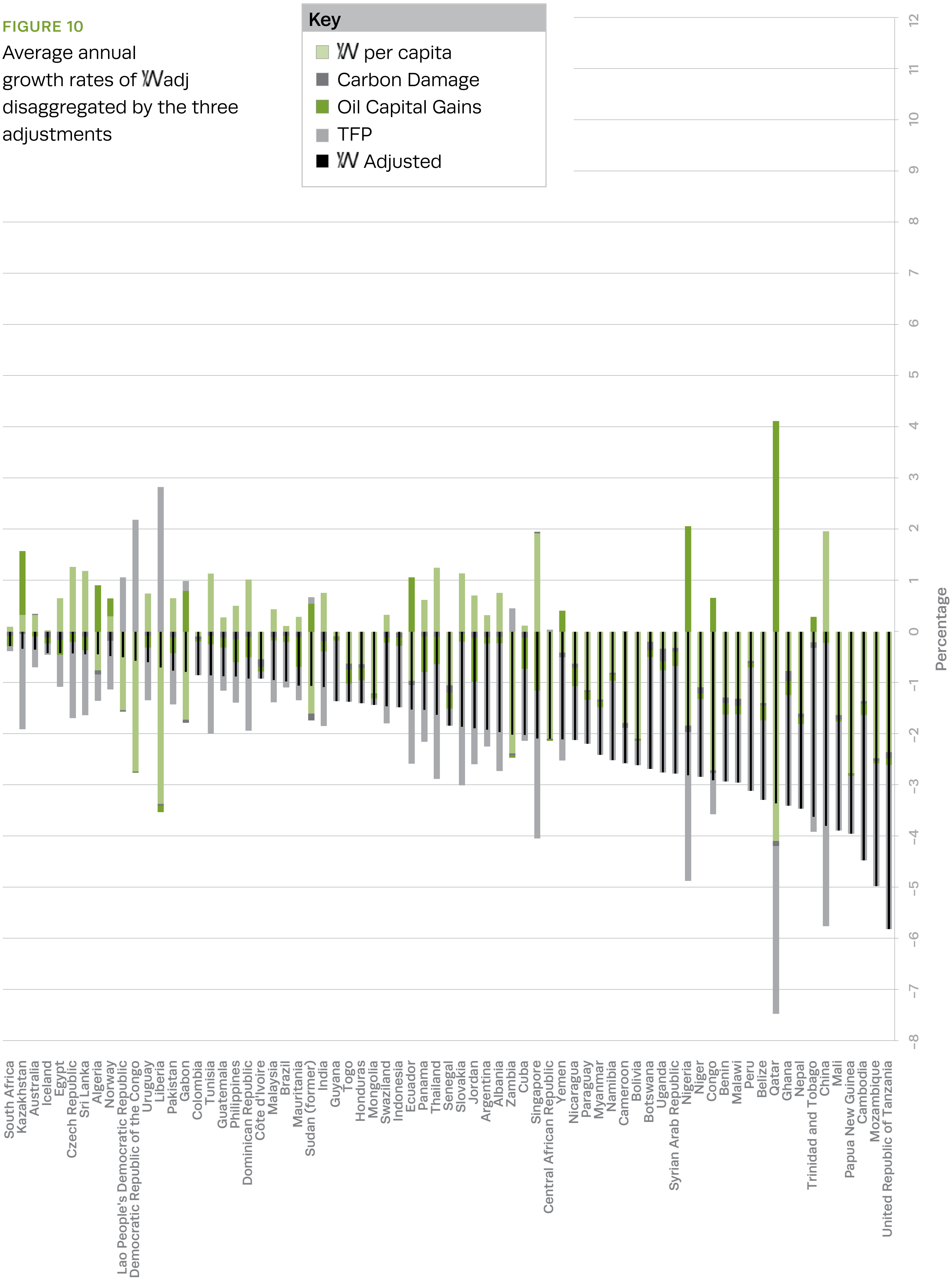


FIGURE 11

Average annual growth rates of IW per capita, GDP per capita, and HDI, period 1990–2010 (in percentage)

FIGURE 11 a: IW per capita

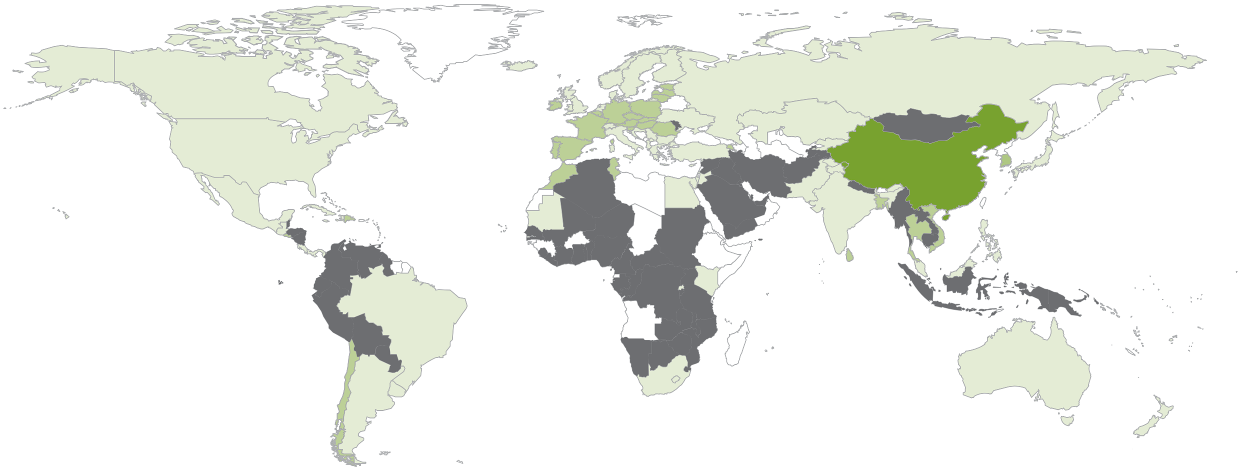


FIGURE 11 b: GDP per capita

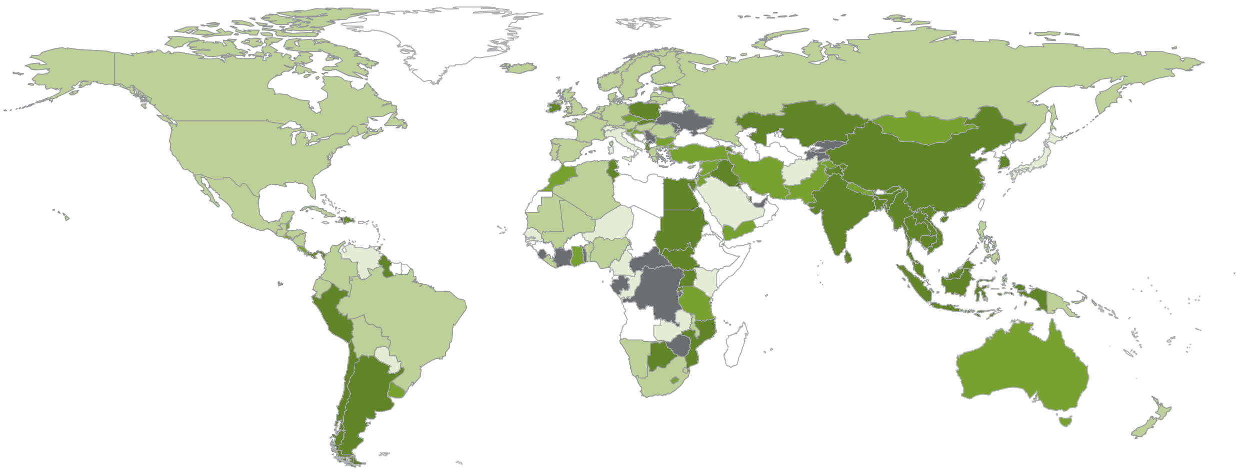


FIGURE 11 c: HDI

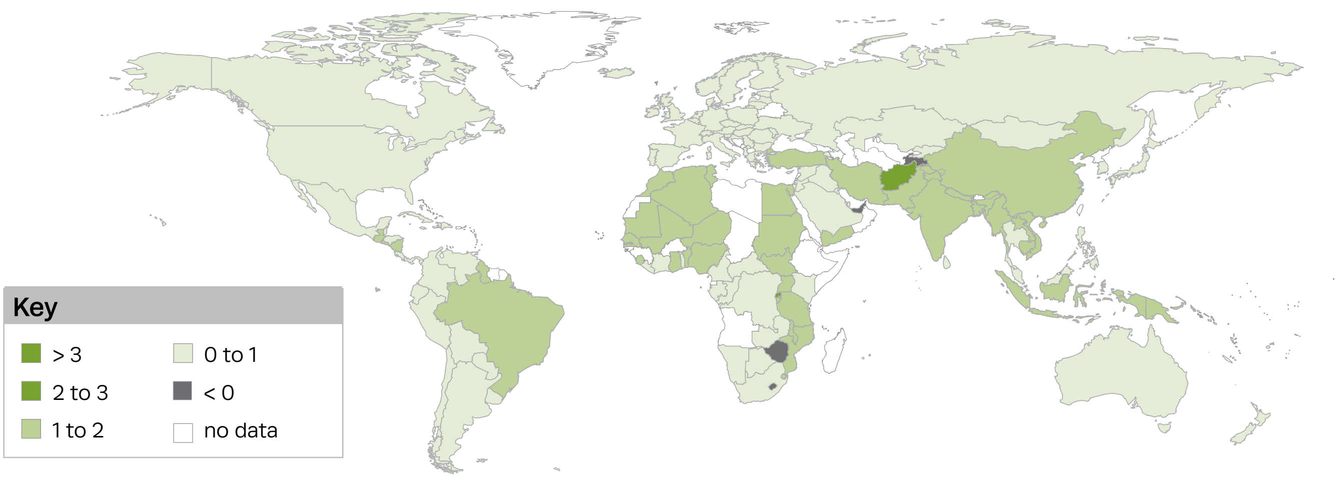


FIGURE 12 a: HDI vs. IW per capita

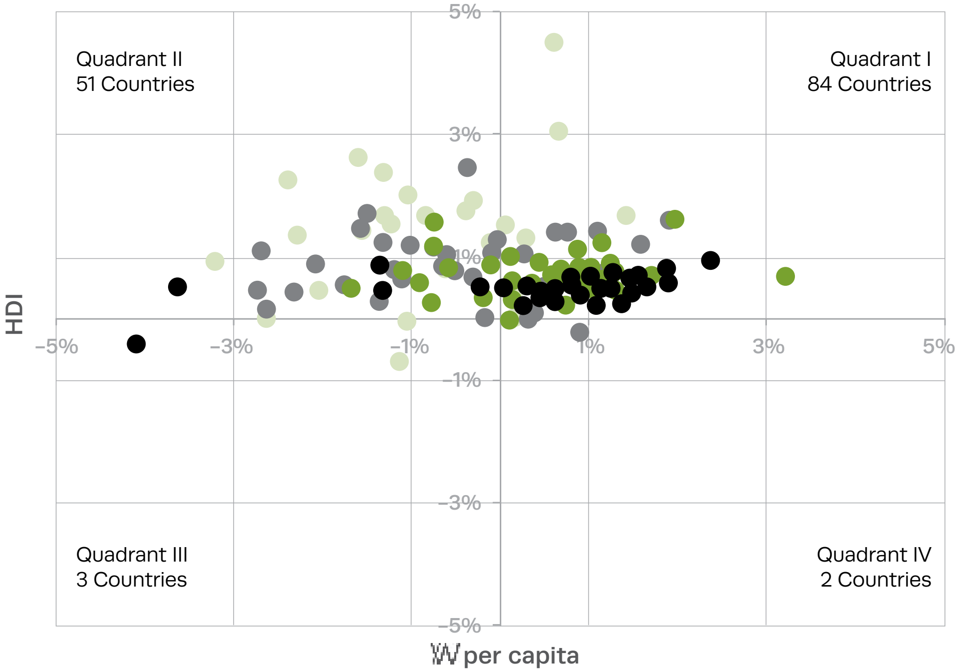


FIGURE 12 b: GDP per capita vs. IW per capita

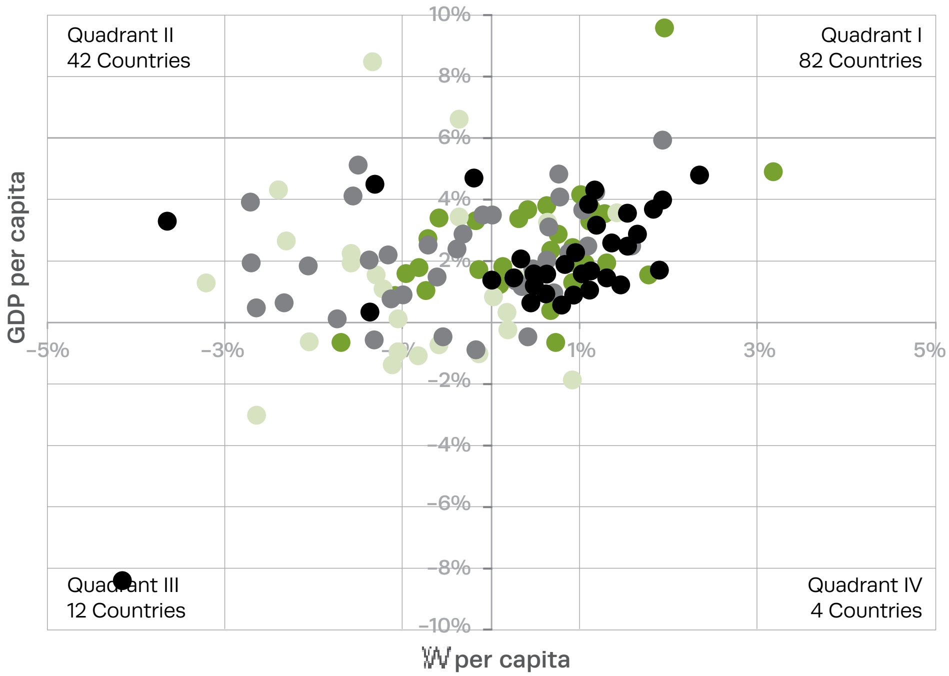


FIGURE 12

Comparing annual avarage growth in IW per capita, GDP per capita, and HDI, period 1990–2010

Note: as previously mentioned, due to missing data, Afghanistan, Cambodia, Czech Republic, and Estonia are compared for the period of 2000 to 2010, and Iraq, Nigeria, and United Arab Emirates for 2005 to 2010.

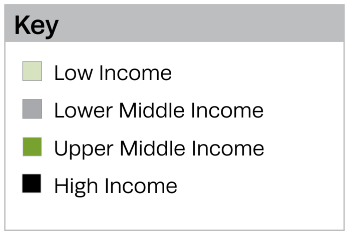
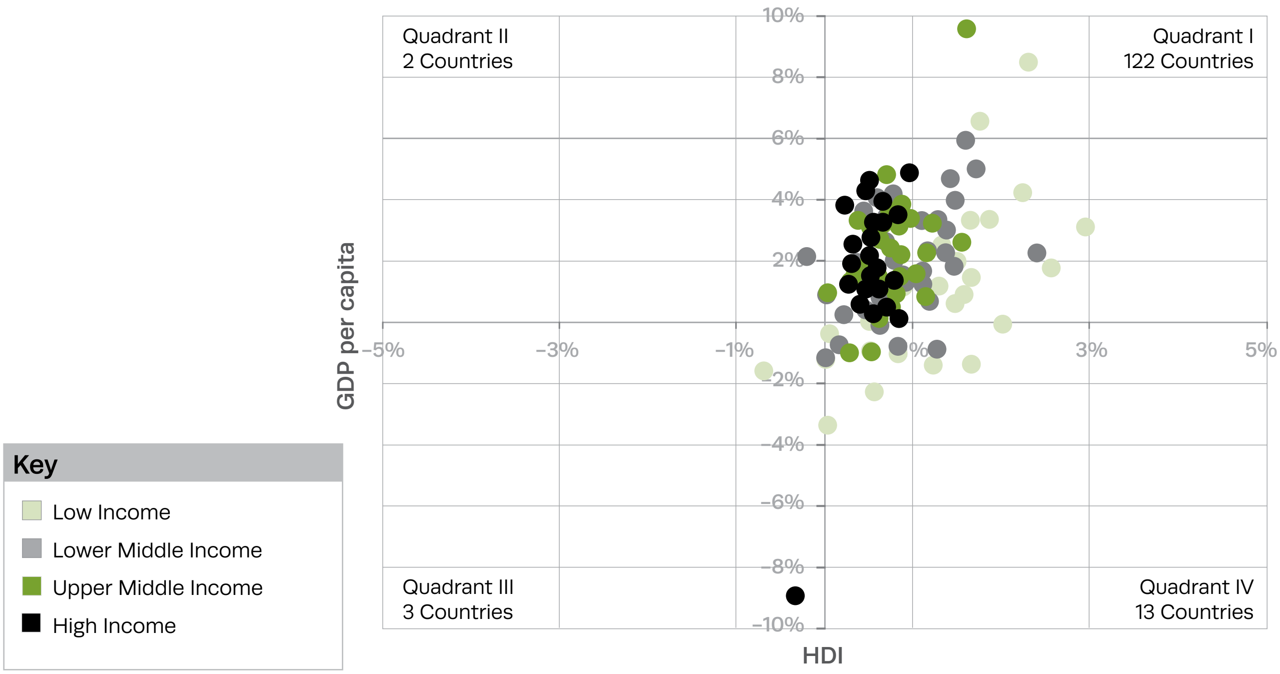


FIGURE 12 c: GDP per capita vs. HDI



non-renewable resources explains to a large extent the negative growth rates in IW. The increases in human and produced capital during the period of analysis were not high enough to compensate for the loss in natural capital. From this information, it is recommendable that these countries invest in other forms of capital development in order to compensate for non-renewable natural capital depletion and return to a sustainable trajectory. For low-income economies, we see that 18 of 26 countries experience negative IW growth, even though most exhibit high growth rates in GDP and HDI (Figure 12 a-b).

In four countries – Haiti, Kyrgyzstan, Serbia, and Ukraine – we see positive development in terms of IW and HDI but declines in GDP. All these countries did well in increasing their human capital, but, as suggested also by the negative GDP growth rate, they should increase their productive base, particularly their produced capital. When comparing HDI to IW and GDP, we see two countries – Swaziland and Lesotho – with declining HDI growth rates but positive in the other indices. This indicates that while both countries have increased human capital, there are still conditions that need further improvements to assure peoples' well-being, for instance in life expectancy.

Most importantly, the comparison demonstrates that excluding environment in GDP and HDI provides usually a more optimistic impression of nations' development, one based in short-term performance rather than long-term potential. The evidence supports the contention that a broader set of indicators is needed to adequately measure nations' economic performance and progress in order to accommodate sustainability objectives, as well as improve comprehensive well-being assessments.

3.6 Understanding changes in human capital accounts

Human capital indicators, such as average years of total educational attainment (hereafter education) show that almost all countries in the world achieved growth in this metric[17] over the past two decades. This positive trend is in line with the IWR human capital accounts shown in previous sections that reflect the educational component of human capital (but exclude health). Findings not only reveal an increasing positive trend in this measure, but also show that human capital is the most important, and largest, source of inclusive wealth as well for the majority of countries.

Indeed, such evolution in both metrics should not come as a surprise as education is one of the inputs in the IWR human capital framework. However, along with education the method considers other variables to arrive at the final human capital outcome of a country, including number of adults[18] that achieved the average education level, and expected lifetime working period for the average person. Because there are several inputs interacting in the methodological framework, our interest in this section is to explore the following questions: Which inputs are driving the changes in the IWR human capital accounts? What is the relative importance of these human capital driving forces in different countries[19] and regions for the growth in human capital? To answer these questions we carried out a decomposition analysis of those interacting factors that drive the changes in this category of the accounts.

As presented in Chapter 4 and Annex 2, the method used for calculating the wealth of human capital consists in general of three multiplied components, or "terms"[20]. "Term I" is a function of education; "Term II" provides information on the population of a country that has reached the average education level; and "Term III" is the present value of the average labor compensation per unit of human capital received by workers over an entire life's working period.

Table 4 illustrates the results as percentage changes in human capital and the breakdown for the three drivers under analysis (Terms I, II, and III), as well as showing the relative importance among the drivers of total change in human capital. For simplicity, results are additionally presented as the change between the years 1990 and 2010 and the average among countries comprising each region and subregion. Results at country level can be additionally found in Appendix 3.

Table 4 shows that Term II, representing the number of people in a country who achieved the average education level, is the main driving force of the changes in human capital on a global and regional scale, with Europe as the only exception. Similar results also apply at country level, with 103 of 140 countries exhibiting this pattern (see Appendix 3). On average globally (the average of the 140 countries in our sample), Term II is responsible for 48 of the 65 percent change in human capital from 1990 to 2010, demonstrating that Term II is the most significant of the three terms in driving change. For this driver, Africa (61 percent) and Asia (78 percent) exhibit the strongest development in relation to the changes in other regions. In particular Western Asia shows a remarkable

17 Barro and Lee (2010) database reports that only 2 out of the 140 countries here studied present a regress in the average year of total education. These countries are Namibia and Tajikistan.

18 We define adults as those individuals who reach the age of five plus the average years of total educational attainment.

19 The study of national polices boosting these results is out of the scope of analysis.

20 The formulation used for estimating human capital follows the method described in Arrow et al. (2012) and Klenow and Rodríguez-Clare (1997) where the

$$Wealth\ of\ Human\ Capital = \underbrace{e^{(\rho \cdot Edu)}}_{Term\ I} \cdot \underbrace{P_{5+Edu}}_{Term\ II} \cdot \underbrace{\int_{t=0}^{T} \bar{r} \cdot e^{-\delta \cdot t}\, dt}_{Term\ III}$$

being: ρ= return on human capital; Edu= education; P_{5+edu}= adult population; T= life's working period of the average person; $\bar{r}$ = compensation per unit of human capital that is kept constant at the average value of the period 1990–2010; and δ= discount rate. For further details on this formulation, refer to Chapter 4 and Annex 2. Note that the only variable changing in Term III is T.

improvement, with an average increase of over 132 percent; this enormous growth is largely due to vast changes in the United Arab Emirates (455 percent), Qatar (367 percent), and Bahrain (219 percent).

Term I was identified as the second largest driver in our human capital accounts in the global average, representing 19 percent out of the 65 percent total change in human capital between 1990 and 2010. Such change represented about 32 percent of the total increase in human capital for the average country. In the case of Europe, Term I was the most significant source of growth, representing 15 percent of the 21 percent total increase in human capital; for this region, this source leads almost half (48 percent) of the total changes in relation to the other two terms (see Table 4). Overall, 100 of 140 countries count Term I as the second largest driving force of human capital, for 35 countries it is the most important driver of change.

In contrast to the trajectories of Terms I and II, Term III actually declined in the average country by two percent from the base year of 1990. In other words, despite increases in the embodied human capital per person and the total number of educated people, the time period that the average person stays in the labor market (Term III) decreased in the majority of countries (86 of 140). Term III's contribution to total human capital did not have a significant impact on total human capital growth in relation to Term I and II, representing only around 9 percent for the average country (see Table 4).

Picturing the overall development of human capital through the prism of the different drivers of human capital has shown that, in most of the cases, the number of people who reach the average education level is the primary source of growth in total human capital, with Europe as the only exception due to relatively low changes in population. It should be noted, however, that a per capita adjustment would diminish the importance of this driver (Term II).

Developing countries saw higher gains in terms of the embodied physical human capital as represented by Term I compared to those of Europe, Northern America, and Oceania. This is partly because most of the countries in those regions had already achieved high educational standards in the past, and marginal changes diminished over time.

4. Practical considerations and study limitations

While the accounting and management of capital assets are important to understanding inter-temporal benefit flows, it is challenging in several cases to obtain data on the complete set of assets available in an economy, as well as the measurement of the full contribution of a particular asset to human well-being, due to the variety of benefits that may result from a specific capital stock. In this section we elaborate on specific challenges in the context of the IWR 2014 wealth accounts, as well as other practical considerations and limitations that should be taken into account together with the findings presented in this chapter.

In compiling wealth accounts for the IWR 2014, we substantially extended the country coverage from the IWR 2012 sample (from 20 to 140 countries). In actuality, we assessed more than 140 countries in terms of human, produced, and natural capital; however, while over 180 countries had available data for produced capital and at least one type of natural capital – a requirement for our assessment – data on human capital was available for only 144. Intersecting these requirements led to a reduction to the final sample size of 140. Thus, existing country data on required input variables was one of the restrictions encountered in our effort to further extend IW accounting.

Despite the efforts of trying to better understand nations' resource base, there are still several areas for which assets are incompletely described. For instance, explicit estimates on the quantification of social capital are still missing from the IWR 2014, despite our efforts to extend our capital asset groups to include this category. For natural capital, we are still missing fisheries,

TABLE 4

Decomposition analysis of the three terms accounted in for human capital and their contribution to the changes in human capital

	percentage change with respect to 1990				percentage contribution to human capital growth of each term			
	Term I	Term II	Term III	total	Term I	Term II	Term III	total
Africa	**19**	**61**	**–1**	**79**	**24**	**72**	**4**	**100**
Eastern Africa	18	56	–2	73	25	71	3	100
Middle Africa	16	68	0	84	18	80	2	100
Northern Africa	27	49	–6	69	33	60	8	100
Southern Africa	18	52	–6	64	24	67	9	100
Western Africa	20	72	2	94	21	76	3	100
Asia	**22**	**78**	**–3**	**98**	**26**	**65**	**8**	**100**
Eastern Asia	18	25	–7	36	37	46	16	100
South-Central Asia	24	54	0	78	33	62	5	100
South-Eastern Asia	22	54	–3	73	29	66	5	100
Western Asia	22	132	–3	151	15	74	11	100
Europe	**15**	**8**	**–3**	**21**	**48**	**36**	**16**	**100**
Eastern Europe	13	1	–6	8	49	29	21	100
Northern Europe	16	8	–4	20	48	37	15	100
Southern Europe	16	12	–3	26	50	37	14	100
Western Europe	16	13	2	31	47	41	12	100
Latin America and the Caribbean	**21**	**41**	**0**	**62**	**35**	**59**	**6**	**100**
Caribbean	17	27	–3	41	35	52	13	100
Central America	24	56	1	80	31	67	2	100
South America	21	38	2	61	38	56	6	100
Northern America	**12**	**25**	**–4**	**34**	**29**	**62**	**9**	**100**
Northern America	12	25	–4	34	29	62	9	100
Oceania	**9**	**42**	**1**	**52**	**17**	**80**	**3**	**100**
Australia/New Zealand	8	35	3	45	17	77	6	100
Melanesia	10	49	0	59	18	82	0	100
Total World Average	**19**	**48**	**–2**	**65**	**32**	**59**	**9**	**100**

Note: Term I = human capital embodied per person; Term II = adults who reached the average education level; and Term III = capitalized labor compensation per unit of human capital. Negative changes in Term III are considered in absolute numbers to estimate the relative contribution among Term I, II, and III.

water accounts, and several ecosystem services (e.g., estuarine and coastal ecological systems[21]), due to a lack of data interpreting the dynamic of these important services for human well-being. Moreover, in order to include a country in our sample we required data for at least one of the natural capital assets, along with produced and human capital. While data availability in renewable resources tends to be relatively good across nations, estimates on mineral reserves tend to be incomplete, despite a prevalence of mineral extraction (or production) flow reports.

A key challenge for this report was in capturing the true contribution of particular assets to human well-being. To truly understand this, we must understand the full set of benefits resulting from a given asset's diverse roles. For example, human capital has been defined as "the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (OECD 2001A, P.18). How, though, does one measure such stocks in a population? One compelling solution is to look at the returns of such human capital in future income streams, also referred to as the income-based approach (see Chapters 3, 4, and Annex 2). However, the inter-temporal sum of the marginal payments for such labor (wages) reflects only the market compensation for the human capital contribution to production. Yet we know there are other benefits for human well-being, from human capital investment including health, subjective well-being, informed citizens, and willingness to cooperate, among others (see Chapter 3).

In the case of produced capital, the System of National Accounts (SNA) captures investments in produced capital by the market value of the capital goods and services acquired in a time period, which is also what our accounts are reflecting. Nonetheless, capital goods recorded in the SNA that serve to satisfy infrastructural needs may bring about amenities to a population beyond its central functionalities. Natural capital benefits resulting from changes in agricultural land are, for example, measured based on the contribution of this resource to the production system only. Any other role of agricultural land to human well-being has so far been excluded. For climate change damages, results should also be taken cautiously, since these estimates rely on a single study (NORDHAUS AND BOYER 2000), conducted more than a decade ago. Incorporating recent knowledge and additional study estimates would, given the considerable variability in the findings among the works in this area, help to improve accuracy on the level of damages resulting from (anthropogenic) changes in climate. Other aspects of note are the inherent uncertainties related to modeling any similar phenomenon, such as unknown functional relationships, errors in the prediction of future parameters in natural events and/or human behavior, and the lack of measurement of some important impacts[22] affecting particular countries (SCHNEIDER ET AL. 2002).

To compensate for such missing and incomplete data on country balance sheets and capital asset contributions to human well-being, we introduced total factor productivity (TFP) as a proxy variable for Adjusted Inclusive Wealth Index calculations. In our accounts, TFP represents the contribution to production of multiple implicit factors after produced, human, and natural capital items have been isolated. However, it is worth remarking this multifactor variable again accounts only for "market" production, and as such excludes our absent assets' informal and "direct" (e.g., several ecosystem services) contributions to human well-being.

Another important component of the index is the associated value attached to changes in physical stocks. Theoretical models refer to shadow (social) prices, which measure the marginal contribution of an asset to inter-temporal welfare. In several cases, however, empirical applications use

21 See Chapter 7 in this report and Chapter 8 in the IWR 2012 for insights into this type of natural capital.

22 In the work of Nordhaus and Boyer (2000) Carbon damages have been measured in the following areas: agriculture, sea-level rise, other vulnerable market sectors (energy systems), health, and non-market amenity impacts. For further details see Nordhaus and Boyer (2000).

market prices as a proxy for unavailable shadow prices. This practice may distort an asset's contribution to well-being in the case of market failures, such as environmental externalities.

The fact that a shadow price collects information of an asset's benefits for human well-being "beyond the market" brings with it some difficulties in comparing wealth (or per capita wealth) in two or more countries at a given point in time. There are several issues that may arise from this. For example, two individuals with identical physical human capital (i.e., skills, knowledge, or others) in different nations may still generate substantially different human capital wealth per person. One of the reasons for this could be that the citizen in the first country faces a labor market condition in which the resource in analysis is abundant, while the person in the second nation experiences the opposite situation – that is, a scarcity in the respective production factor. This would lead to divergent shadow prices for each individual's lifetime earnings – a key input for the lifetime income approach framework.

The previous issue would also be reflected on the consumption side, as an inter-temporal basket of consumed goods and services may have different prices in different countries. This should be corrected by using a sort of international dollars as adjusted by purchasing power parity, but across an inter-temporal framework. Other valuation issues might also arise when using a wealth measure at the level. For instance, using the marginal price at a specific period in time to value a complete forest stock ignores changes in willingness to pay over time in those cases when the resource is being depleted. These are some of the issues that could lead to misleading conclusions when comparing wealth (or per capita wealth) at the level.

Other caveats are inherent to the methodologies used to quantify the amount of a resource available in a country. For human capital, for example, the lifetime working period forecasts are based on contemporaneous indicators of mortality and labor force across age cohorts, and not in temporal projections (for details on this see Chapter 4). In the case of natural capital, one should be particularly cautious with the interpretation of values used in non-timber forest accounts, since the estimated benefits per unit of forest are based on global average. This may in some cases not be representative for all countries (see Annex 2 and Chapter 7 for further details).

Additional limitations refer to linear interpolations carried out to obtain information on the annual basis. For instance, the indicator on the average years of total schooling is reported every five years in Barro and Lee (2013), meaning that we were forced to perform estimates of the indicator for intermediate years. Similar interpolations were carried out to estimate annual survival rates in the human capital accounts, as well as annual growth of forest stock in our natural capital accounts.

Despite these limitations, we believe that the trends we have observed in a wide range of capital assets, and their analysis, provide important insight and knowledge into discussions of sustainable economic performance.

5. Final remarks

In this chapter, we assessed nations' performance in the light of changes in inclusive wealth – that is, the changes in the aggregated value of capital assets contributing to human well-being. Evaluating the changes in wealth of a particular country provides us with insights into its economy's ability to sustain present levels of welfare over the long term. Changes in wealth were carried out from an inclusive perspective by factoring in not only produced capital, but also human and natural capital. For the IWR 2014, we expanded our country sample, now covering 140 countries over a twenty one-year period (1990 to 2010).

Empirical evidence shows that nations' growth in inclusive wealth, while generally positive, has been considerably less rapid than growth in GDP, or even HDI. While 124 countries demonstrated growth in GDP and 135 in HDI (out of the 140 countries we looked at), only 85 countries showed progress in inclusive wealth. This is primarily because of a factor missing from both GDP and HDI: the environment. Depleting forests or extracting fossil fuels and mineral resources will increase GDP in the short run, but will endanger consumption potentials of a nation in the future if resources are not appropriately devoted to building the resource base, including not only human or produced capital, but also other forms of natural capital. Indeed, many countries that improved GDP might merely be transforming natural wealth into present consumption.

The depreciation of natural capital, together with population growth, constitutes the main driving force behind declining per capita wealth in the majority of countries. Population increased in 127 of 140 countries, while natural capital declined in 116 out of 140 countries. While population was a greater factor, both negatively impact growth in inclusive wealth per person. The study also reveals that human capital was the major contributor to growth rates in wealth for 101 of 140 countries. Even more, human capital is the single largest source of wealth in most countries. Produced capital came in second, representing the greatest contribution of wealth per person in 27 out of 140 countries. It is worth noting that produced capital, the capital type for which the vast majority of data and corresponding analysis exists, represents on average only about 18 percent of total wealth; while the rest of the capital types, which constitute the remaining 82 percent (54 percent human capital and 28 percent natural capital), are at best treated as satellite accounts in the System of National Accounts.

When the Inclusive Wealth Index is adjusted by carbon damages, oil capital gains, and total factor productivity, results show that all three factors negatively affected inclusive wealth growth in most countries.

While the estimates in this report are often incomplete – due both to missing data, as well as to difficulties in capturing the complete set of benefits to human well-being from particular assets – we consider that the trends we have uncovered provide important insight into understanding the development pathways of nations over the past two decades.

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Appendix 1: Key statistics

Data as averages containing measurements from 1990–2010*

Country	Code	Income level	IW per Capita Growth rate	Population Growth rate	IW Growth rate	IW Contribution by capital form HC	IW Contribution by capital form PC	IW Contribution by capital form NC
Africa			–0.8	2.3	1.5	1.3	0.4	–0.3
Eastern Africa			–0.8	2.3	1.5	1.3	0.5	–0.3
Burundi	BDI	LI	–0.1	2.0	1.9	1.9	0.2	–0.2
Kenya	KEN	LI	0.2	2.8	3.0	2.5	0.5	0.0
Mozambique	MOZ	LI	–2.4	2.8	0.3	0.4	0.2	–0.3
Mauritius	MUS	UMI	1.3	1.0	2.3	1.2	1.2	0.0
Malawi	MWI	LI	–1.3	2.3	1.0	1.0	0.3	–0.2
Rwanda	RWA	LI	0.7	2.1	2.8	2.3	0.5	0.0
United Republic of Tanzania	TZA	LI	–2.3	2.9	0.5	0.5	0.8	–0.8
Uganda	UGA	LI	–0.3	3.2	2.9	2.2	1.1	–0.5
Zambia	ZMB	LMI	–2.3	2.6	0.2	0.3	0.2	–0.2
Zimbabwe	ZWE	LI	–1.1	0.9	–0.2	0.7	0.0	–0.9
Middle Africa			–2.2	2.5	0.3	0.5	0.1	–0.3
Central African Republic	CAF	LI	–2.1	2.0	0.0	0.1	0.0	–0.1
Cameroon	CMR	LMI	–1.7	2.4	0.6	1.0	0.2	–0.6
Democratic Republic of the Congo	COD	LI	–2.7	3.0	0.3	0.5	0.0	–0.2
Congo	COG	LMI	–2.6	2.7	0.0	0.0	0.3	–0.4
Gabon	GAB	UMI	–1.7	2.4	0.7	1.0	0.1	–0.4
Northern Africa			0.1	1.7	1.8	1.4	0.7	–0.3
Morocco	MAR	LMI	1.1	1.3	2.4	1.5	0.9	0.0
Algeria	DZA	UMI	–0.7	1.7	0.9	1.1	0.5	–0.7
Egypt	EGY	LMI	0.6	1.8	2.5	1.9	0.9	–0.4
Sudan (former)	SDN	LMI	–1.6	2.5	0.9	0.8	0.5	–0.4
Tunisia	TUN	UMI	1.1	1.2	2.4	1.7	0.8	–0.1
Southern Africa			0.1	1.8	1.8	1.4	0.6	–0.1
Botswana	BWA	UMI	–0.2	1.9	1.7	1.0	1.1	–0.4
Lesotho	LSO	LMI	0.9	1.4	2.3	1.4	0.9	0.0
Namibia	NAM	UMI	–0.8	2.4	1.6	1.5	0.3	–0.2
Swaziland	SWZ	LMI	0.3	1.6	1.9	1.6	0.3	0.0
South Africa	ZAF	UMI	0.1	1.6	1.7	1.4	0.4	–0.1
Western Africa			–1.0	2.8	1.7	1.7	0.3	–0.3
Benin	BEN	LI	–1.2	3.1	1.8	1.9	0.4	–0.5
Côte d'Ivoire	CIV	LMI	–0.5	2.3	1.8	1.7	0.1	0.0

* For Croatia, Kazakhstan, Kyrgyzstan, Lithuania, Russian Federation, Slovenia, Tajikistan, and Ukraine the wealth account starts from 1991; for Czech Republic and Slovakia from 1992.
** GDP and HDI for Afghanistan, Cambodia, Czech Republic, and Estonia are averaged for the period 2000–2010 and Iraq, Nigeria, and United Arab Emirates for 2005–2010.

IW adjusted per capita				Percentage of inclusive wealth by capital form					Other indicators**	
Growth rate	Contribution by adjustment			HC	PC	NC	Breakdown NC		GDP per capita	HDI
	Carbon Damage	Oil Capital Gains	TFP				Renewable resources	Non-renewable resources	Growth rate	Growth rate
−1.4	−0.1	0.0	−0.5	47	13	40	36	4	1.2	1.1
−1.6	−0.1	−0.2	−0.5	47	12	41	40	1	1.7	1.3
0.4	−0.1	−0.1	0.7	66	14	20	20	0	−1.1	1.3
0.1	−0.2	−0.3	0.3	72	14	14	14	0	0.2	0.5
−5.0	0.0	−0.1	−2.4	14	4	82	81	1	4.4	2.3
0.8	−0.1	−0.4	0.0	76	22	2	2	0	3.5	0.8
−3.0	−0.1	−0.2	−1.3	36	18	46	46	0	1.5	1.7
1.3	−0.2	−0.2	1.1	79	13	7	7	0	3.2	3.1
−5.8	−0.1	−0.1	−3.2	17	11	72	71	1	2.6	1.4
−2.7	−0.2	−0.2	−2.0	61	18	20	20	0	3.4	2.0
−2.0	0.0	0.0	0.5	9	4	86	85	1	0.6	0.5
0.2	−0.1	−0.2	1.7	42	3	55	50	5	−1.4	−0.7
−1.8	0.0	0.3	0.2	16	7	77	73	4	−0.8	0.4
−2.1	0.0	0.0	0.0	3	2	95	95	0	−0.7	0.5
−2.6	−0.1	0.0	−0.7	34	10	56	55	1	0.1	0.6
−0.6	0.0	0.0	2.2	14	2	85	84	0	−3.1	0.0
−2.9	−0.1	0.7	−0.8	1	8	91	82	9	0.4	0.2
−0.8	−0.1	0.8	0.2	28	14	58	47	11	−0.7	0.5
−0.4	−0.1	0.1	−0.6	56	18	26	15	11	2.8	1.4
0.7	−0.1	−0.3	0.0	73	20	7	7	0	2.4	1.4
−0.4	−0.1	0.9	−0.5	37	27	37	5	31	1.0	1.2
−0.4	−0.2	−0.3	−0.6	72	16	13	1	12	3.1	1.4
−1.1	−0.1	0.5	0.1	27	4	68	60	9	4.1	1.6
−0.9	−0.1	−0.2	−1.7	71	24	5	2	3	3.4	1.3
−1.3	−0.1	−0.1	−1.1	59	18	23	19	4	1.9	0.1
−2.7	−0.2	−0.1	−2.2	32	17	51	50	1	3.3	0.4
0.4	−0.1	−0.1	−0.3	76	24	1	1	0	2.2	−0.2
−2.5	0.0	−0.1	−1.6	53	11	35	35	0	1.7	0.3
−1.5	−0.1	−0.1	−1.6	71	24	5	3	2	1.0	0.0
−0.3	−0.1	−0.2	−0.1	62	17	21	5	16	1.1	0.0
−1.7	−0.1	−0.1	−0.5	52	12	37	33	3	0.5	1.4
−2.9	−0.1	−0.2	−1.3	52	10	38	38	0	1.1	1.6
−0.9	−0.2	−0.1	−0.1	62	11	27	26	1	−0.5	0.9

HI High income
LMI Lower middle income
UMI Upper middle income
LI Low income

Appendix 1: Key statistics

Data as averages containing measurements from 1990–2010*

Country	Code	Income level	IW per Capita	Population	IW	Contribution by capital form		
			Growth rate	Growth rate	Growth rate	HC	PC	NC
Ghana	GHA	LMI	–0.7	2.5	1.8	1.4	0.7	–0.3
Gambia	GMB	LI	0.0	3.0	3.0	2.1	0.7	0.1
Liberia	LBR	LI	–3.2	3.2	–0.1	0.5	–0.1	–0.5
Mali	MLI	LI	–1.6	2.9	1.3	1.2	0.3	–0.2
Mauritania	MRT	LI	0.3	2.8	3.1	2.8	0.5	–0.2
Niger	NER	LI	–1.1	3.5	2.4	2.6	0.1	–0.3
Nigeria	NGA	LMI	–1.8	2.5	0.6	1.2	0.0	–0.6
Senegal	SEN	LMI	–1.0	2.7	1.7	1.3	0.7	–0.3
Sierra Leone	SLE	LI	–0.9	2.0	1.1	1.4	0.1	–0.3
Togo	TGO	LI	–0.6	2.5	1.9	2.3	0.0	–0.4
Asia			0.0	2.1	2.1	1.6	0.8	–0.2
Eastern Asia			1.0	0.7	1.7	0.6	1.2	–0.2
China	CHN	UMI	2.0	0.8	2.8	0.9	2.0	–0.2
Japan	JPN	HI	0.9	0.2	1.1	0.4	0.7	0.0
Republic of Korea	KOR	HI	2.4	0.6	2.9	1.0	1.9	0.0
Mongolia	MNG	LMI	–1.2	1.2	–0.1	0.1	0.3	–0.5
South-Central Asia			0.3	1.7	2.0	1.6	0.6	–0.1
Afghanistan	AFG	LI	–0.8	4.5	3.7	3.5	0.2	0.0
Bangladesh	BGD	LI	1.4	1.7	3.2	2.2	1.0	0.0
India	IND	LMI	0.7	1.7	2.5	1.5	1.1	–0.1
Iran (Islamic Republic of)	IRN	UMI	–0.7	1.5	0.8	0.9	0.3	–0.4
Kazakhstan	KAZ	UMI	0.3	–0.2	0.2	0.3	0.2	–0.3
Kyrgyzstan	KGZ	LI	0.2	1.0	1.1	0.6	0.2	0.3
Sri Lanka	LKA	LMI	1.2	0.9	2.1	1.5	0.7	0.0
Maldives	MDV	UMI	3.2	1.8	5.1	3.0	2.1	0.0
Nepal	NPL	LI	–1.6	2.3	0.7	0.9	0.5	–0.8
Pakistan	PAK	LMI	0.6	2.2	2.9	2.4	0.6	–0.1
Tajikistan	TJK	LI	–1.0	1.3	0.2	0.8	–0.6	0.0
South-Eastern Asia			0.2	1.7	1.9	1.3	1.0	–0.3
Indonesia	IDN	LMI	0.0	1.3	1.3	1.0	0.8	–0.4
Cambodia	KHM	LI	–1.3	2.0	0.6	0.8	0.4	–0.5
Lao People's Democratic Republic	LAO	LMI	–1.5	2.0	0.4	0.3	0.4	–0.2
Myanmar	MMR	LI	–1.3	1.0	–0.3	0.3	0.3	–1.0

* For Croatia, Kazakhstan, Kyrgyzstan, Lithuania, Russian Federation, Slovenia, Tajikistan, and Ukraine the wealth account starts from 1991; for Czech Republic and Slovakia from 1992.
** GDP and HDI for Afghanistan, Cambodia, Czech Republic, and Estonia are averaged for the period 2000–2010 and Iraq, Nigeria, and United Arab Emirates for 2005–2010.

IW adjusted per capita				Percentage of inclusive wealth by capital form					Other indicators**	
Growth rate	Contribution by adjustment			HC	PC	NC	Breakdown NC		GDP per capita	HDI
	Carbon Damage	Oil Capital Gains	TFP				Renewable resources	Non-renewable resources	Growth rate	Growth rate
−3.4	−0.2	−0.3	−2.2	45	23	32	30	1	2.4	1.2
1.6	−0.2	−0.4	2.1	61	8	31	31	0	0.7	1.5
−0.7	0.0	−0.1	2.8	11	7	81	81	0	1.3	0.9
−3.9	−0.1	0.0	−2.1	36	7	57	57	0	1.9	2.7
−1.1	−0.1	−0.6	−0.7	78	12	11	3	8	1.3	1.3
−2.8	−0.1	−0.1	−1.5	66	18	16	15	1	0.1	2.1
−2.8	−0.1	2.1	−2.9	44	12	44	16	28	−0.6	1.3
−1.8	−0.1	−0.3	−0.3	40	15	46	45	1	0.8	1.2
−0.1	−0.1	−0.3	1.2	55	3	41	41	0	−1.2	1.7
−1.4	−0.1	−0.3	−0.4	70	15	15	14	1	−0.8	0.9
0.2	−0.1	0.5	−0.5	51	18	31	15	16	3.2	1.1
−0.9	−0.1	−0.2	−1.7	47	22	31	24	7	4.3	1.0
−3.7	0.0	−0.2	−5.5	49	19	32	21	11	9.6	1.7
0.3	0.0	−0.1	−0.4	64	35	1	1	0	0.8	0.4
1.1	−0.2	−0.4	−0.7	67	28	5	5	0	4.8	1.0
−1.4	0.0	−0.1	−0.1	7	6	87	70	17	2.1	0.8
1.5	−0.1	0.0	0.4	54	19	26	11	16	3.3	1.3
0.5	−0.1	−0.1	1.5	67	25	8	5	3	10.0	4.5
1.1	−0.1	−0.2	0.0	78	16	6	6	0	3.5	1.7
−1.1	−0.2	−0.2	−1.5	65	14	21	9	12	4.8	1.5
0.0	0.0	2.4	−1.7	26	12	63	3	60	2.7	1.6
8.9	0.0	1.2	0.5	24	19	57	1	56	3.3	0.6
3.4	−0.1	−0.5	2.2	37	24	38	17	22	−0.2	0.0
−0.4	−0.1	−0.3	−1.3	80	15	6	6	0	4.3	0.8
4.9	−0.1	−0.6	2.4	77	23	0	0	0	4.8	0.7
−3.5	−0.1	−0.1	−1.7	31	10	58	58	0	2.2	1.5
−0.8	−0.1	−0.3	−1.0	69	17	14	7	6	2.0	1.5
3.9	−0.1	−1.0	5.0	43	38	20	5	15	−1.0	0.0
−1.4	−0.1	−0.3	−1.2	46	16	39	35	4	4.7	1.4
−1.5	−0.1	−0.2	−1.2	47	13	40	32	8	3.5	1.3
−4.5	−0.1	−0.2	−2.8	23	6	71	71	0	6.7	1.8
−0.5	0.0	0.0	1.1	10	3	87	87	0	5.1	1.7
−2.4	0.0	−0.1	−0.9	18	2	79	74	5	8.5	2.4

HI High income
LMI Lower middle income
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Appendix 1: Key statistics

Data as averages containing measurements from 1990–2010*

Country	Code	Income level	IW per Capita Growth rate	Population Growth rate	IW Growth rate	IW Contribution by capital form HC	PC	NC
Malaysia	MYS	UMI	0.4	2.2	2.7	2.0	1.0	−0.3
Philippines	PHL	LMI	0.5	2.1	2.6	1.7	0.8	0.0
Singapore	SGP	HI	1.9	2.6	4.6	2.7	1.9	0.0
Thailand	THA	UMI	1.2	1.0	2.2	0.9	1.5	−0.1
Vietnam	VNM	LMI	1.9	1.4	3.3	1.7	1.5	0.1
Western Asia			−0.6	3.1	2.5	2.0	0.7	−0.3
United Arab Emirates	ARE	HI	−3.0	7.4	4.2	4.0	0.6	−0.4
Armenia	ARM	LMI	1.0	−0.7	0.4	−0.2	0.6	−0.1
Bahrain	BHR	HI	0.8	4.9	5.7	4.5	1.4	−0.2
Cyprus	CYP	HI	1.0	1.8	2.8	2.2	0.6	0.0
Iraq	IRQ	LMI	−2.9	3.0	0.1	0.4	0.0	−0.4
Israel	ISR	HI	0.9	2.5	3.4	2.5	0.9	0.0
Jordan	JOR	UMI	0.7	3.0	3.7	2.9	0.8	0.0
Kuwait	KWT	HI	−1.3	1.4	0.0	0.2	0.4	−0.6
Qatar	QAT	HI	−3.7	7.0	2.9	2.2	1.3	−0.5
Saudi Arabia	SAU	HI	−1.3	2.7	1.3	1.3	0.4	−0.3
Syrian Arab Republic	SYR	LMI	−0.3	2.6	2.2	2.1	0.6	−0.4
Turkey	TUR	UMI	0.9	1.5	2.4	1.5	1.0	0.0
Yemen	YEM	LMI	−0.4	3.6	3.2	3.0	0.5	−0.3
Europe			1.0	0.2	1.2	0.6	0.6	0.0
Eastern Europe			0.8	−0.3	0.5	0.2	0.3	−0.1
Bulgaria	BGR	UMI	1.0	−0.8	0.1	−0.2	0.3	0.0
Czech Republic	CZE	HI	1.3	0.1	1.4	0.6	0.8	−0.1
Hungary	HUN	HI	1.3	−0.2	1.1	0.7	0.5	0.0
Republic of Moldova	MDA	LMI	−0.2	−1.0	−1.2	−0.5	−0.8	0.1
Poland	POL	HI	1.1	0.0	1.1	0.5	0.7	−0.1
Romania	ROU	UMI	1.0	−0.4	0.6	0.2	0.6	−0.1
Russian Federation	RUS	UMI	0.1	−0.2	−0.1	0.2	0.0	−0.3
Slovakia	SVK	HI	1.1	0.2	1.3	0.6	0.7	0.0
Ukraine	UKR	LMI	0.4	−0.7	−0.3	0.0	−0.2	−0.1
Northern Europe			0.9	0.2	1.2	0.6	0.7	−0.1
Denmark	DNK	HI	0.5	0.4	0.9	0.2	0.7	0.0
Estonia	EST	HI	1.7	−0.8	0.9	0.1	0.8	0.0

* For Croatia, Kazakhstan, Kyrgyzstan, Lithuania, Russian Federation, Slovenia, Tajikistan, and Ukraine the wealth account starts from 1991; for Czech Republic and Slovakia from 1992.
** GDP and HDI for Afghanistan, Cambodia, Czech Republic, and Estonia are averaged for the period 2000–2010 and Iraq, Nigeria, and United Arab Emirates for 2005–2010.

IW adjusted per capita				Percentage of inclusive wealth by capital form					Other indicators**	
Growth rate	Contribution by adjustment			HC	PC	NC	Breakdown NC		GDP per capita	HDI
	Carbon Damage	Oil Capital Gains	TFP				Renewable resources	Non-renewable resources	Growth rate	Growth rate
-0.9	-0.1	-0.1	-1.2	60	16	23	12	12	3.6	0.9
-0.9	-0.1	-0.4	-0.8	65	24	11	10	1	1.7	0.6
-2.1	0.0	-1.1	-2.9	70	30	0	0	0	3.7	0.8
-1.6	-0.1	-0.5	-2.2	53	32	14	11	4	3.5	0.9
1.9	-0.1	-0.2	0.3	66	13	21	16	5	6.0	1.7
0.6	-0.1	1.6	-0.3	53	16	31	3	28	1.6	0.7
0.3	-0.1	3.3	0.3	42	16	43	0	43	-8.7	-0.4
0.8	-0.1	-0.8	0.6	71	25	4	4	0	3.6	0.7
0.3	-0.2	-0.2	-0.2	68	28	4	0	4	0.5	0.5
-0.1	-0.1	-0.3	-0.7	80	19	1	1	0	1.8	0.4
8.3	0.0	5.9	5.5	12	3	86	0	85	3.9	0.5
0.0	0.0	-0.2	-0.7	78	22	0	0	0	1.9	0.5
-1.9	-0.1	-0.9	-1.6	71	24	5	2	3	2.4	0.8
5.7	-0.1	7.0	0.2	9	6	85	0	85	4.5	0.5
-3.4	-0.1	4.1	-3.3	22	11	68	0	68	3.3	0.5
2.2	-0.1	3.5	0.1	33	8	59	13	47	0.3	0.9
-2.8	-0.1	-0.3	-2.1	70	16	14	0	13	2.8	0.7
0.8	-0.1	-0.2	0.2	73	20	8	6	1	2.4	1.2
-2.1	-0.1	0.4	-2.0	67	10	23	11	12	2.4	2.5
1.2	-0.1	-0.2	0.4	66	26	8	5	3	1.8	0.5
1.8	0.0	-0.2	0.8	57	28	15	7	9	1.9	0.4
-0.1	0.0	-0.4	-0.6	55	26	19	6	12	2.1	0.5
2.6	0.0	-0.2	1.4	65	33	2	0	2	3.2	0.6
1.7	0.0	-0.2	0.6	70	26	4	2	2	1.5	0.8
2.2	0.0	-0.4	2.9	45	49	7	7	0	-1.0	0.0
0.2	0.0	-0.2	-0.7	78	17	5	1	4	3.9	0.2
0.9	0.0	-0.2	0.1	62	25	14	12	2	1.9	0.5
3.1	0.0	0.1	0.9	31	17	52	27	25	1.7	0.4
-0.1	0.0	-0.2	-1.1	67	31	3	2	1	4.3	0.5
6.1	0.0	-0.2	3.7	38	28	34	2	32	-0.5	0.1
0.8	-0.1	-0.1	0.1	67	24	9	8	1	2.0	0.6
0.6	-0.2	0.0	0.3	73	25	1	0	1	1.2	0.5
2.1	0.0	-0.2	0.7	65	24	11	11	0	4.0	0.7

HI High income
LMI Lower middle income
UMI Upper middle income
LI Low income

Appendix 1: Key statistics

Data as averages containing measurements from 1990–2010*

Country	Code	Income level	IW per Capita: Growth rate	Population: Growth rate	IW: Growth rate	IW: Contribution by capital form: HC	IW: Contribution by capital form: PC	IW: Contribution by capital form: NC
Finland	FIN	HI	0.7	0.4	1.1	0.6	0.5	0.0
United Kingdom	GBR	HI	0.9	0.4	1.3	0.7	0.6	–0.1
Ireland	IRL	HI	1.5	1.2	2.7	1.5	1.2	0.0
Iceland	ISL	HI	0.0	1.1	1.2	0.9	0.6	–0.3
Lithuania	LTU	UMI	1.3	–0.6	0.7	0.2	0.5	0.0
Latvia	LVA	UMI	1.7	–0.8	0.9	0.1	0.6	0.1
Norway	NOR	HI	0.3	0.7	1.0	0.8	0.6	–0.4
Sweden	SWE	HI	0.6	0.5	1.1	0.6	0.5	0.0
Southern Europe			1.1	0.3	1.4	0.8	0.7	0.0
Albania	ALB	LMI	0.8	–0.1	0.6	0.2	0.4	0.0
Spain	ESP	HI	1.9	0.9	2.8	1.8	1.0	0.0
Greece	GRC	HI	1.0	0.6	1.5	0.9	0.8	–0.1
Croatia	HRV	HI	0.9	–0.2	0.8	0.2	0.5	0.0
Italy	ITA	HI	0.8	0.3	1.1	0.5	0.7	0.0
Malta	MLT	HI	1.6	0.6	2.3	1.4	0.9	0.0
Portugal	PRT	HI	1.0	0.4	1.4	0.7	0.7	0.0
Serbia	SRB	UMI	0.7	0.2	0.9	0.6	0.2	0.1
Slovenia	SVN	HI	1.4	0.3	1.6	0.8	0.8	0.0
Western Europe			1.1	0.6	1.7	0.9	0.8	0.0
Austria	AUT	HI	1.1	0.5	1.6	0.8	0.8	0.0
Belgium	BEL	HI	1.0	0.4	1.4	0.7	0.7	0.0
Switzerland	CHE	HI	0.4	0.7	1.1	0.6	0.6	0.0
Germany	DEU	HI	1.5	0.2	1.7	1.2	0.5	0.0
France	FRA	HI	1.1	0.5	1.6	1.0	0.6	0.0
Luxembourg	LUX	HI	1.5	1.4	3.0	1.5	1.5	0.0
Netherlands	NLD	HI	0.9	0.5	1.5	0.7	0.8	0.0
Latin America and the Caribbean			0.0	1.4	1.5	1.2	0.5	–0.2
Caribbean			0.5	0.9	1.4	1.1	0.4	–0.1
Barbados	BRB	HI	0.6	0.3	0.9	0.6	0.3	0.0
Cuba	CUB	UMI	0.1	0.3	0.4	0.4	–0.1	0.1
Dominican Republic	DOM	UMI	1.0	1.6	2.6	1.8	0.9	0.0
Haiti	HTI	LI	0.9	1.7	2.6	2.3	0.3	0.0
Jamaica	JAM	UMI	0.7	0.7	1.4	0.9	0.6	–0.1

* For Croatia, Kazakhstan, Kyrgyzstan, Lithuania, Russian Federation, Slovenia, Tajikistan, and Ukraine the wealth account starts from 1991; for Czech Republic and Slovakia from 1992.
** GDP and HDI for Afghanistan, Cambodia, Czech Republic, and Estonia are averaged for the period 2000–2010 and Iraq, Nigeria, and United Arab Emirates for 2005–2010.

𝕎 adjusted per capita				Percentage of inclusive wealth by capital form					Other indicators**	
Growth rate	Contribution by adjustment			HC	PC	NC	Breakdown NC		GDP per capita	HDI
	Carbon Damage	Oil Capital Gains	TFP				Renewable resources	Non-renewable resources	Growth rate	Growth rate
-0.1	-0.1	-0.1	-0.5	65	27	8	8	0	1.7	0.5
0.1	-0.2	-0.1	-0.5	78	21	1	0	1	1.8	0.5
0.5	-0.2	-0.1	-0.7	69	29	2	2	0	3.4	0.7
-0.4	-0.1	-0.1	-0.2	48	17	35	35	0	1.3	0.5
2.2	0.0	-0.3	1.3	68	27	5	5	0	1.8	0.5
3.9	0.0	-0.3	2.4	67	21	11	11	0	1.5	0.7
-0.5	-0.2	0.3	-1.0	61	27	12	2	9	1.9	0.6
0.0	-0.2	-0.1	-0.3	70	24	6	5	0	1.6	0.5
1.4	-0.1	-0.2	0.6	70	24	6	4	2	1.8	0.6
-2.0	-0.1	-0.1	-2.5	38	35	27	13	14	4.1	0.6
2.5	-0.1	-0.2	0.9	71	27	2	2	0	1.6	0.8
-0.1	-0.2	-0.3	-0.7	59	31	10	7	3	1.7	0.6
2.7	0.0	-0.2	2.0	80	17	3	3	0	2.2	0.6
0.6	-0.2	-0.1	0.1	67	31	2	2	0	0.6	0.7
1.8	-0.1	-0.4	0.7	80	20	0	0	0	2.8	0.5
1.4	-0.1	-0.2	0.7	77	22	1	1	0	1.5	0.7
4.2	0.0	-0.1	3.5	83	12	5	5	0	-0.7	0.3
1.7	0.0	-0.2	0.5	72	24	5	4	1	2.7	0.3
0.8	-0.2	-0.2	0.1	70.1	28.1	1.7	0.9	0.8	1.5	0.5
0.4	-0.2	-0.1	-0.4	68	30	2	2	0	1.6	0.6
1.1	-0.2	-0.2	0.5	73	27	0	0	0	1.4	0.5
0.5	-0.2	-0.1	0.3	71	27	2	2	0	0.7	0.4
1.6	-0.2	-0.1	0.4	69	26	5	0	4	1.3	0.7
1.3	-0.2	-0.1	0.5	73	25	1	1	0	1.0	0.6
0.3	-0.3	-0.3	-0.7	68	32	1	1	0	2.5	0.5
0.4	-0.2	-0.2	-0.1	70	29	2	0	1	1.7	0.4
-1.0	-0.1	-0.1	-0.8	52	17	31	27	4	2.0	0.8
-0.4	-0.1	-0.3	-0.5	68	22	10	6	5	1.6	0.6
0.4	-0.1	-0.2	0.0	78	21	1	1	0	0.8	0.4
-2.0	-0.1	-0.6	-1.4	66	26	8	5	3	1.8	0.7
-0.9	-0.1	-0.4	-1.4	75	16	9	9	0	4.0	0.9
2.9	-0.2	-0.3	2.5	82	17	1	1	0	-2.0	0.6
0.9	-0.1	-0.6	0.9	57	25	18	16	3	0.3	0.6

HI High income
LMI Lower middle income
UMI Upper middle income
LI Low income

Appendix 1: Key statistics

Data as averages containing measurements from 1990–2010*

Country	Code	Income level	IW per Capita	Population	IW			
			Growth rate	Growth rate	Growth rate	Contribution by capital form		
						HC	PC	NC
Trinidad and Tobago	TTO	HI	−0.2	0.5	0.3	0.9	0.1	−0.7
Central America			0.2	1.9	2.1	1.7	0.7	−0.2
Belize	BLZ	LMI	−1.4	2.5	1.1	1.0	0.5	−0.3
Costa Rica	CRI	UMI	0.8	2.1	2.9	2.3	0.7	−0.1
Guatemala	GTM	LMI	0.3	2.4	2.7	2.3	0.6	−0.1
Honduras	HND	LMI	−0.6	2.2	1.6	1.7	0.6	−0.7
Mexico	MEX	UMI	0.9	1.5	2.4	1.6	1.0	−0.1
Nicaragua	NIC	LMI	−0.6	1.7	1.1	1.1	0.3	−0.4
Panama	PAN	UMI	0.6	1.9	2.5	1.8	0.9	−0.1
El Salvador	SLV	LMI	1.6	0.8	2.3	1.7	0.7	0.0
South America			−0.3	1.4	1.0	0.9	0.4	−0.2
Argentina	ARG	UMI	0.3	1.1	1.4	1.0	0.5	−0.1
Bolivia (Plurinational State of)	BOL	LMI	−2.1	2.0	−0.1	0.3	0.1	−0.4
Brazil	BRA	UMI	0.1	1.3	1.4	1.3	0.3	−0.2
Chile	CHL	UMI	1.1	1.3	2.4	1.6	0.9	−0.1
Colombia	COL	UMI	−0.1	1.7	1.6	1.3	0.4	−0.2
Ecuador	ECU	UMI	−0.9	1.7	0.8	0.9	0.6	−0.7
Guyana	GUY	LMI	−0.1	0.2	0.1	0.0	0.1	0.0
Peru	PER	UMI	−0.6	1.5	0.9	0.7	0.4	−0.2
Paraguay	PRY	LMI	−1.1	2.1	1.0	1.0	0.3	−0.3
Uruguay	URY	UMI	0.7	0.4	1.1	0.7	0.5	0.0
Venezuela (Bolivarian Republic of)	VEN	UMI	−1.1	2.0	0.8	1.0	0.2	−0.4
Northern America			0.4	1.0	1.5	0.9	0.7	−0.1
Northern America			0.4	1.0	1.5	0.9	0.7	−0.1
Canada	CAN	HI	0.3	1.0	1.3	0.9	0.6	−0.1
United States of America	USA	HI	0.6	1.0	1.6	0.9	0.8	0.0
Oceania			−0.3	1.5	1.2	0.8	0.6	−0.2
Australia/New Zealand			0.4	1.3	1.7	1.0	0.9	−0.2
Australia	AUS	HI	0.3	1.3	1.7	0.9	0.9	−0.1
New Zealand	NZL	HI	0.5	1.3	1.7	1.1	0.8	−0.2
Melanesia			−1.0	1.7	0.7	0.7	0.2	−0.2
Fiji	FJI	LMI	0.7	0.8	1.5	1.2	0.4	0.0
Papua New Guinea	PNG	LMI	−2.7	2.5	−0.2	0.2	0.1	−0.5
World			**0.0**	**1.5**	**1.6**	**1.2**	**0.6**	**−0.2**

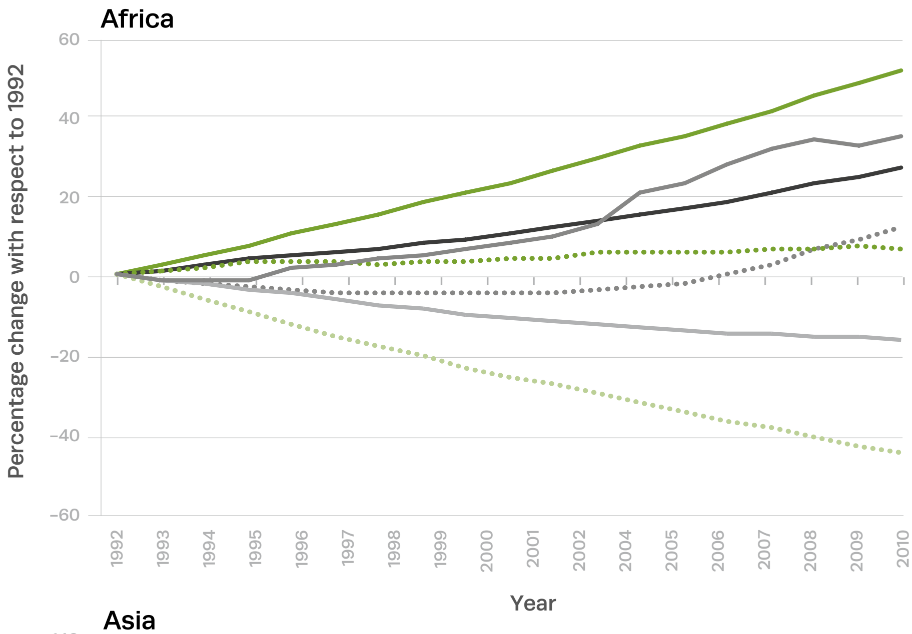
*For Croatia, Kazakhstan, Kyrgyzstan, Lithuania, Russian Federation, Slovenia, Tajikistan, and Ukraine the wealth account starts from 1991; for Czech Republic and Slovakia from 1992.

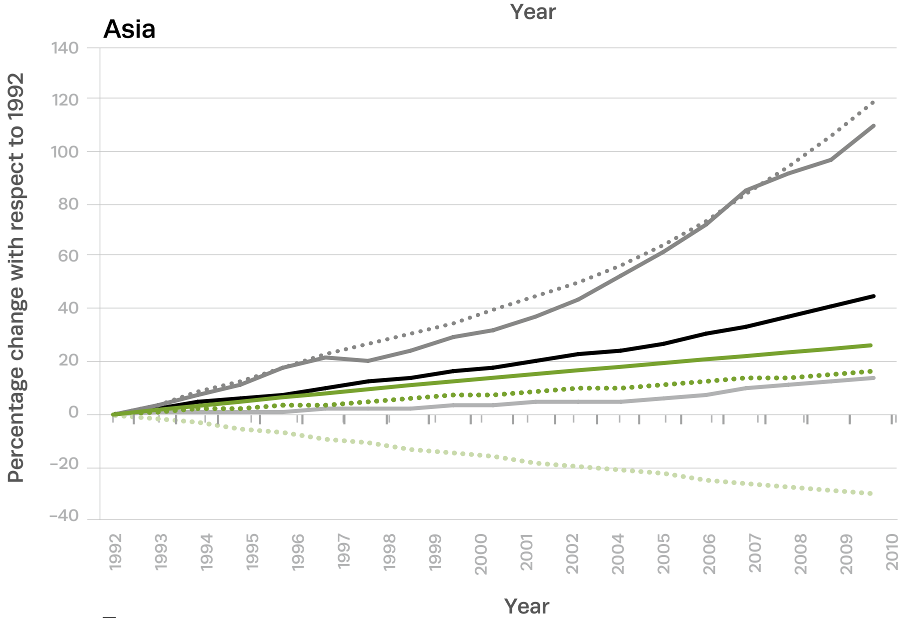
IW adjusted per capita				Percentage of inclusive wealth by capital form					Other indicators**	
Growth rate	Contribution by adjustment			HC	PC	NC	Breakdown NC		GDP per capita	HDI
	Carbon Damage	Oil Capital Gains	TFP				Renewable resources	Non-renewable resources	Growth rate	Growth rate
-3.6	-0.1	0.3	-3.6	48	27	25	3	22	4.7	0.5
-1.0	-0.1	-0.3	-0.7	58	18	25	24	0	2.0	0.9
-3.3	0.0	-0.3	-1.6	28	11	61	61	0	2.0	0.3
-0.2	-0.1	-0.2	-0.7	73	14	13	13	0	2.6	0.7
-0.9	-0.1	-0.2	-0.8	75	16	9	9	0	1.3	1.1
-1.4	-0.1	-0.2	-0.4	50	13	37	37	0	1.4	1.0
0.9	-0.1	-0.3	0.4	60	27	13	11	2	1.2	0.8
-2.1	-0.1	-0.4	-1.0	40	23	37	37	0	1.4	1.1
-1.5	-0.1	-0.7	-1.4	61	17	22	22	0	3.7	0.7
0.8	-0.1	-0.3	-0.4	74	21	5	5	0	2.5	1.3
-1.3	-0.1	0.2	-1.1	39	13	48	41	7	2.3	0.8
-1.9	-0.1	-0.1	-2.0	54	21	25	21	3	3.3	0.7
-2.6	0.0	0.0	-0.5	9	2	90	88	2	1.8	0.9
-1.0	-0.1	-0.1	-0.9	50	16	34	31	2	1.7	1.0
0.3	-0.1	-0.3	-0.5	65	14	21	16	4	3.7	0.7
-0.8	-0.1	0.0	-0.7	47	13	40	34	6	1.7	0.9
-1.5	-0.1	1.1	-1.5	35	23	42	24	19	1.6	0.6
-1.4	0.0	-0.1	-1.2	5	3	93	92	1	3.5	1.1
-3.1	0.0	-0.1	-2.4	27	11	61	58	3	3.4	0.9
-2.2	0.0	-0.2	-0.9	31	11	57	57	0	0.7	0.7
-0.6	-0.1	-0.2	-1.0	68	18	14	14	0	2.8	0.6
0.6	0.0	2.4	-0.6	35	15	50	14	36	0.8	0.8
0.8	0.0	0.3	0.1	62	19	19	11	8	1.4	0.3
0.8	0.0	0.3	0.1	62	19	19	11	8	1.4	0.3
1.0	0.0	0.8	0.0	51	17	31	18	13	1.4	0.2
0.6	0.0	-0.2	0.2	72	21	7	4	4	1.5	0.3
-1.0	0.0	-0.2	-0.5	45	17	38	33	5	1.6	0.6
-0.3	0.0	-0.1	-0.6	53	24	23	15	8	1.8	0.4
-0.3	0.0	-0.1	-0.6	48	21	31	17	14	2.0	0.3
-0.2	0.0	-0.2	-0.5	58	27	15	14	1	1.5	0.5
-1.8	-0.1	-0.2	-0.4	37	9	53	52	2	1.4	0.9
0.4	-0.1	-0.4	0.3	68	16	16	16	0	0.9	0.7
-4.0	0.0	0.0	-1.1	6	3	91	87	4	1.8	1.1
-0.2	**-0.1**	**0.1**	**-0.3**	**54**	**18**	**28**	**21**	**7**	**2.0**	**0.8**

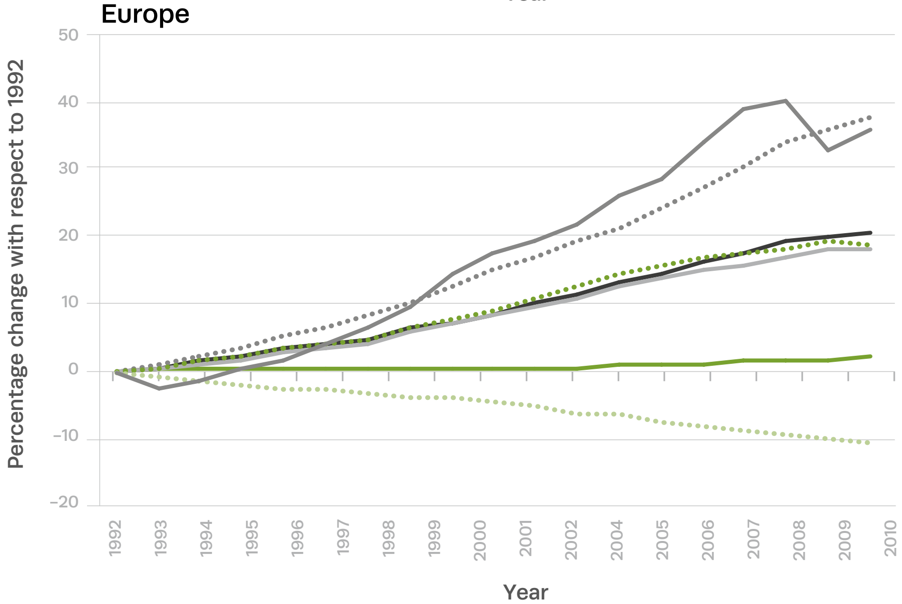
HI High income
LMI Lower middle income
UMI Upper middle income
LI Low income

Appendix 2:

Changes in aggregated inclusive wealth per capita by region, 1992–1990



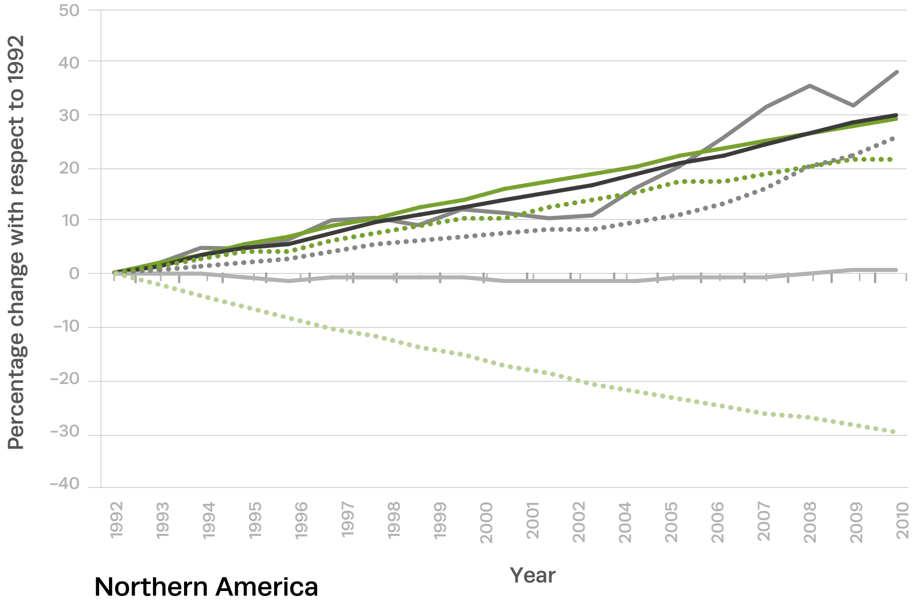




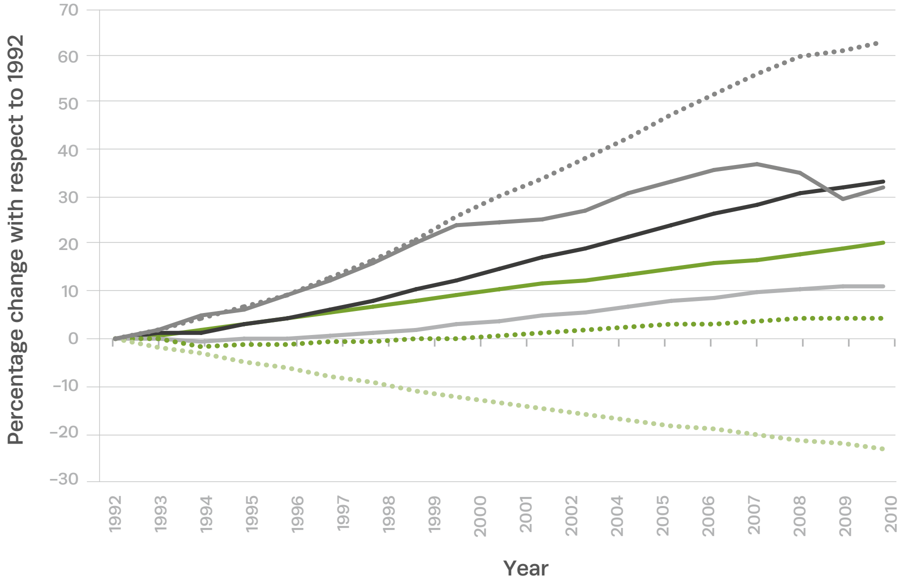
Key

- Population
- IW
- IW per capita
- PC per capita
- HC per capita
- NC per capita
- GDP per capita

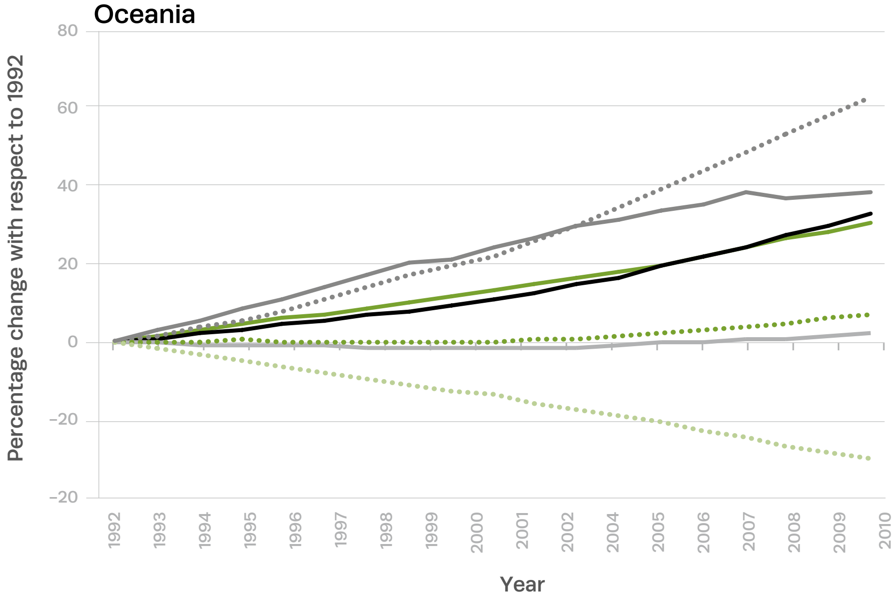
Latin America and the Caribbean

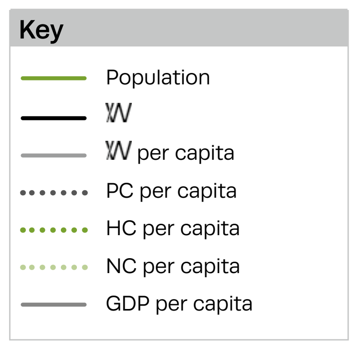


Northern America



Oceania





Appendix 3: Decomposition analysis of the three terms accounted in for human capital and their contribution to the changes in human capital

Country	Percentage change with respect to 1990				Relative contribution in percentage to human capital growth of each term			
	Term I	Term II	Term III	total	Term I	Term II	Term III	total
Afghanistan	40	138	4	182	22	76	2	100
Albania	10	9	−5	13	43	35	22	100
Algeria	35	57	−8	84	35	56	8	100
Argentina	10	31	4	45	23	68	9	100
Armenia	0	−1	−5	−6	5	19	76	100
Australia	5	36	2	44	12	83	5	100
Austria	16	11	1	28	56	39	5	100
Bahrain	39	219	−2	256	15	84	1	100
Bangladesh	31	47	−4	74	38	58	5	100
Barbados	9	12	−4	17	37	47	17	100
Belgium	9	8	5	22	40	38	23	100
Belize	10	85	1	96	11	88	1	100
Benin	26	84	0	110	24	76	0	100
Bolivia (Plurinational State of)	31	50	2	84	38	60	3	100
Botswana	31	60	−2	89	33	65	2	100
Brazil	34	34	−1	67	49	49	2	100
Bulgaria	9	−10	−4	−6	38	46	17	100
Burundi	17	58	−1	73	22	76	2	100
Cambodia	7	88	2	96	7	91	2	100
Cameroon	19	61	−1	79	24	75	1	100
Canada	16	27	−4	39	35	57	8	100
Central African Republic	10	51	−1	61	16	82	1	100
Chile	19	39	3	62	32	64	4	100
China	26	26	−6	46	45	44	11	100
Colombia	20	48	8	76	26	63	11	100
Congo	6	70	3	79	8	89	3	100
Costa Rica	18	69	0	87	20	79	0	100
Côte d'Ivoire	21	56	−2	75	26	71	3	100
Croatia	11	2	−6	6	57	9	34	100
Cuba	12	10	−8	14	39	34	27	100
Cyprus	11	58	4	72	15	80	5	100
Czech Republic	12	11	−1	22	49	46	5	100
Democratic Republic of the Congo	5	88	2	96	5	92	3	100
Denmark	5	5	−5	6	35	33	32	100
Dominican Republic	16	47	−2	61	24	72	4	100

Note: Term I = human capital embodied per person; Term II = adults who reached the average education level; and Term III = capitalized labor compensation per unit of human capital. Negative changes in Term III are considered in absolute numbers to estimate the relative contribution among Term I, II, and III.

Country	Percentage change with respect to 1990				Relative contribution in percentage to human capital growth of each term			
	Term I	Term II	Term III	total	Term I	Term II	Term III	total
Ecuador	11	53	2	67	17	79	4	100
Egypt	29	46	–6	69	36	56	8	100
El Salvador	35	21	0	56	63	37	1	100
Estonia	22	–12	–5	4	56	30	14	100
Fiji	9	32	0	41	21	78	0	100
Finland	16	8	–5	19	56	27	17	100
France	29	7	–5	31	71	17	12	100
Gabon	38	69	–2	105	35	63	2	100
Gambia	21	78	1	99	21	78	1	100
Germany	39	2	–1	40	92	6	3	100
Ghana	14	72	–4	83	16	80	4	100
Greece	22	14	–2	34	57	37	6	100
Guatemala	15	64	3	82	19	78	3	100
Guyana	17	0	–1	16	94	2	4	100
Haiti	19	51	5	75	25	68	7	100
Honduras	31	68	1	99	31	69	1	100
Hungary	27	–3	–3	20	81	9	10	100
Iceland	21	29	–6	44	38	52	10	100
India	18	43	–5	57	28	65	7	100
Indonesia	21	35	–4	52	35	57	7	100
Iran (Islamic Republic of)	46	64	–10	100	39	53	9	100
Iraq	18	77	–3	91	18	79	3	100
Ireland	12	37	5	54	22	69	9	100
Israel	8	78	3	88	9	88	3	100
Italy	16	6	–7	15	54	21	25	100
Jamaica	27	17	–10	34	50	32	18	100
Japan	15	7	–10	11	46	22	32	100
Jordan	37	99	–9	127	26	68	6	100
Kazakhstan	25	1	0	26	94	5	1	100
Kenya	20	84	–4	101	19	78	3	100
Kuwait	4	42	2	49	9	87	4	100
Kyrgyzstan	6	32	1	38	15	82	3	100
Lao People's Democratic Republic	18	63	2	83	22	76	2	100
Latvia	22	–12	–7	3	53	30	17	100
Lesotho	21	34	–11	44	31	52	17	100

Appendix 3: Decomposition analysis of the three terms accounted in for human capital and their contribution to the changes in human capital

Country	Percentage change with respect to 1990				Relative contribution in percentage to human capital growth of each term			
	Term I	Term II	Term III	total	Term I	Term II	Term III	total
Liberia	37	90	8	135	27	67	6	100
Lithuania	18	–5	–6	6	61	17	22	100
Luxembourg	12	34	9	55	21	62	17	100
Malawi	19	49	–2	66	28	70	3	100
Malaysia	37	65	–7	94	34	60	7	100
Maldives	27	73	14	114	24	64	12	100
Mali	14	74	2	89	16	82	2	100
Malta	17	25	–1	40	40	59	2	100
Mauritania	24	75	3	102	24	73	3	100
Mauritius	14	26	–5	35	32	58	10	100
Mexico	30	40	–3	67	42	55	4	100
Mongolia	8	47	–2	53	14	82	4	100
Morocco	23	35	–7	51	35	54	11	100
Mozambique	10	69	–2	77	13	85	3	100
Myanmar	21	27	–3	45	41	53	6	100
Namibia	–1	73	2	74	2	96	2	100
Nepal	18	60	1	79	23	76	1	100
Netherlands	8	11	4	23	35	48	17	100
New Zealand	10	33	3	46	22	72	7	100
Nicaragua	28	46	1	75	37	62	1	100
Niger	11	99	8	118	9	84	7	100
Nigeria	11	62	0	73	15	84	1	100
Norway	16	15	–2	29	49	45	6	100
Pakistan	34	60	2	97	35	62	2	100
Panama	22	54	1	77	28	70	1	100
Papua New Guinea	11	66	0	77	15	85	0	100
Paraguay	32	56	–2	86	35	63	2	100
Peru	20	44	6	70	29	63	9	100
Philippines	17	56	–3	69	22	74	4	100
Poland	12	11	–9	14	39	34	27	100
Portugal	12	10	–3	19	46	42	12	100
Qatar	25	367	5	397	6	92	1	100
Republic of Korea	24	20	–10	34	45	37	18	100
Republic of Moldova	11	–11	–20	–19	27	26	48	100
Romania	10	0	–3	6	72	3	24	100

Country	Percentage change with respect to 1990				Relative contribution in percentage to human capital growth of each term			
	Term I	Term II	Term III	total	Term I	Term II	Term III	total
Russian Federation*	16	3	−6	13	65	12	24	100
Rwanda	18	50	2	70	25	72	3	100
Saudi Arabia	34	94	−11	118	24	68	8	100
Senegal	21	69	0	90	23	76	1	100
Serbia	11	7	−3	16	53	34	13	100
Sierra Leone	15	41	4	60	25	68	7	100
Singapore	30	80	1	111	27	72	1	100
Slovakia	6	18	−3	21	21	67	12	100
Slovenia	9	14	1	24	37	59	4	100
South Africa	19	46	−8	56	25	63	12	100
Spain	39	22	2	64	61	35	4	100
Sri Lanka	22	27	−6	43	40	50	10	100
Sudan (former)	13	68	0	81	16	84	1	100
Swaziland	20	48	−11	57	26	61	14	100
Sweden	12	9	−4	17	50	35	15	100
Switzerland	2	17	−2	17	11	80	9	100
Syrian Arab Republic	9	83	−13	80	8	79	12	100
Tajikistan	−1	44	1	44	2	96	2	100
Thailand	21	26	−9	38	38	47	16	100
Togo	22	69	1	93	24	75	1	100
Trinidad and Tobago	16	26	2	44	37	59	4	100
Tunisia	33	37	−9	60	41	47	11	100
Turkey	21	40	−13	48	28	54	17	100
Uganda	23	79	0	102	22	77	0	100
Ukraine	14	−6	−6	2	53	23	24	100
United Arab Emirates	48	455	−1	502	9	90	0	100
United Kingdom	14	8	−3	19	57	32	11	100
United Republic of Tanzania	18	66	−1	83	21	78	1	100
United States of America	8	24	−4	28	23	67	10	100
Uruguay	10	8	3	21	48	37	15	100
Venezuela (Bolivarian Republic of)	23	56	0	79	29	71	0	100
Vietnam	26	44	−3	68	36	60	4	100
Yemen	37	102	2	141	26	72	2	100
Zambia	22	57	1	80	28	71	1	100
Zimbabwe	20	23	−4	39	43	49	8	100

CHAPTER 2

The IWR and policy lessons

Anantha Kumar Duraiappah, Cecília Fernandes, Pushpam Kumar, and Rodney Smith

KEY MESSAGES

Countries striving to improve their citizens' well-being – and do so sustainably – should reorient economic policy planning and evaluation away from targeting GDP growth as a primary objective toward incorporating inclusive wealth accounting as part of a sustainable development agenda.

Investments in human capital – in particular education – would generate higher returns for IW growth, as compared to investments in other capital asset groups, in countries with high rates of population growth.

Investments in natural capital, in particular agricultural land and forest, can produce a twofold dividend: First, they can increase IW directly; second, they can improve agricultural resiliency and food security to accommodate anticipated population growth.

Investments in renewable energy can produce a triple dividend: First, they can increase IW directly by adding to natural and produced capital stocks; second, they improve energy security and reduce risk due to price fluctuations for oil-importing countries; third, they reduce global carbon emissions and thus carbon-related damages.

Investments in research and development to increase total factor productivity, which decreased in 65 percent of countries, can immediately contribute to growth in inclusive wealth in nearly every country.

Countries should expand the asset boundary of the present System of National Accounts (SNA), which currently captures only 18 percent of a country's productive base, to include human and natural capital, which are now measured only through satellite accounts, if at all.

1. Introduction

In the majorities of countries, growth-led economic policy planning is incompatible with sustainable development. Policy-makers are concerned primarily with increasing market activity as a means to increase employment and improve quality of life. Success in this strategy is measured in gains in gross domestic product (GDP). This strategy, however, is facing increasing scrutiny, as evidence mounts that countries are improving GDP growth rates but seeing little or no gains in employment, stagnating incomes for the majority of citizens, and often little improvement in other measures of well-being, such as health outcomes, access to quality education, and economic security. The "trickle-down" effect from economic production (measured in GDP) to employment and wages, and quality of life, is no longer happening in modern economies (Stiglitz et al. 2009, Easterlin 2003, Deaton and Kahnenam 2010, Jackson 2009).

When we talk about growth-led economic policy planning, we are generally referring to macroeconomic fiscal and monetary policies, and within those, various levels of sector-specific investment and regulatory policy, in areas such as agriculture, industry, health, transportation, and energy.

At the same time, many governments have introduced efforts toward improving sustainability or sustainable development, most of which remain secondary to central policy planning priorities, and are usually focused solely on environmental protection. The mantra has always been: growth will come first, and growth will enable the time, effort, and money necessary to protect the environment.

As we are now seeing, the foundations of both sides of this equation are crumbling: growth in GDP will not assure nations of greater well-being; and there is far more to sustainability than environmental protection. To right the course, we must first broaden our understanding – and evaluation – of well-being and progress beyond GDP, and extend sustainable development beyond environment to encompass the full spectrum of well-being.

Results from Chapter 1 demonstrate how a focus on production growth alone has led many countries onto an unsustainable growth trajectory. The Inclusive Wealth Index (IWI) aims to help economists, policy-makers, and anyone interested in sustainability better understand what the basis of inclusive wealth (IW) is, and how countries are doing in assuring sustainable growth in wealth over the long term.

This chapter is not meant to be an exhaustive analysis of the results presented in Chapter 1, nor does it present a complete range of associated policy prescriptions. Rather, it demonstrates how the Inclusive Wealth Report (IWR) can be used by countries to inform and guide policy-making today.

The chapter begins with some general policy lessons relating to human capital that can be taken from the results presented in Chapter 1. Although human capital comprises both health and education, this report excludes health from the computation of human capital due to inconsistencies in methodology and lack of sufficient data. Therefore, our human capital figures essentially represent education, and the concrete returns for human well-being of education. However, some key policy considerations relating to health are shown in Box 1.

Following sections cover in more detail two specific social problems countries face today – food and energy security – and explain how the IWR can be used to guide policy design in order to address them. Specific country results used to demonstrate significant changes in the respective capitals pertaining to the discussion are used purely for illustration, and should not be regarded as criticizing or endorsing the policies of any specific country.

In addition, this chapter includes a section on national accounts and policy suggestions for revising, modifying, and developing national accounts. The section provides arguments for including human capital and natural capital within the asset boundaries of core

BOX 1

Health policy and the IWR

Health plays a key role in both sustainable development, as well as the inclusive wealth of nations, as demonstrated quantitatively in this report (see Chapter 5). Quantifying health as a form of human capital is an important advancement, one that opens up new opportunities for policy in sustainable development. Yet, it is important to recall that health only recently became a "center stage" priority, with the formulation of the Millennium Development Goals (MDGs).

However, health development has sometimes been seen as expenditure, the magnitude of which has occasionally been a hindrance to increased action and investment. We have been slow to adopt the language of investment in health. This is changing, however; and with the formulation of the post-2015 Sustainable Development Goals (SDGs), the change is timely.

Nevertheless, making the case for health as a vital component of sustainable development is not yet a question of settled science, and it is one that is being answered in various ways by diverse developments in an emerging field. Within the UN system, the IWR and the Human Development Index (HDI) provide two examples. In the context of the broader international community, two other notable efforts stand out: the Human Capital Project of the World Economic Forum, and the Social Progress Index of the Social Progress Imperative.

While each of these methods arguably has its advantages and disadvantages, the benefit of the IWR is that it integrates health as an integral part of the inclusive wealth of nations, something to be invested in rather than spent on, and which yields return in national wealth and well-being.

It also gives a clear conceptual framework for clarifying what is meant by "the investment case for health", which already contains within its proposition health as an asset in the wealth of a nation. These advances are useful, moreover, since they address governments and donors in terms adapted to their needs, such as demonstrating accountability in decision-making regarding the use of resources. Health technology assessment (HTA) is a growing institutional focus for such concerns. In 2014, the World Health Assembly passed a resolution calling for increased use of health technology assessment in the context of a renewed focus on universal health coverage.

As countries scale up coverage with a range of health services, they need to decide which population groups should be covered first. Some choose to prioritize specific poor and vulnerable communities, offering selected services at minimal cost, while others choose to assure universal access to a limited set of services for a period of time. When new money becomes available, either through efficiency savings or the raising of new finance, additional choices must be made about whether to cover more people for the existing set of services, cover more services for the people already covered (and/or increase quality), or reduce out of pocket payments further for people currently covered with a set of services.

These decisions are difficult, and there is no single recipe for success. One of the roles of the IWR in these discussions is to provide a clear conceptual framework for understanding that, when health must compete for scarce resources, its benefits are not only intrinsic, but also instrumental to progress in many other domains.

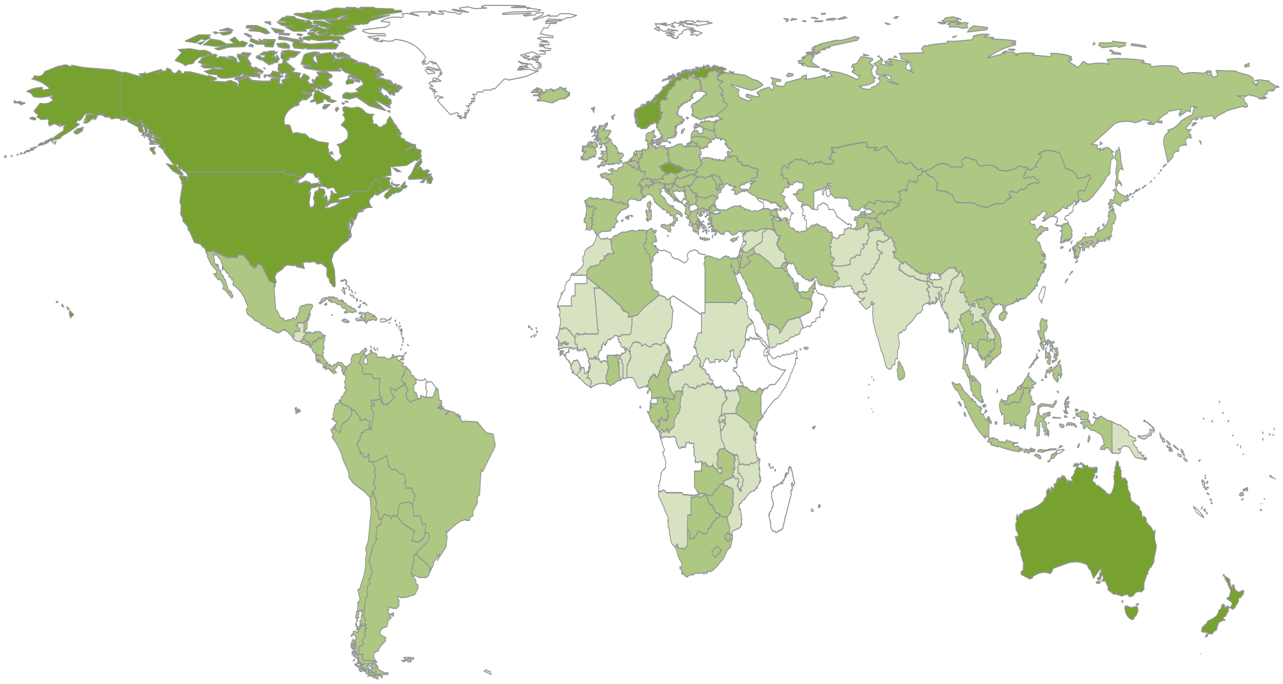
economic accounts. It also demonstrates why these capital asset groups' current placement within satellite accounts misrepresents 82 percent of the assets that contribute to IW, while the mere 18 percent captured by the present system of national accounts (produced capital) might actually be providing false interpretations of progress.

2. Policy lessons for education

As shown in Chapter 1, only 85 of 140 countries – 60 percent – were found to be on a sustainable growth trajectory in terms of inclusive wealth. The remaining 55 countries are unable to maintain a productive base to accommodate the present state of well-being, nor increases of

FIGURE 1

Average education levels attained across countries (in years)



Key

12 to 14	0 to 6
6 to 12	no data

well-being (see Chapter 1). That is to say, the present consumption patterns of these countries are not sustainable.

Countries on unsustainable trajectories have essentially two available options: they can either increase investments to post positive gains in the rate of IW growth, or reduce consumption levels to levels which their productive base can maintain (ARROW ET AL. 2001 2).

Countries aiming to increase their productive base growth rate based on the results of Chapter 1 can invest in human and/or natural capital depending on the rate of return of these capital asset bases. It was found that investment in produced capital provides the lowest rate of return for the majority of countries.

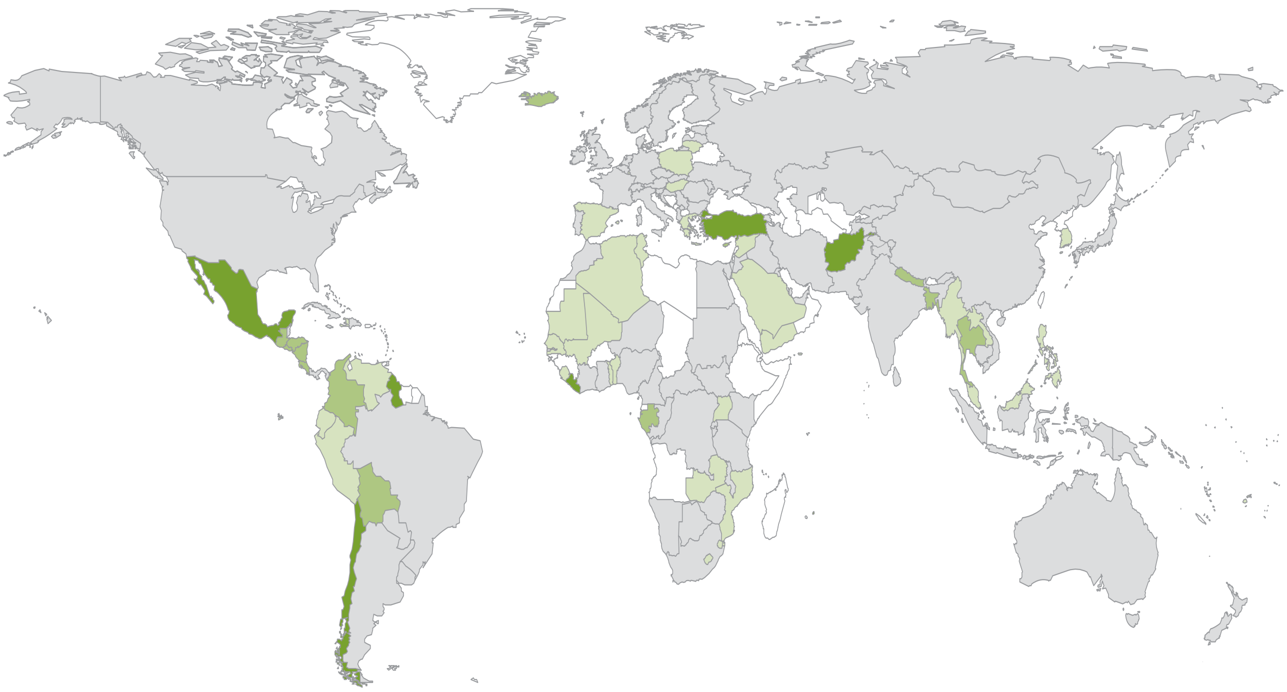
Human capital, which in this IWR 2014 is primarily education, was found to be the greatest component of IW – nearly 54 percent of total inclusive wealth – in about 70 percent of countries. The largest contributions to IW – what we call inclusive investment – were also made into developing human capital. However, many countries were not investing proportionally in natural capital based on its contribution to IW.

Most investments were in the traditional produced capital category, consisting of infrastructure, roads, buildings, etc. This might be understandable as it is the only category recorded explicitly in the core economic accounts a country maintains (the System of National Accounts). The human and natural capital components, including education, are relegated to so-called satellite accounts, if at all recorded.

Within education, there are a number of target areas in which investments can be made. The education-related accounts within the IW refer to years of schooling, gender dimensions, demographic profiles, and wage returns on education. A large number of countries, as shown in Figure 1, have a low number of average years of schooling, and thus significant potential for returns on investment. In investing in education, countries can improve present well-being, future productivity and income, and

FIGURE 2

Growth rates of investment in education per capita across countries (in percentage), 2010/2009



higher levels of long-term inclusive wealth – and thus sustainability.

Figure 1 shows that most countries have not reached average education levels that include post-secondary schooling. Canada, Australia, the United States, and Norway have an average of 12 to 14 years of education. The majority of countries have achieved education levels that include secondary schooling (6 to 12 years) while most of the African and South Asian countries have only reached education levels commensurate with primary school levels (0 to 6). The potential to increase human capital through further investment in education is therefore high.

However, there is clear indication of a slowing-down of investment in education, as shown in Figure 2. Six countries show a rate of growth in inclusive investment in education per capita greater than 2 percent. The majority of them fall in the -4 to 1 percent rate, which might explain the relatively low growth rate of IW in many of the countries.

Several reasons can be assumed, but a key factor is likely the way education is presently factored in national accounts. Investments in education are considered expenditures, since contributions to GDP are not direct (as with IW). Governments whose primary goal is GDP growth, particularly those lacking advanced educational monitoring and assessment facilities, will often focus on investments which are directly reflected in GDP, such as in produced capital.

Although produced capital is important, our results indicate that many countries place disproportional emphasis on the growth rate of produced capital compared to those of human and natural capital, if one takes into consideration the relative weight these capitals have towards overall well-being.

The recommendation of the IWR to increase investment in human capital resonates well with the proposed Sustainable Development Goals on education (UN-OWG 2014). The education inclusive wealth accounts go further than simply tracking literacy levels, providing information on the actual "value" generated by literacy rates (among other educational outcomes) for inter-temporal human well-being.

3. Food security, agriculture, and land

Food security is a central policy priority for many countries today. While food security is a complex issue, one critical factor is availability of suitable arable land. It is estimated that an additional 3 to 5 million hectares of cropland might be required to feed the growing world population over the next 30 years (Wirsenius et al. 2010).

The competition for land to produce not only food grains for direct consumption, but also feed grain for livestock and horticultural food products, has been a continuous struggle, one recently compounded by the addition of a third competitive sector: biofuels.

The demand for agricultural land changes as the diet of populations changes. The trend seen across countries of late has been that as incomes grow, diets shift from grains to meat and vegetables (Alexandratos and Bruinsma 2012, Tilman et al. 2011). This in turn suggests a different use of agricultural land, and the amount of land that needs to be made available.

At the same time, countries hoping to mitigate climate change and reduce (or compensate for) greenhouse gas emissions have increasingly resorted to biofuels. This has had the effect of shifting grains and feedstocks such as maize, palm oil, and sugarcane, among others, toward use as biofuels. For example, the United States shifted 27 percent of its maize production from use as feed to the production of ethanol (UNEP 2012). The long term impacts of these shifting trends on food supply are still not certain, but increasing demands for land for multiple uses, as well as for grains for multiple end uses, will certainly have an impact on food supply.

Further, increases in social conflict incidence recorded across much of the world have often been attributed to rising prices of food commodities, which in turn have been driven by a combination of droughts (drought frequency is expected to increase with climate change), shifts towards biofuels, and encroachment of arable crop land by urbanization (IPCC 2014).

In summary, key factors influencing food demand are:

- growing global population;
- changing demographics with shifting dietary-driven demands for grains, meat, and vegetables; and
- growing demand for biofuels.

The main variables determining supply are:

- decreasing supply of suitable arable land, as cropland is lost to urbanization and other alternate uses due to low valuation of agriculture in national accounting systems;
- increasing rate of land degradation caused by intensive unsustainable practices;
- diminishing water supplies;
- decreasing rate of technological innovations to boost productivity; and
- decreasing ecosystem services supporting food production from declining forest ecosystems.

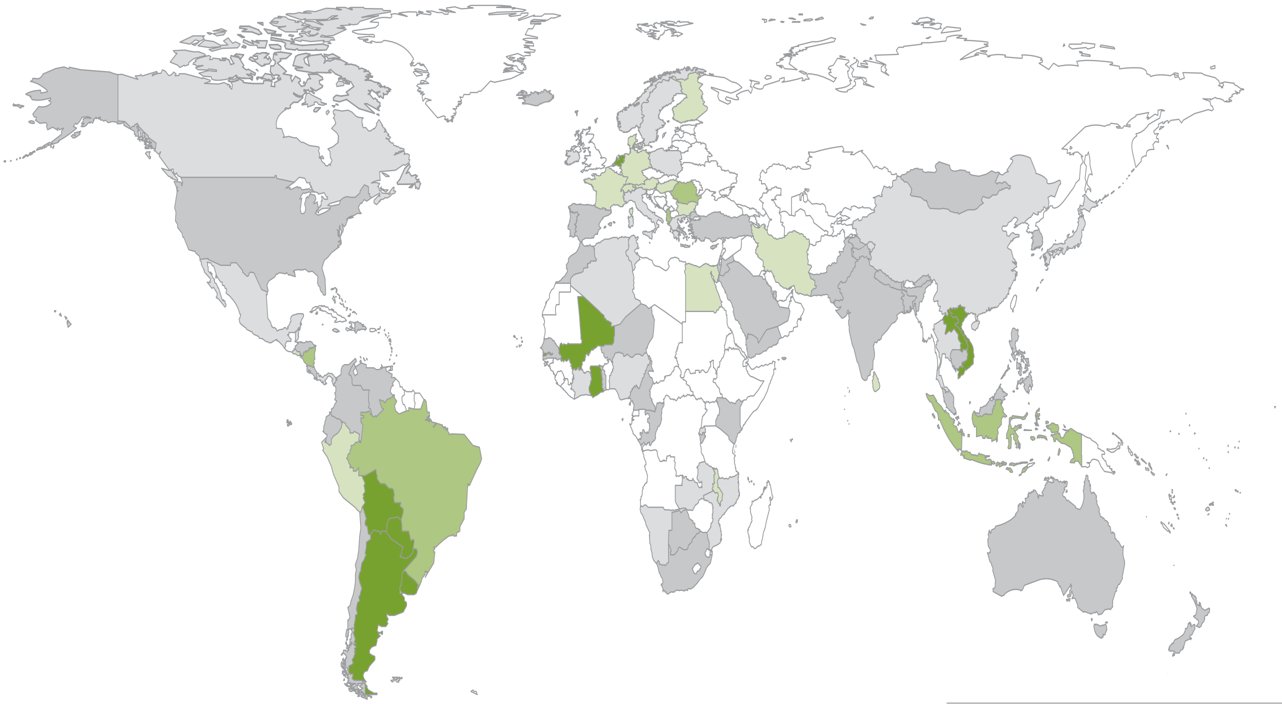
Figure 3 shows the percentage changes in agriculture land (cropland) for some of the main food growing areas in the world. The lack of data for many African countries highlights a knowledge gap that needs to be closed quickly, as land on the continent is often converted to cropland for producing food for export to other major food demand centers.

An important trend seen at the global level is the reduction of the inclusive wealth of cropland in traditional major cereal-exporting countries like Canada, the United States, and Australia. The exceptions were mostly in South America, where cropland has increased, in particular in Argentina and Brazil.

Similar trends are observed in changes in pastureland as shown in Figure 4. Most regions around the globe have seen significant declines

FIGURE 3

Change in cropland wealth per capita (in percentage), 2010/1990



in the inclusive wealth of pasturelands[1], even as the demand for meat increases. This might be explained by the transition from extensive gazing of livestock to significantly more-intensive livestock management, which requires less land. The impacts on the inclusive wealth are still unclear, as the increase in produced capital arising from intensification of livestock management cannot be isolated from the present inclusive wealth accounts. It is a potential area of further refinement for future reports to address.

Caution is warranted in interpreting data showing increased cropland, since such increases might be the result from land cleared for biofuels. Figure 5 shows the changes in cropland wealth per capita for USA, Brazil, China, India, and Canada. Unfortunately, the data available does not make the distinction between agricultural land for food crops and agricultural land for biofuels. Furthermore, when using IW to analyze food policy, we must not only pay attention to land availability, but also to land productivity. Here, linking total factor productivity (TFP) into the agricultural component with IW would provide valuable and insightful findings for food policy. This can be done, for example, in a country such as India, through investment in increasing the value of per unit cropland by investing in irrigation, fertilizers, soil management, and crop yield technologies (BAGLA 2014).

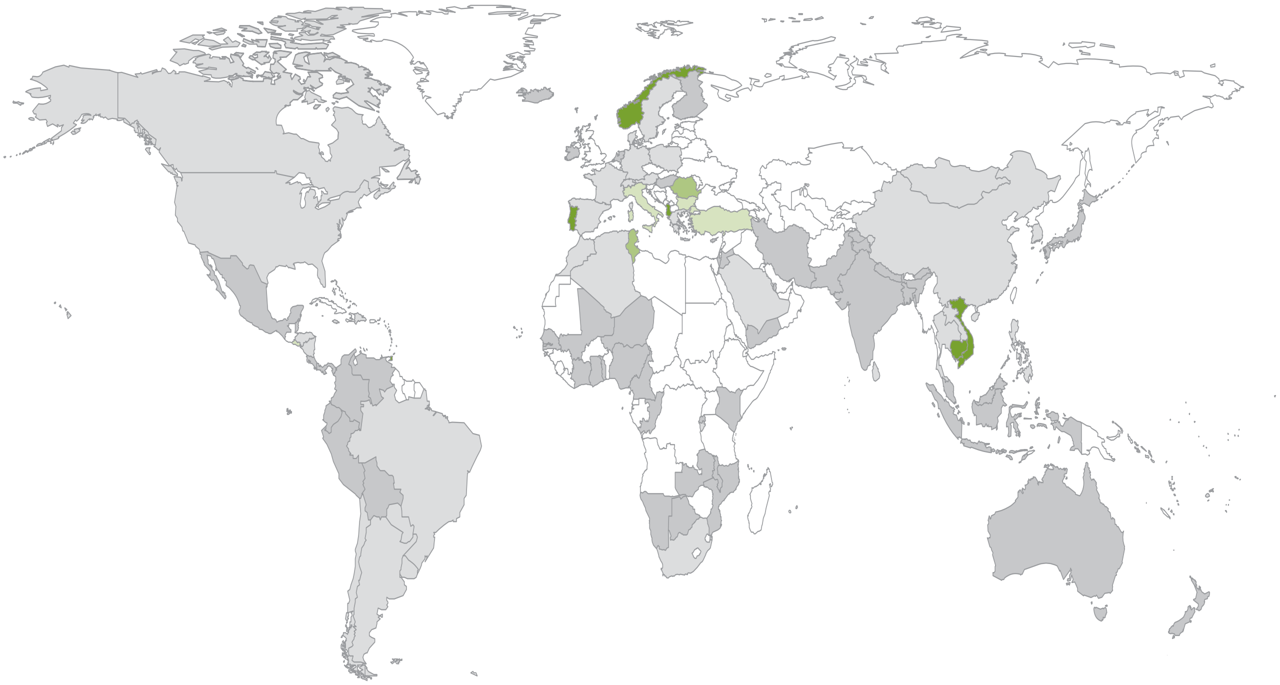
A key value-added of using inclusive wealth accounts is in tracking total land change by observing changes in other categories of land. For example, in the case of Brazil and China, the inclusive wealth of forestland, which includes timber and non-timber forest products per capita, has decreased and increased, respectively.

Expansion might also entail replacing forests with cropland; this information can be derived from the IWR, too. The trade-off between cropland and forest can be observed in many

1 Inclusive wealth of pastureland implies the change in physical land under pasture multiplied by the value of the pastureland. These are on a per capita basis.

FIGURE 4

Changes in pastureland wealth per capita (in percentage), 2010/1990



countries. In fact, the most important driver of land conversion into agriculture in the tropics has been the conversion of forests to agriculture (Lambin and Meyfroidt 2011).

Information on land use as provided by the IWR, together with data on actual food production and exports, can be extremely useful in determining what trade-offs a country has been managing, and where future investment is needed. Such investment could be in restoring degraded lands, bringing irrigation to drought-affected areas, or elsewhere.

Similarly, the data provided by the IWR, together with data on agricultural production, can be used to gather information on productivity and henceforth options to increase food production. In fact results show that TFP has been decreasing in 87 countries. Increasing investments in areas such as technology and efficiency measures – thought to make up the bulk of TFP – might be used to increase agricultural productivity and thus the IW of agricultural-based economies, particularly those for which natural capital constitutes at least one third of the total inclusive wealth base. Investments in agricultural technologies, such as drought resistant seed varieties, soil improving technologies, and solar energy sources, are some options that might increase the productivity of the agricultural sector. This could help mitigate shifts from agriculture to manufacturing (based on the proportion of these sectors to GDP) that are underway in most countries. The picture changes when the values of these sectors are compared against IW.

The IWR also includes data on pastureland, which provides information on livestock production-related impacts on grain production. This also has implications for policies to ensure food security, as well as nutrition improvement efforts, which are gaining importance in developing countries.

The illustrations above show that the IWR can be a useful policy tool by itself for illustrating changes in the underlying

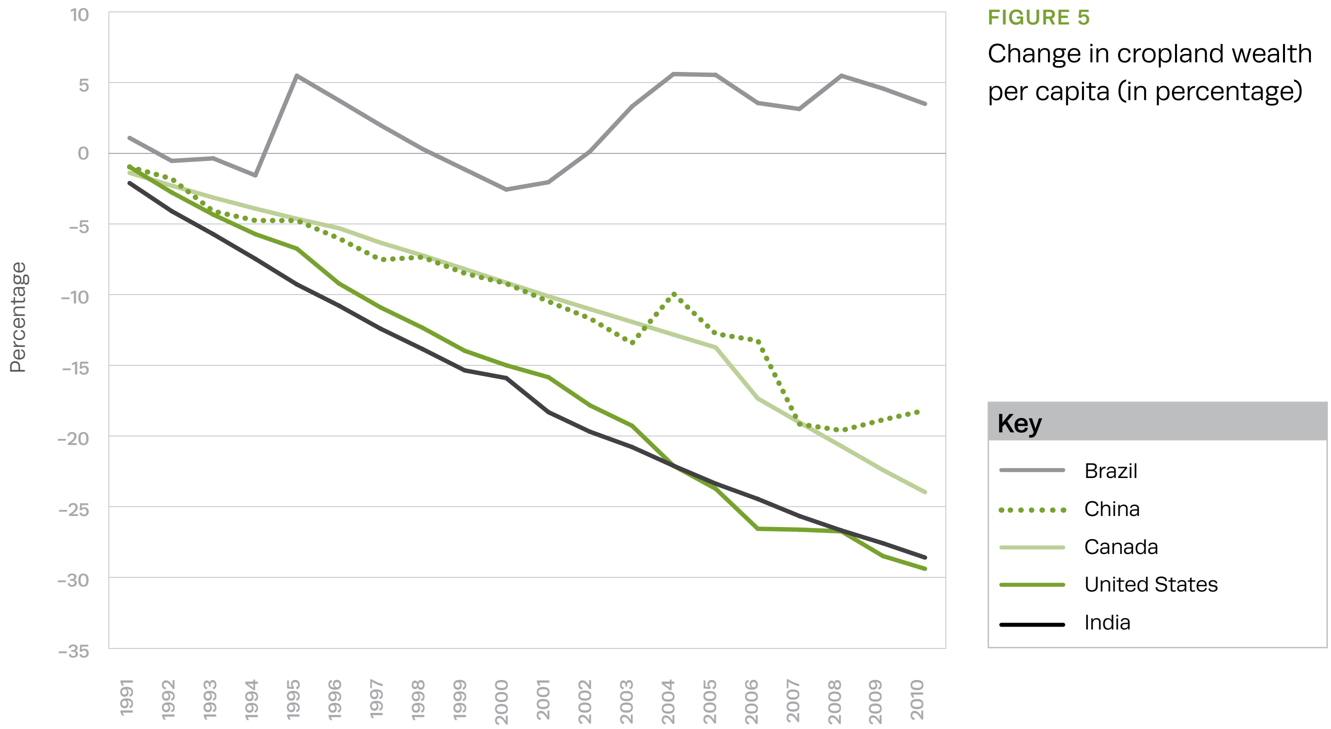


FIGURE 5

Change in cropland wealth per capita (in percentage)

asset base necessary for food production. In tandem with other sources of information, it is even more powerful, providing information on issues such as productivity potentials, or optimal land use options that include both market-driven and non-market opportunities.

The IWR also provides insights into trade-offs across competing uses of land, and where future investments are needed if a primary policy objective is food security versus, for example, forest preservation. The ability to highlight trade-offs among the various assets comprising the productive base of an economy, in the pursuit of social, environmental, and economic objectives, is one of the IWR's key strengths.

4. Energy policy (non-renewable and renewable): produced and natural capital investment

A sustainable and secure supply of energy is essential for any country's development aspirations. Energy is not only important for supporting activities that lead to economic growth, but also for key aspects regarding human development and social transformations. Energy is central to improving life quality for a population, as it is a primary and required factor in providing essential humans needs, such as education, health, and infrastructure.

The link between energy and wealth is straightforward. In the IWR, natural capital captures changes in fossil fuels, which currently account for approximately 81 percent of energy supply. Increase in demand for energy translate to a direct negative impact on natural capital through the depletion of finite fossil fuel deposits, and thus negative impact on the overall inclusive wealth of a country.

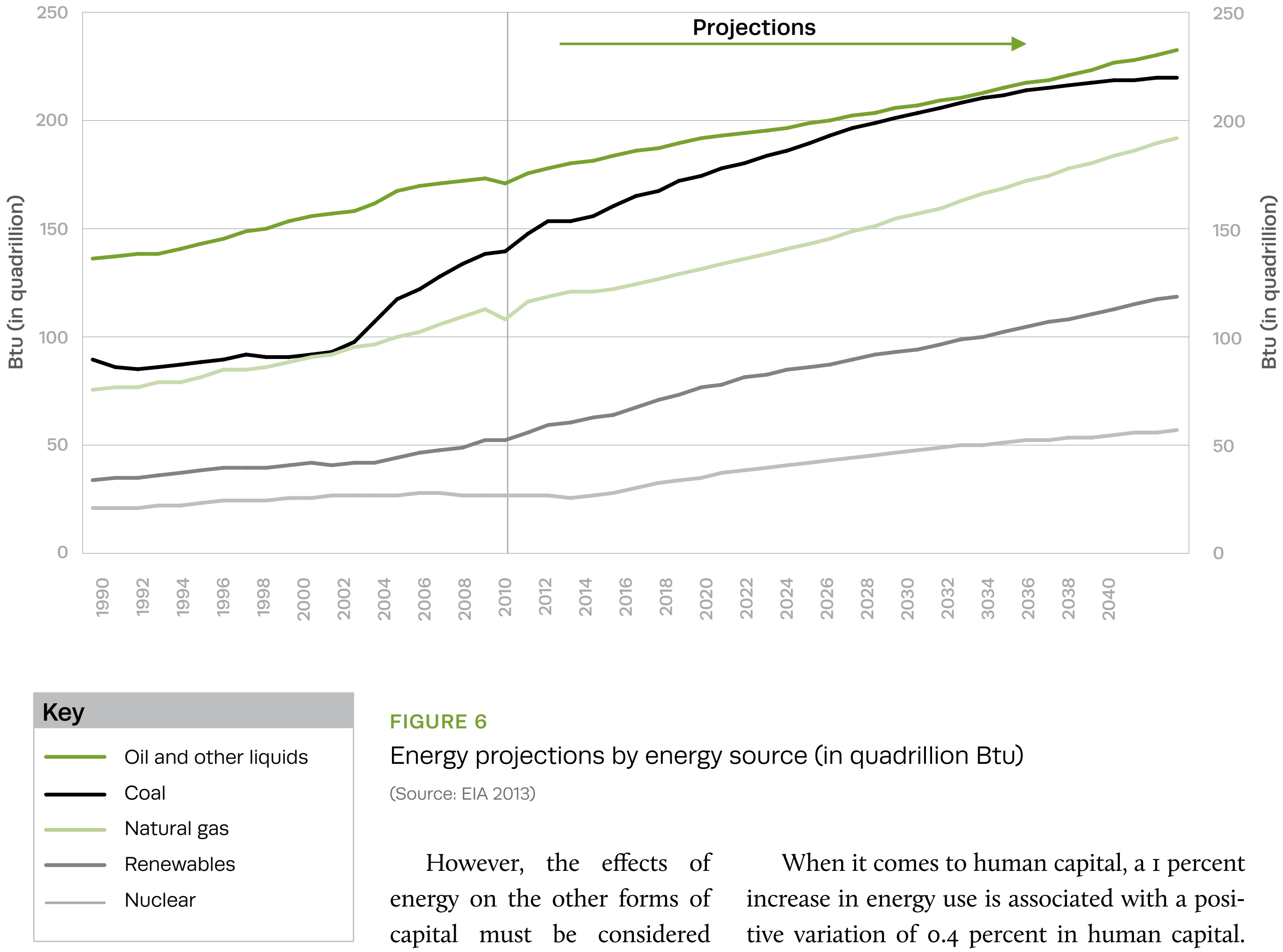


FIGURE 6

Energy projections by energy source (in quadrillion Btu)

(Source: EIA 2013)

However, the effects of energy on the other forms of capital must be considered as well. Looking at elasticity, which measures how responsive (or sensitive) one variable is to a change in another, it is possible to discern the relationship between energy and wealth, as well as with its components.

For the IWR 2014 we ran simple regression analyses using our sample of 140 countries to estimate elasticities. Although these preliminary results are rough, and thus seen as first approximations, they are nonetheless illuminating. First, they suggest that an increase of 1 percent in energy consumption is associated with a positive variation of 0.64 percent in produced capital.[2] Part of this result can in practice be explained by the impact that energy consumption has on the production of produced capital.

When it comes to human capital, a 1 percent increase in energy use is associated with a positive variation of 0.4 percent in human capital. This result could be practically explained with direct benefits of electricity use, for instance, to educational outcomes thanks to increased hours and flexibility for studying, as well as greater numbers of schools. Clearly other variables also contribute to this, but there certainly seems to be a degree of direct correlation between energy use and growth in different forms of capital.

The decision to switch from fossil fuels to alternative energy sources, which lead to reduced detrimental impact on natural capital, will be made when the marginal change in natural capital stock is greater than, or equal to, the marginal changes in produced and human capital, accruing from the energy used to produce these capitals, resulting in an overall negative impact on wealth (all other things being held constant). However, the equation becomes a bit more complicated when renewable energy sources are introduced in the analysis, also contributing to changes in natural and produced capital.

2 Estimations based on Granger causality tests also indicated bi-directional Granger causality between energy and produced capital. Results suggest that an increase of 1 percent in produced capital is associated with a positive variation of 0.62 percent in energy consumption.

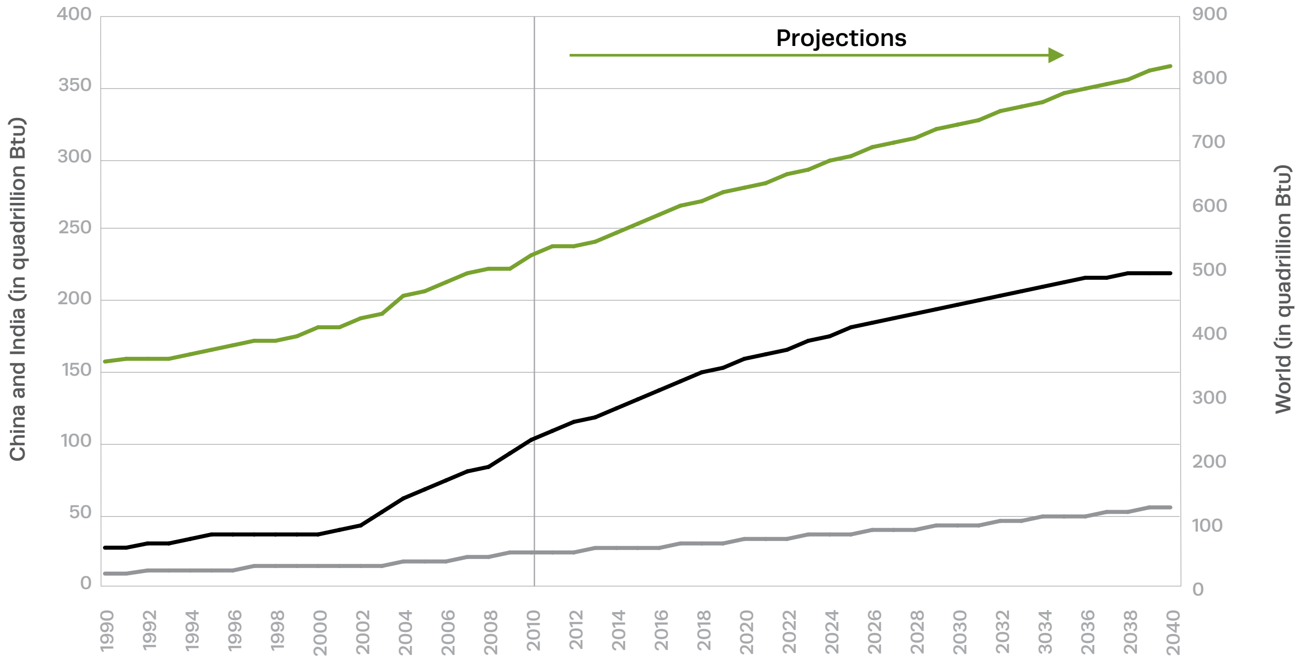


FIGURE 7

Energy demands until 2040 (in quadrillon Btu)

(Source: EIA 2013)

5. Scarcity and the need for change

Over the past two decades, the renewable energy sector has gained momentum. However despite these improvements, approximately 81 percent of the current global energy supply comes from fossil fuels[3]. It is still the fastest-growing energy source in the world, increasing 2.5 percent per year, together with nuclear power. Despite the recent increases in renewable energy use worldwide, fossil fuels are still expected to supply about 80 percent of the total energy through 2040, when the energy consumption is projected to increase 56 percent compared to 2010.

A projection of the global demand for energy sources is given in Figure 6. Demand for fossil fuels (oil and other liquids, coal, and gas) is expected to dominate the energy sector for the next 50 years. This will represent an increase of 46 percent in energy-related carbon dioxide emissions in the same period (IEA 2013).

More than 85 percent of the energy demand from 2010 and 2040 comes from developing countries, reflecting growing populations and industrial expansion. Although there has been some degree of decoupling of energy use from economic growth, many rapidly-developing countries such as China and India can expect to see continued increase in demand for energy, as shown in Figure 7.

The main sources of energy, including oil, coal, and gas, are captured within the natural capital category. They supply 32 percent, 29 percent, and 21 percent of the world energy mix, respectively. Figure 6 shows increases in the demand for the various categories of fuels, indicating decreasing stocks of fossil fuels and subsequently decreasing natural capital.

According to the BP Statistical Review of World Energy (2014), if the world production of coal, natural gas, and crude oil continues at

3 According to the International Energy Agency, in 2011, 31.5 percent of the world's energy supply was from oil, 21.3 percent from natural gas, 28.8 percent from coal and peat, 10 percent from biofuels and waste, 5.1 percent from nuclear sources, 2.3 percent from hydro sources, and 1 percent from others.

FIGURE 8

Reserves-to-production: remaining extract years of fossil fuels

Source: BP Statistical Review of World Energy 2014

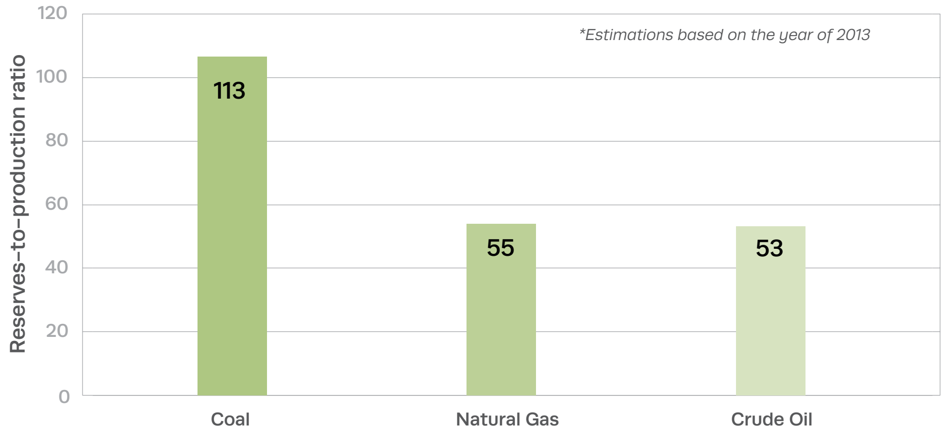
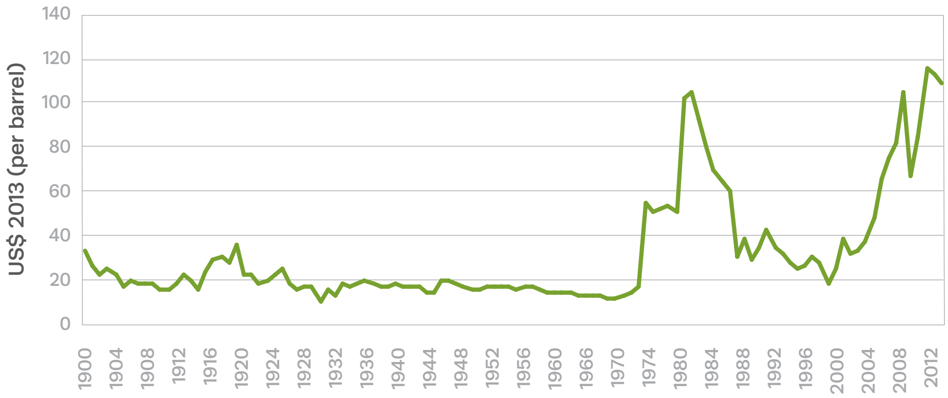


FIGURE 9

Oil crude prices (US$ 2013 – per barrel)

Source: BP Statistical Review of World Energy 2014



the rate of 2013, the remaining time for these reserves to be depleted are 113 years in the case of oil, 55 years for coal, and 53 years for gas as shown in Figure 8.[4]

Besides being the energy source that risks suffering the most rapid scarcity among the three main types, oil is responsible for about 36 percent of carbon dioxide emissions from fuel combustion.[5] Another aspect of relevance for policy-makers, especially from countries without oil reserves, concerns its price volatility. As shown in the Figure 9, in the last years, crude oil now costs more than it has in 100 years (in dollars of 2013), surpassing even the shocks of the late 1970's.

4 The reserves-to-production rate is calculated by dividing remaining reserves at the end of the year by the production in that year.

5 Estimation from the International Energy Agency 2012.

The declining rates of oil per capita in constant U.S. dollars are also alarming. The figure 10 shows that the change rates from 2010, compared to 1990, have varied from -15 percent to more than -66 percent worldwide.

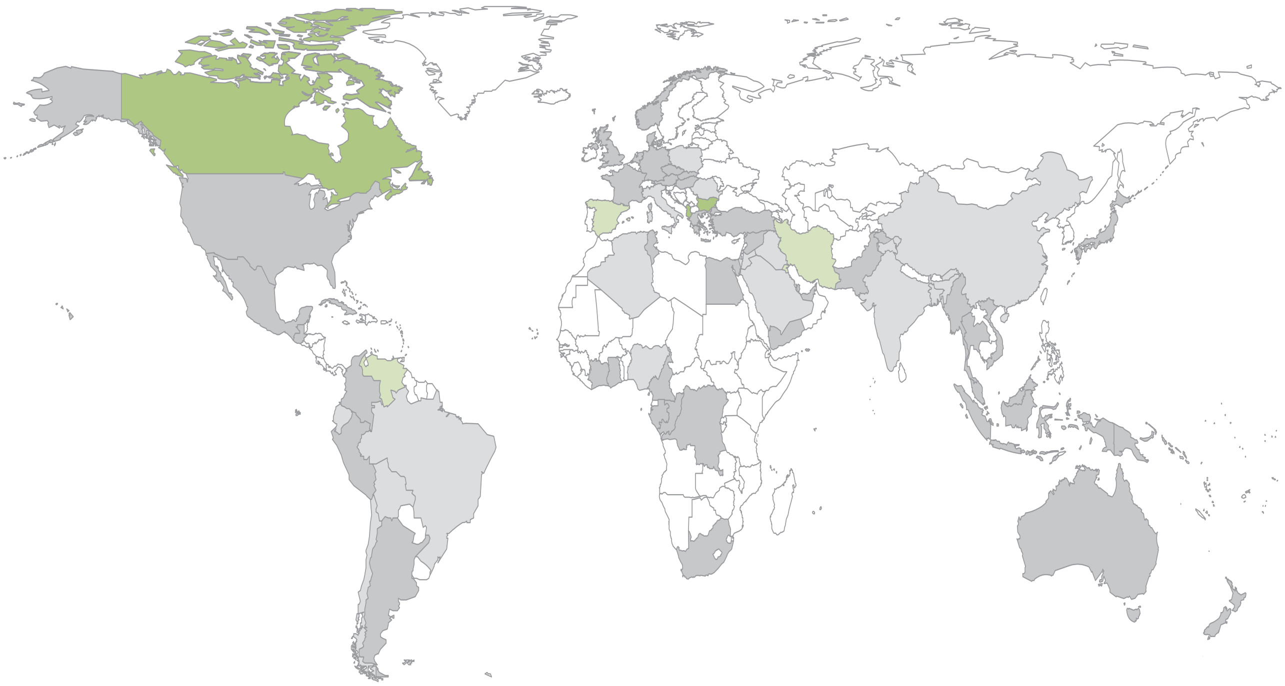
6. The IW and renewable energy

As mentioned earlier, energy, while being an essential factor for improving well-being, imposes a policy trade-off by causing externalities, mainly to the environment. The key driving force in declining wealth per capita followed by population growth is the depreciation of natural capital. The Adjusted Inclusive Wealth[6]

6 IW adjusted shows the results when climate change, oil capital gains, and TFP are included in the index. The results are available in Chapter 1, sections 3.4.

FIGURE 10

Change in oil wealth per capita (in percentage), 2010/1990



confirms that most countries (134 countries out of 140) would suffer to some degree from climate change.

The Inclusive Wealth Index (IW) also shows that for technological change, total factor productivity (TFP)[7] has been negative in 65 percent of the countries – TFP being the most influential component in affecting countries' inclusive wealth in a negative way.

Energy invariably requires the use of natural resources. Holding everything else constant, the increasing extraction of fossil fuels results in the decline of natural capital, which leads to an overall decline in IW. In the face of increasing scarcity, the natural direction should thus be toward investments in renewable resources – meeting energy production requirements through renewable energy, such as solar, biomass, wind, and others. Future IW accounts will have to be revised to reflect increases in these sectors, either within the natural capital or produced capital components.

New investments in technology should be allocated in renewable energy such that the positive marginal benefits to IW from produced capital and components of natural capital related to renewable energy capital offset the marginal costs from natural capital declines driven by fossil fuels extraction, as illustrated by Figure 13. These results are underscore the urgent need for investments in new technologies in order to improve the efficiency and alternatives for energy.

Considering this framework, allocating resources to improve energy efficiency will result in overall improvement of wealth in every country. Chapter 1 clearly illustrates the decline in natural capital in the majority of countries, much of which can be attributed to the decline in fossil fuels. Because energy is a vital part of

7 We used therefore total factor productivity (TFP) as a proxy variable of technological change. TFP growth measures the change in aggregated output (GDP) that cannot be explained by the growth rate of observable inputs or capital assets.

FIGURE 11

Germany: natural capital per capita – annual growth rates

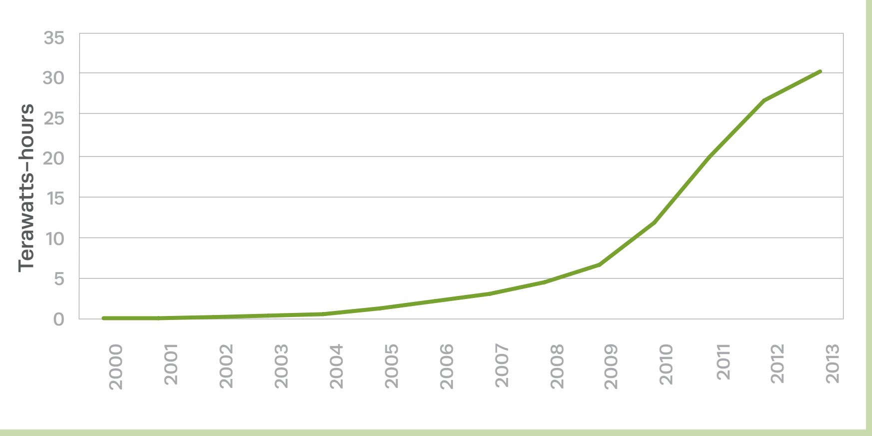


FIGURE 12

Germany: consumption of solar energy (terawatts-hours).

Source: BP Statistical Review of Energy 2014

BOX 2

Case: Germany's energy transformation

Germany is considered the world's first major renewable energy economy, having one of the most innovative renewable energy sectors in the world. Figure 12 shows the share of electricity produced from renewable energy has increased from 6.3 percent in 2000 to 31 percent in the first half of 2014, mainly from solar, wind, and biogas. The federal government designated a significant change in energy policy in 2011, known as "Energiewende", or energy transformation, focusing particularly on offshore wind farms and distributed generation rather than centralized energy sources.

Natural capital has generally been improving since 2001, although

development, it is not possible to reduce energy demand significantly.

Currently, renewable energy supplies only a fraction of that energy demand. Therefore, investment in renewables offers a triple dividend: First, investment in renewables, particularly in biomass, would mitigate downward trends in natural capital, thereby increasing inclusive wealth; second, investment in most forms of renewable energy, such as solar energy, will increase produced capital, thereby increasing inclusive wealth; third, greenhouse

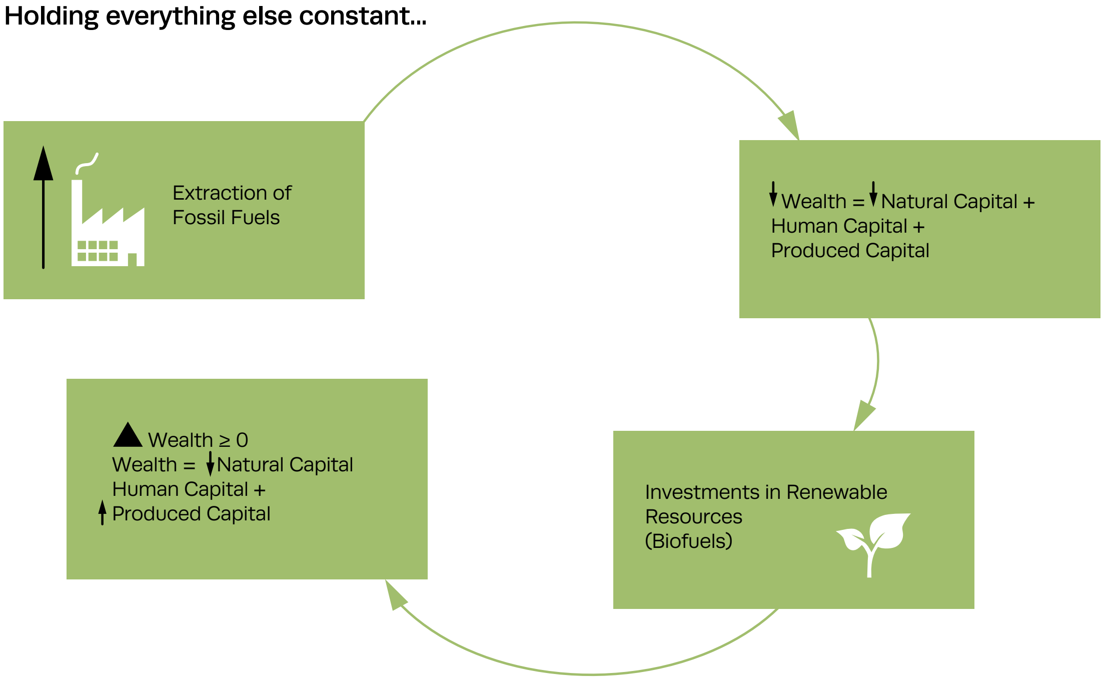


FIGURE 13
The fossil fuel, natural capital, renewable energy, inclusive wealth cycle

gas emissions are reduced, reducing carbon-related damages and thus increasing inclusive wealth.

7. The System of National Accounts: time for change

National income accounts (NIA) are central macroeconomic statistics, showing the level and performance of economic activities in the economy. The System of National Accounts (SNA) of the United Nations attempts to provide a benchmarked framework for measuring and summarizing national income data across all activities within an economy and to facilitate comparing such data across countries (UNITED NATIONS ET AL. 2012). A crucial component of the SNA is the estimation of GDP, where, at given market prices, the gross value of all the goods and services produced within an economy is estimated.

The basic reason countries construct standard national accounts is to use them as macroeconomic planning tools. With the data a country obtains from implementing the standard SNA, it can quantitatively answer questions on specific policy planning issues. For instance, if a country is looking to bring about a 5 percent increase in transportation sector output over the next five years, how would production in other sectors be reorganized to meet this demand?

A country is able to use the data in a general equilibrium model, computing the Leontief input-output coefficients to derive knowledge on optimal resource allocations (how much investment, labor, etc. resources must be pumped into each interdependent sectors?) to meet this planning target. The focus is on production.

Economists are now increasingly in agreement that instead of measuring growth in GDP or income – which are flow accounts – a more meaningful and correct approach would be to comprehensively measure growth in wealth: not just income wealth, but rather the entire stock of wealth that includes the value of natural and human capital, in addition to produced capital

(DASGUPTA AND MÄLER 2000, ARROW ET AL. 2004, DASGUPTA 2009).

In measuring GDP, various contributions of ecosystem services, such as bioremediation by wetlands, storm and flood protection by mangroves, or the prevention of soil erosion by forests, are ignored. This is due both to the relatively low perceived value of ecosystem services, as well as the fact that these resources and their contributions usually fall outside the domain of the market and production boundary of the SNA, and hence remain un-priced.

Similarly, investments in education are absent from the SNA. Education is only reflected in accounts as an expenditure flow, while no references are made to the notion of human capital in national accounts (BOS 2011). There has been some discussion on developing satellite accounts for monitoring and keeping track of the changes in human capital, but these remain at an early stage.

Considering the enormous contribution human capital – in particular education – plays in determining the size of an economy's productive base, as we see in this report, this is a serious oversight of national accounting.

A country investing in constructing true inclusive wealth accounts will seek to gather and interpret information on the following:

- natural resource asset and stock accounts: the physical and economic value of stocks of natural resources, such as forests, water, fisheries, agriculture land, range land, etc.;
- flow accounts from management and use of the resource stocks: material flows, environmental services, and pollution by sector linked to input-output tables;
- environmental protection and resource management expenditure accounts: resource user fees, subsidies, expenditures by government to manage resources;
- information on how human capital or education, in this case, is utilized in the economy; and
- private and social rates of return and the relative prices of different types of labor, based on education levels and demographics

This is information that can feed into the macroeconomic policy planning process, just as the SNA feeds into policy processes, while adding crucial input on sustainability:

A country that generates inclusive wealth accounting data as outlined above will be able to quantitatively answer critical questions, such as:

1. How much of the stock of a particular asset, required to produce a sustainable flow of consumption, has changed over the previous x years?
2. Can the present stock of assets, i.e., the productive base of an economy, be sufficient to maintaining the present level of consumption in the future? For how long?
3. Where should investment be directed to ensure that change in the overall asset base of an economy remains positive?
4. How much of the productive base of an economy is lost due to climate change? How much is needed to invest in reducing and/or adapting to climate change?

Countries have long kept a close watch on national income accounts to evaluate economic performance and assess the effectiveness of development policies and plans. Yet, conventional indicators based on national income accounts, such as GDP, can be misleading because they say nothing about whether growth is sustainable.

Countries can grow in the short term by running down their assets, including natural capital assets such as forests, minerals, and water. But such growth cannot be maintained over the long term. Wealth accounting serves as an indicator for the sustainability of growth.

A key element of wealth accounting systems is the conversion of physical stocks of different attributes to a single common denominator – generally monetary – through prices.

In many cases, market prices are sufficient. However, there are various instances in which market prices for particular stocks either do not exist, or do not reflect the true value of the assets. In such cases, it is imperative to determine the shadow price (or social price) of these assets using different economic and non-economic techniques. This is an area for which there is still a lack of a concerted action by governments to acquire these prices. In most cases, isolated valuation case studies are used to determine shadow prices.

Countries should undertake scoping studies to evaluate methodologies and strategies for determining the social prices of these non-market assets, and put in place systematic efforts to collect the information required to determine them. This is of paramount importance for accurately valuating natural and human capital assets.

8. Lessons and conclusions

The key information the IWR offers policy-makers is an overview of changes in the productive base of a country. It provides insights into trends within the individual capital asset groups, particularly human and natural capital – central pillars of inclusive wealth that remain underserved by current statistical collection, analysis, and economic policy-making. For natural capital in particular, the IWR gives insight into how subcomponents have changed, for instance changes in land use and cover, or fossil fuel reserves.

The Inclusive Wealth Index (IWI) is, after two years, still in an early – essentially experimental – stage. However, it fills a crucial gap among the indicators of well-being and sustainability available today, giving information on the state of the productive base of an economy, as well as insights into relationships and trade-offs among the capital components of the productive base.

The IWR by itself provides information only on changes in asset bases. However, its utility vastly increases when used in conjunction with other information about an economy. For instance, we showed that changes in land use gleaned from the IWR, together with information on crop yields, can be utilized to inform investment decisions on how to direct investments to increase productivity. This type of composite analysis is possible for all the forms of capital comprising inclusive wealth.

Another potential area of use for the IWR is in education. The wealth of information in the report as well as the potential areas for research it identifies makes it a unique tool within the education spectrum. It offers a broader understanding of economics and its contribution to human well-being. Moreover, the multidisciplinary nature of the exercise makes it fertile ground for multidisciplinary collaboration bringing together economists, ecologists, demographers, health specialists, and educationalists, among others.

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Part II:

Human capital

CHAPTER 3

Human capital measurement: a bird's eye view

Gang Liu and Barbara Fraumeni

KEY MESSAGES

Measuring human capital can serve many purposes: it can help one better understand what drives economic growth; assess the long-term sustainability of a country's development path; measure the output and productivity of the educational sector; and facilitate informed discussions on social progress and well-being. In spite of this, human capital has not yet been included within the asset boundary of the System of National Accounts (SNA).

The multifaceted nature of the concept of human capital creates substantial challenges for its measurement. By focusing on formal education and economic returns for individuals – rather than on human capital in general and all the benefits due to human capital investment – we can begin from an empirically manageable and practical point of departure.

All existing approaches to measuring human capital have both advantages and disadvantages. However, the monetary measures generated from the cost-based and the income-based approaches should arguably be designated a "core" status. One reason for this is to enable direct comparison of figures with those for traditional produced capital covered by the SNA, the construction of which is a primary task of national statistical offices.

Drawing on country experiences and international initiatives in the field of human capital measurement, one may conclude that an international trend is emerging toward an income-based approach, specifically the lifetime income approach. Estimates based on this approach can be used to assess the relative contribution of a range of factors (demographic, education, and labor market) to the evolution of human capital, and facilitate corresponding policy interventions.

Despite significant progress having been made, there remain considerable challenges regarding data availability and detailed methodological choices inherent in applying monetary measures. Further research should therefore be encouraged, including toward the compilation of quality data for use in international and inter-temporal comparisons; the construction of experimental satellite accounts, in order to better understand and reconcile the discrepancies between estimates based on the cost-based and the income-based approaches; and, eventually, toward incorporating human capital measures into the SNA in the future.

1. Introduction[1]

Human capital is, according to a number of empirical studies, by far the single most important component of national wealth (e.g., GREAKER ET AL. 2005, GU AND WONG 2008, WORLD BANK 2006, 2011). A robust measure of human capital, together with those for other assets, can therefore be used to gauge how well a country is managing its national wealth, and assess the long-term sustainability of its development path (UNECE 2009, ARROW ET AL. 2012).

Measuring human capital can also serve many other purposes, for instance, to facilitate a better understanding of the driving forces behind economic growth (e.g., LUCAS 1988, ROMER 1990A, BARRO AND SALA-I-MARTIN 1995, ARNOLD ET AL. 2007), or to measure the output and productivity performance of the educational sector (e.g., JORGENSON AND FRAUMENI 1992A, SIANESI AND VAN REENEN 2003, SCHREYER 2010, GU AND WONG 2010A). In addition, measuring human capital is crucial for the discussions on "beyond GDP" that have recently gained a resurgence among policy-makers, since the distribution of human capital across households and individuals, as well as the non-economic benefits due to human capital investment, are among the crucial determinants for "quality of life" and well-being (e.g., STIGLITZ ET AL. 2009, OECD 2011, and various EU initiatives[2]).

Despite this, human capital has not yet been incorporated into the asset boundary of the System of National Accounts (SNA). Empirical human capital models are usually based on various proxies of human capital measures. The diversity of approaches to measuring human capital makes it difficult to draw policy implications by comparing these estimates within and across countries.

The purpose of this chapter is to discuss the multifaceted nature of the concept of human capital, to review the various measuring approaches currently available, and to draw on the experiences from national studies and international activities in the field of human capital measurement in order to identify the most promising approach(es) for finally incorporating human capital measures into the SNA. Overall, Chapter 3 provides a framework for understanding general discussions presented regarding the conceptual and methodological issues related to human capital measurement; while Chapter 4 focuses on the implementation of several specific methodologies, with corresponding empirical results compared and discussed in detail.

In the *Inclusive Wealth Report 2012* human capital was considered to have the following four components: education, skills, tacit knowledge, and health (UNU-IHDP AND UNEP 2012). Compared with the first three, the health component is apparently of a distinct nature, although it is an essential part of human capital in a broad sense,[3] and without it, none of the other components can be utilized in a meaningful and proper way.

Within the section including empirical estimation of the *Inclusive Wealth Report 2012*, human capital was *de facto* referred to as the contribution of education to the productive base only, and the term health capital was deliberately reserved for the study of the progress

1 This chapter builds on the work that was carried out when one of the authors (Gang Liu) led the human capital project at the OECD. The authors are very grateful for the valuable comments by three reviewers (Dale W. Jorgenson, Katharine G. Abraham, and Hui Wei), and for the important suggestions by all the participants in an Inclusive Wealth Report (IWR) Workshop held in Kuala Lumpur in May 2014. However, any remaining errors and omissions are the sole responsibility of the authors.

2 For more information on these initiatives and a later European Commission Communication on "GDP and Beyond – Measuring progress in a changing world", please visit the following links: http://www.beyond-gdp.eu/ and http://www.eubusiness.com/topics/finance/beyond-gdp.

3 For example, Gary S. Becker viewed education, on-the-job training, and *health* as components of human capital, all having consequences for earnings and economic productivity (Becker 1993).

made in the life expectancy of the population. For the 2014 report, we shall follow the same tradition and refer to human capital as comprising exclusively education, skills, and tacit knowledge.[4] In particular, unless otherwise stated, human capital from education remains the focus of Chapter 3 and Chapter 4, while health capital is separately dealt with in Chapter 5.

The rest of the chapter is structured as follows:

Section 2 explains why human capital has not yet been included within the asset boundary of the current SNA and illustrates the conventional practices dealing with the output of the educational sector in the SNA. Advances in researches attempting to incorporate human capital into the SNA are also briefly introduced in this section.

Section 3 provides comprehensive discussions about the concept and definitions of human capital, as well as the resulting implications for its measurement. The strengths and weaknesses of different measuring approaches currently available are then discussed. In particular, the purpose of Section 3 is to identify those promising approach(es) most likely to be employed to make human capital estimates for incorporation into the SNA in the future.

In Section 4, an overview on country experiences and international initiatives is given, based on an international questionnaire collected by the UNECE and the OECD, as well as on a literature survey of the leading activities in the field of human capital measurement.

Main issues and challenges remained are described in Section 5.

Section 6 concludes the chapter and includes recommendations for suggested future research.

4 Human capital defined as such is closer to the OECD definition (see OECD 2001), which has gradually received wide acceptance. More on the OECD definition will be discussed in Section 3 of this chapter.

2. Human capital and the SNA

The System of National Accounts (SNA) is an internationally agreed-upon standard statistical framework that provides a comprehensive, consistent, and flexible set of macroeconomic accounts suitable for measuring, monitoring, and analyzing the economy and its constituents, so as to assist national policy planning processes.

Human input is the primary input in most production processes. The value of that input is not only raw labor, but is to a large extent dependent on the knowledge, skills, and competencies human beings bring to production processes. Nowadays it is generally recognized that an educated population is vital to economic well-being in most countries. It is often proposed that expenditures on education and staff training should be classified as gross fixed capital formation – as a form of investment in human capital. Clearly the acquisition of knowledge, skills, and qualifications increases the productive potential of the individuals in concern and is a source of future economic benefit to them.

There exist repeated efforts to bring the concept of human capital, including its formation and utilization, into the framework of the SNA. There are essentially two arguments against these requests: One is attributed to the "production boundary" and the other to the "asset boundary", as stipulated by the SNA (e.g., SNA 2008).

First, human capital is usually acquired by learning, studying, and practicing. But these activities cannot be undertaken by anyone else on behalf of the person considered, and thus do not satisfy the "third party criterion" that delineates the production boundary of the SNA. As a consequence, the acquisition of knowledge and skills is not considered as a process of production, even if the provision of the services by educational institutions (schools, colleges, universities, etc.) is.

Second, human capital cannot be detached from the person in whom it is embodied, nor can it be transacted separately and in its own right in the market like conventional fixed capital. Simply because it is practically difficult, if not impossible, to envisage an "ownership right" in connection with people, human capital is not treated by the SNA as an asset.

Within the framework of the current SNA, education services produced by educational institutions are treated as being consumed by students in the process of their acquiring knowledge and skills. In other words, this type of education is treated as final consumption, rather than as input used in the production of human capital by the students. When training is given by an employer to enhance the effectiveness of staff, those costs are treated as intermediate consumption. In both cases, the learning and practicing processes of the individuals in question are entirely ignored.

Sometimes the entire educational sector (instead of the students themselves) is regarded as the supplier of human capital, and the product of the educational sector treated as human capital investment. Because most educational expenditures are often financed by public funds that are allocated by the government and/or non-profit institutions, the output of the educational sector is currently measured merely based on the costs of the market inputs into this sector, i.e., teachers' wages and salaries, the consumption of fixed capital (e.g., school buildings), household expenditures for school fees and educational materials, etc.

This input-based approach to measuring the output of the educational sector (which is human capital investment) is, however, inadequate for productivity analysis, since it ignores changes in the efficiency with which various inputs are used in production. To support a proper analysis of the productivity performance of the educational sector, independent output-based measures of its economic production are therefore required, which subsequently necessitates a good measure of human capital due to education.

Despite the difficulties of compiling a complete system of accounts for investment in human capital, wealth in the form of human capital, and the services of human capital that are integrated with the SNA, research efforts along this line are ongoing. For instance, Jorgenson and Fraumeni (1989) present a complete system of national accounts that include investment in human capital. The flow of human capital services, cross-classified by age, gender, and educational attainment, provides a price and volume of market labor compensation that has been integrated with the national accounts in ten countries following the EU KLEMS project (O'MAHONY AND TIMMER 2009).

Several attempts to measure the output of the educational sector beyond the conventional input-based approach have also been carried out. For example, by considering the output of the educational sector to be investment in human capital through formal education, Jorgenson and Fraumeni (1992a) and Gu and Wong (2010a) measure the output of this sector in terms of increments to lifetime incomes of individuals taking this education.

3. Concept and measuring approaches

3.1 Concept and definition of human capital

The origin of the human capital concept can be traced back to the work of Adam Smith in the 18th Century. Smith underlined the importance of "the acquired and useful abilities of all the inhabitants or members of the society"; while an individual will incur costs to obtain such abilities, once acquired, they stand as "a capital fixed and realised, as it were, in his person" (SMITH 1776).

The practical implications of treating an individual's abilities as a kind of capital were not widely recognized until the 1960s, when economists began to incorporate the notion into their works. This shift partly reflected the view that the concept of human capital could be employed to explain the large difference between the increase of the economic output of a country and that of the traditional trio-inputs (land, labor, and produced capital). Some

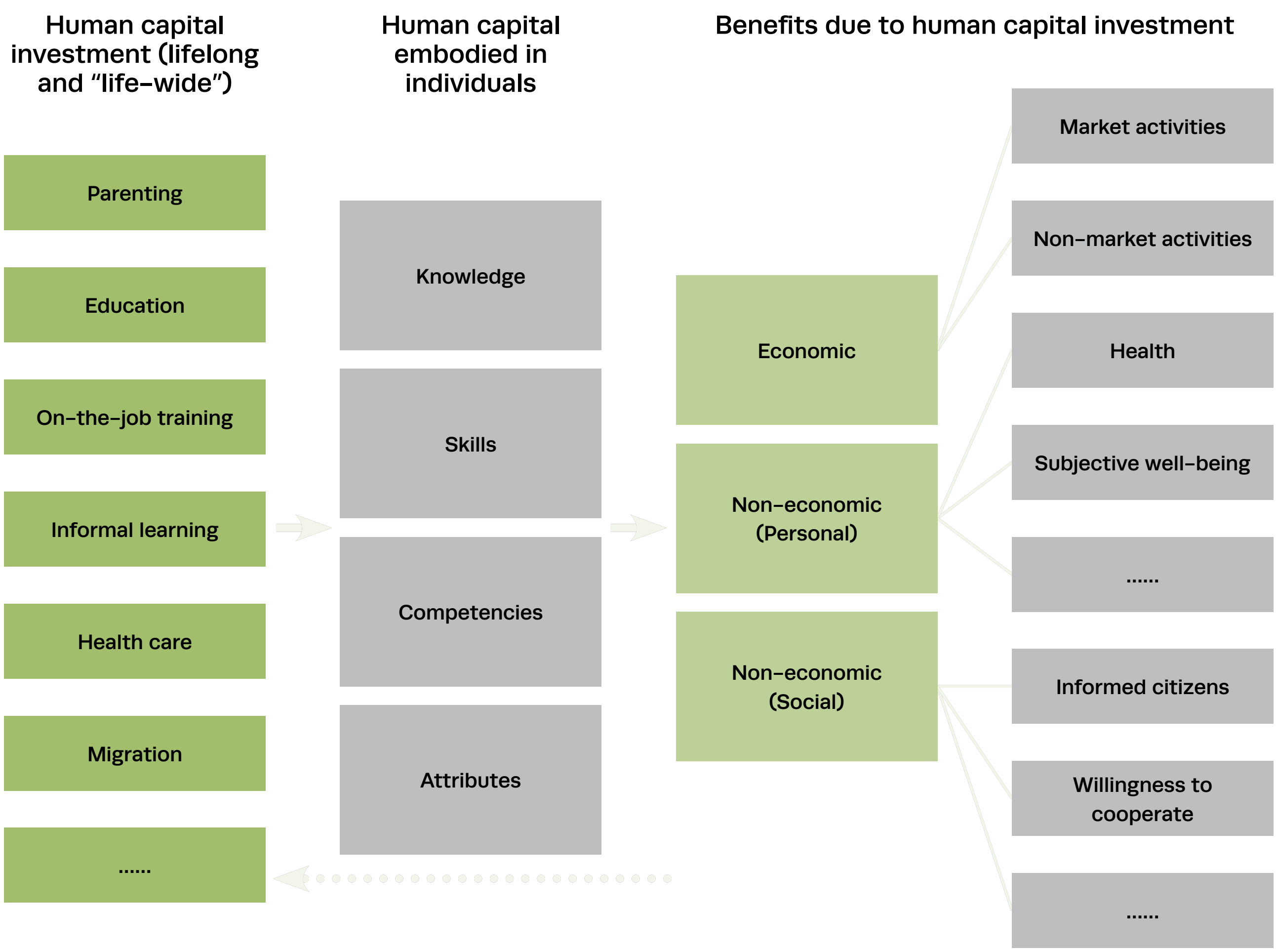


FIGURE 1

Human capital: a sketch of its formation, composition, and benefits generated

Source: The OECD human capital project (see Boarini et al. 2012).

economists contended that investment in human capital was probably the major explanation for this difference (e.g., SCHULTZ 1961).

There are many definitions of human capital in the literature, but most of them stress the economic returns due to human capital investment. Schultz (1961), for example, defined human capital as "acquired skills and knowledge" to distinguish raw (unskilled) labor from skilled labor; likewise, the Penguin Dictionary of Economics (1984) defined human capital as "the skills, capacities and abilities possessed by an individual which permit him to earn income", a definition which emphasizes the improvement of people's economic situation due to human capital investment. The World Bank (2006) similarly defined human capital as the productive capacity embodied in individuals, with special focus on its contribution to economic production.

As today's economies become more knowledge-based and globalized, the economic importance of human capital to both an individual's competitive advantage and to a country's economic success has become more significant than ever. But human capital investment delivers many other non-economic benefits as well, such as improved health, enhanced personal well-being, and greater social cohesion. These broader benefits are viewed by many as being as important as, if not more important than, the economic benefits in the form of higher earnings and economic growth.

Acknowledging these broader benefits, the definition of human capital has been gradually extended. For instance, in an OECD report published in 1998, human capital was defined as "the knowledge, skills, competences and other attributes embodied in individuals *that are relevant to economic activity*" (OECD 1998). A later report, however, updated the definition of human capital as "the knowledge, skills, competencies and attributes embodied in individuals *that facilitate the creation of personal, social and economic well-being*" (OECD 2001).

The OECD definition of human capital according to the 2001 report has gradually obtained wide acceptance. Figure 1 displays a stylized drawing of the elements pertaining to this broad definition, comprising the essential constituents that make up human capital, as well as the numerous channels through which human capital is developed, and the diverse benefits that human capital delivers.

3.1.1 What is included in human capital?

The overarching OECD definition incorporates various skills and competencies that are acquired through learning and experience, but may also include innate abilities. Some aspects of motivation and behavior, as well as the physical, emotional, and mental health of individuals are also regarded as human capital within this broad definition (OECD 2001).

The components of human capital reflect its multifaceted nature. For instance, they include both general and work-specific skills, as well as tacit and explicit ones. They cover not only the cognitive skills that were conventionally recognized but also non-cognitive skills, such as intra- and inter-personal skills, which have assumed an increasingly important role in modern societies.

Distinct from traditional fixed capital, almost all types of knowledge, skills, competencies, and attributes are invisible. While fixed capital wears out through use, human capital typically grows through use and experience, at least at first. However, both human and fixed capitals accumulate through investments and decline due to obsolescence, although not exactly in the same manner. For example, human capital depreciates due to lack of use, obsolescence of knowledge, and ageing.

3.1.2 How is human capital acquired?

The OECD definition also implies that human capital can be accumulated through many channels that may be characterized as both *lifelong*, in terms of learning from birth to death, and *life-wide*, in terms of learning at various occasions, including families (through parenting), schools (through formal and informal education), workplaces (through on-the-job training and work practice), and even daily life (through informal learning, anywhere and anytime).

Human capital development is normally involved with private and public resources, as well as market and non-market inputs. A distinct feature of human capital investment is that almost all types of such investment require learning by individuals themselves, an activity that is not only non-market, but also outside of the production boundary of the current SNA, because it fails to meet the "third party criterion" as mentioned above in Section 2.

How human capital is developed also hinges upon a range of environmental factors, such as cultural backgrounds, social relationships, as well as political, legal, and institutional arrangements. For instance, investment in skills takes place in many different stages of the lifecycle of individuals, during which social capital (i.e., networks and norms) plays a critical role in fostering a culture of learning within a society (COLEMAN 1990). There is considerable agreement drawn from the relevant research that the family, as well as social- and home-backgrounds, will shape school outcomes, although the relative importance of the various factors is not always clearly understood.

Another issue pertinent to human capital measurement that raises practical difficulties is how to distinguish, within education-related expenditures, between purposes for consumption and investment. While the distinction between the two elements is conceptually clear, in practice it is not easy to verify which of the two perspectives is more relevant in any situation. In reality, most of the activities contributing to human capital accumulation are likely to include both consumption and investment elements, as in the case of household expenses for buying school uniforms for students.[5]

Things become even more complicated once the health aspect is taken into account. Health care is regarded as one type of human capital investments in Figure 1, because health condition is one of the vital attributes that are encompassed by the broad notion of human capital. Moreover, a better health status normally enhances an individual's learning abilities and also job market performance, so that his/her embodied human capital can be utilized in a more efficient way. However, it is not always clear-cut whether activities related to health care are pursued for the purpose of investment rather than consumption. For instance, doing exercises may qualify as an investment, but expenses for buying tonic foods and beverages could serve both purposes.

As shown in Figure 1, human capital investment in any given country may also take the form of migration, with the immigration of skilled people representing an addition to the stock of human capital for the country of destination, and a depletion of human capital for the country of origin.

5 Due in part to this reason, there appears an additional difficulty if human capital is measured solely from the input side, i.e., to sum all expenditures made to produce the capital goods. More discussions on this methodological issue are in subsection 3.2 of this chapter.

3.1.3 What benefits stem from human capital investment?

As reflected by the broad OECD definition and as shown in Figure 1 as well, human capital investment can generate both economic and non-economic benefits. Economic benefits include enhanced employability and, if employed, improved earnings and career prospects for individuals undertaking the investment; non-economic benefits can take the form of productivity increases in performing non-market activities (e.g., household production) or of personal benefits that are not related to production (e.g., greater enjoyment of arts and culture, improved health, and subjective well-being).

The benefits can also spill over to other agents and even to society at large. For instance, at the firm level, higher productivity of some employees, due to higher education, may increase the performance of other workers and, hence, company profitability. At macro-economic level, recent evidence has highlighted the positive impact of human capital on economic growth. Further, these spill-overs are not limited to economic returns. For instance, education may make people better citizens and better parents, leading to greater social cohesion.

Finally, as illustrated by the dotted arrow in Figure 1, there also exist feedback effects, running from the benefits generated by human capital investment to the investment itself. For example, workers with higher education are more likely to benefit from, and thus be willing to pursue, further education and training. In addition, the feedback process may lead to a *virtuous cycle* wherein more education makes further learning even easier and faster, and thus more efficient. At the national level, there is a long-standing debate on the direction of causality between education and economic growth. Recent studies have demonstrated that the causality may operate in both directions, suggesting that a feedback loop may also operate at the macro level.

3.1.4 Implications for measurement

In summary, there are so many elements involved in and intertwined with the concept of human capital that getting a full picture of every single element covered by the broad OECD definition of human capital, of the causal links between each type of human capital investment and the corresponding benefits, and of the feedback loops among them, is quite complicated. This implies that encompassing all the elements of Figure 1 into a single measure of human capital is a daunting task, which could not be realistically accomplished in the foreseeable future. The most sensible approach is to address this task following a stepwise approach.

A sensible way is to focus on a narrower range of elements, starting from those aspects characterized as either involving lower conceptual challenges or enjoying greater data availability. For instance, most of the human capital definitions currently employed distinguish human beings themselves from the acquired abilities, and include only the latter within the domain.

Closely related to this choice, health status is often considered separately as another specific asset, i.e., health capital (e.g., ABRAHAM AND MACKIE 2005) because of its apparently distinct feature from the education aspect of human capital, and also due to practical difficulties, such as how to distinguish health-related expenditures between purposes for consumption and investment. However, treating health as a separate type of capital does not imply that health status is irrelevant for the measurement of the "educational" capital explored here. What it implies is that the measure of the human capital stock described here will only reflect the impact of health care activities in improving people's economic returns, which is considered as one of the two outputs of the health sector (ABRAHAM AND MACKIE 2005).[6]

In practice, one frequently-chosen option by many researchers and institutions is to focus on formal education as the main form of human capital investment; and on the accrued economic returns for individuals as the main benefits due to human capital investment,[7] even if the broad OECD definition is accepted as a useful reference point.[8]

3.2 Measuring approaches

Currently there exist several approaches to measuring human capital. In Figure 2, a broad distinction is made between an indicators-based approach and monetary measures. The indicators-based approach relies on physical indicators, which might be further divided into quantitative indicators (e.g., educational attainment, average years of schooling) and qualitative ones (e.g., class size, test scores).

The monetary measures of human capital include estimates based on an indirect or residual approach (e.g., WORLD BANK 2006, 2011),[9] as well as direct estimates that utilize information on its various components. The two main types of direct measures are the cost-based approach (e.g., KENDRICK 1976) and the income-based approach (e.g., JORGENSON AND FRAUMENI 1989, 1992a, 1992b).[10]

6 The other output of the health sector is the value of health capital that can be defined as the expected flow of health consumption over the course of a person's remaining life (Abraham and Mackie 2005).

7 However, it does not imply that there are no other possible ways to move beyond this option.

8 More on this is in Section 4.

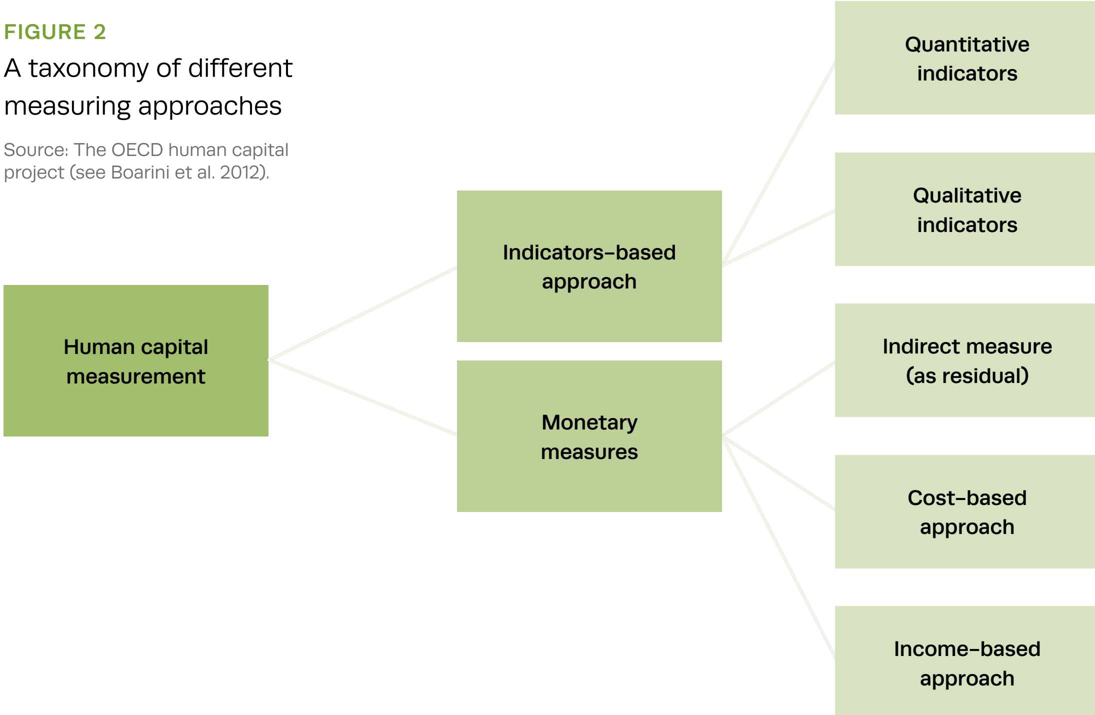
9 Here, the distinction of "direct" versus "indirect" has only relative meaning. Unlike physical capital, human capital is invisible. Therefore, in a strict sense, all methods trying to measure human capital can only be "indirect".

10 The above typology is not the only way to classify the various approaches. For instance, a distinction can also be made between parametric and non-parametric approaches to measuring human capital. The former involves econometric techniques (e.g., Kyriacou 1991, Mulligan and Sala-i-Martin 1995, Barro and Lee 2010), while the latter usually does not.

FIGURE 2

A taxonomy of different measuring approaches

Source: The OECD human capital project (see Boarini et al. 2012).



Different measuring approaches have both advantages and disadvantages, some of which are specific to one approach, while others are common across different approaches. This section reviews some of the most important advantages and disadvantages, with the view to find one or several approaches that are more capable of making human capital estimates that are in accordance with the SNA.

The *indicators-based approach* measures human capital through various educational characteristics of the population. Indicators often used as single proxies for human capital in the academia include adult literacy rates (e.g., Azariadis and Drazen 1990, Romer 1990b), school enrollment ratios (e.g., Barro 1991, Mankiw et al. 1992, Levine and Renelt 1992), average years of schooling, and other measures (e.g., Benhabib and Spiegel 1994, Barro and Sala-i-Martin 1995, Gundlach 1995, Islam 1995, O'Neill 1995, Temple 1999, Barro 1997, 2001, Krueger and Lindahl 2001).

However, the use of a single physical indicator as a proxy for human capital, though appealing for its simplicity, cannot on its own adequately measure the various dimensions of skills and competences (OECD 2001), and sometimes poorly specifies the relationship between education and the stock of human capital (Wössmann 2003, Kokkinen 2010). Therefore, only a wider definition can provide useful clues about where investment is most needed and where benefits go.

Sometimes, dashboard-type indicators (e.g., Education at a Glance, Ederer et al. 2007, 2011) are applied, but they rely on a number of statistics that, though rich in information, lack a common metric and, as a result, cannot be easily aggregated into an overall measure. This makes them less suitable for comprehensive comparisons of the stock of human capital across countries and over time.[11] Also, a set of indicators does not allow easy comparison of the relative importance of different types of capital, i.e., produced, natural, and human capitals (Stroombergen et al. 2002).

Recently one type of indicators has attracted growing attention in the world, i.e., pencil and paper test scores of people's competencies. Examples are the OECD Programme

11 For instance, under certain circumstances, information drawn from different statistics may conflict with each other.

for International Student Assessment (PISA), which tests 15 to 16 year olds students for cognitive skills in terms of reading, mathematics, science, and problem solving; and the OECD Programme for International Assessment of Adult Competencies (PIAAC), which tests adults for their competencies in terms of literacy, numeracy, and ability to solve problems in technology-rich environments.[12]

These programs provide vitally important information for policy-making, in particular for evaluating educational programs. However, like all surveys, they are subject to survey and test limitations (e.g., with respect to sample size, range of variables included, country coverage, etc.). More importantly, as these programs are resource-intensive in terms of both money and time required to implement, administer, process, analyze, and report, they are typically undertaken with low frequency. Finally, the information generated from these programs is not easily integrated into human capital accounts.[13]

Within the group of monetary measures, the *indirect (residual) approach* is applied by the World Bank through its comprehensive wealth accounting. This approach measures the stock of human capital as the difference between the total discounted value of each country's future consumption flows (taken as a proxy for total wealth) and the sum of the tangible components of that wealth, i.e., produced capital and the market-component of natural capital (World Bank 2006, 2011, Ruta and Hamilton 2007, Ferreira and Hamilton 2010).[14] A similar approach has also been applied by Statistics Norway at the country level (Greaker et al. 2005).

While this indirect approach can be applied to a large number of countries based on less-demanding statistics,[15] it has certain limits. First, by taking as its starting point the discounted value of future consumption flows, it apparently ignores the non-market benefits of various capital stocks. Second, this measure is affected by measurement errors in all the terms entering the accounting identities, resulting in potential biases in the final estimates of human capital. Third, the approach cannot explain what drives the observed changes of the human capital over time, thus offering less valuable information for policy interventions.

Among direct measuring approaches, the *cost-based approach* measures human capital by looking at the stream of past investments undertaken by individuals, households, employers, and governments (e.g., Schultz 1961, Kendrick 1976, Eisner 1985). This approach relies on information on all the costs that are incurred when producing human capital. These costs include monetary outlays by each of the agents mentioned above, but can also incorporate non-market inputs (e.g., the imputed value of the time devoted to education by students, their parents, and volunteers).

The cost-based approach is relatively easy to apply, at least when limited to market inputs, because of the ready availability of data on both public and private expenditures in formal education. The approach can also be extended

12 For more information on the PISA and PIAAC, please visit the following websites: http://www.pisa.oecd.org/pages/0,2987,en_32252351_32235731_1_1_1_1_1,00.html; http://www.oecd.org/document/35/0,3746,en_2649_201185_40277475_1_1_1_1,00.html.

13 The last point is also relevant when considering differences between parametric and non-parametric approaches to measuring human capital. Parametric approaches are frequently used in academic researches; however, since they rely on econometric techniques, different assumptions and model specifications, even if based on the same dataset, will typically lead to different estimates. On the contrary, non-parametric approaches avoid these problems and are more akin to the tools typically used by national statistical offices and other producers of human capital statistics.

14 This difference is labelled by the World Bank as "intangible assets", of which human capital is found to be the most important component (World Bank 2006, 2011).

15 The World Bank work of comprehensive wealth accounting covers more than 100 countries over the decade from 1995 to 2005 (World Bank 2011).

to account for expenditures undertaken for on-the-job training. However, the approach has been criticized on conceptual grounds, with some arguing the value of human capital should be regarded as determined by demand and supply rather than solely by production costs (LE ET AL. 2003)[16].

In addition, following this approach, it is hard, if not impossible, to distinguish between expenditures for investment and consumption. Consequently, estimates by this approach usually rely on arbitrarily allocating spending between these two categories. For instance, during the period of taking education, part of household expenditures is used for paying students' food and clothes, which could serve both consumption and investment purposes. Challenges are also involved with the choice of the price index used to deflate historical expenditures related to human capital investment in order to construct a stock value based on the perpetual inventory method.

Moreover, the depreciation rate, which matters a great deal when constructing the stock of human capital based on the perpetual inventory method, is usually set arbitrarily in practice, although this treatment is not uncommon during the estimation of the stock of traditional fixed capital based on the same method. Overall, the cost-based approach ignores a fundamental feature of the process of education, i.e., the lengthy gestation period between current outlays for educational inputs and the resulting generation of human capital embodied by more competent people (JORGENSON AND FRAUMENI 1989, 1992A).

The *income-based approach* measures human capital by looking at the stream of future earnings that human capital investment generates. In contrast to the cost-based approach, which focuses on the input side, the income-based approach measures the stock of human capital by looking at the output side.[17] By focusing on the earning power of each person (usually proxied by wage), the income-based approach values human capital at market prices, under the assumption that these prices are good signals of the value of human capital services that result from the interaction of demand and supply in the labor market.

This approach has been used at least since the 1960s (e.g., WEISBROD 1961, GRAHAM AND WEBB 1979). However, it was the seminal works of Jorgenson and Fraumeni (1989, 1992a, 1992b) that spawned interests in measuring human capital by applying the lifetime income approach (also called the Jorgenson-Fraumeni approach). The lifetime income approach applies the neoclassical theory of investment (JORGENSON 1967) to human capital. According to this theory, the price of capital goods depends upon the discounted value of all future capital services derived from the investments. On a per capita basis, this means that the value of an individual's human capital can be determined from that person's discounted lifetime income.

The lifetime income approach has other advantages. In particular, the extension of this approach naturally leads to an accounting system that includes values, volumes, and prices as basic elements. This opens the way for the construction of a sequence of accounts similar to those used for produced capital within the framework of the SNA (FRAUMENI 2009).

However, the income-based approach is not immune from drawbacks. For instance, it has been found that the relative value of human capital of a country is positively correlated with that of its produced capital, i.e., an increase in the latter tends to enhance the marginal product of labor and hence the value of human capital (e.g., HAMILTON AND LIU 2014). Therefore, due caution should be taken when comparing

16 Note that the production costs of human capital include forgone earnings that are usually determined by demand and supply in the labor market.

17 While the outputs from human capital investment are of many types (i.e., monetary and non-monetary, private and public), the output measured by the income-based approach is commonly limited to the private monetary benefits that accrue to the person investing in human capital.

human capital across countries. In addition, in order to calculate expected future earnings, some subjective judgements must be made about the discount rate, real income growth rate, etc. Most crucially, there are reasons to believe that the labor market does not always function perfectly. As a result, the wage rate typically used as a proxy for earning power in the income-based approach is not always equal to the marginal value of a particular type of human capital. Moreover, differences in wages will not truly reflect differences in earning power in some cases where trade unions may command a premium wage for their members, or where real wages may fall in economic recessions.

To sum up, distinct from the indicators-based approach, the monetary measures, in particular, the cost-based and the income-based approaches, combine many different aspects that contribute to human capital in a single metric: money. In other terms, they reflect the different factors that contribute to human capital accumulation. For example, estimates based on the income-based approach allow comparisons between the relative importance of demographic (e.g., the age and gender structure of the population), educational (e.g., the number of people with different levels of educational attainment, enrollment rates), and labor market factors (e.g., the employment probabilities and earning differentials by educational characteristics). Similarly, human capital estimates based on the cost-based approach allow comparisons between the relative importance of the expenditures incurred by different sectors (e.g., public administration, households, and firms) and of market versus non-market inputs (e.g., time devoted to educational-related activities by students, parents, support staff, etc.).

It seems that all approaches to measuring human capital have strengths and weaknesses. Given the importance of the SNA in official statistics and economic analysis, monetary measures – in particular the cost-based and the income-based approaches – are most likely to be used to construct human capital measures based on an explicit accounting framework within the SNA.

Arguably, to address issues related to growth accounting, monitoring sustainability, and measuring the output and productivity performance of the educational sector, monetary measures of human capital will have a key role to play. Even for the purpose of assessing the impact of human capital on "quality of life" and well-being, monetary measures of human capital are also important.

4. Overview of national studies and international initiatives

4.1 Country experiences

This subsection provides an overview of national studies conducted either as part of the research activities of national statistical offices, or by independent researchers, with focus being placed on the purpose, concept, methodology, and data sources used for measuring human capital in different countries. The overview begins with a summary of the results of a recent questionnaire on national practices in measuring human capital that was responded by UNECE CES (Conference of European Statisticians) countries.[18] Given the popularity of the monetary measures in national studies, this subsection also presents some findings from representative country studies based on the cost-based and the income-based approaches.[19]

18 The UNECE CES questionnaire was designed by the OECD, and collected by both the OECD and the UNECE, with the purpose of providing an overview of what countries have done, are doing, and are planning to do in the field of human capital measurement. The questionnaire and answers to it are summarized in Boarini et al. (2012).

19 The indirect/residual approach will not be discussed here, because, at the national level, there are just a handful of countries applying this approach (e.g., Norway, the Netherlands).

TABLE 1

Key findings about country practices on measuring human capital

Questions	Findings
1. Purpose of measurement	Most countries have multiple purposes, including for education-related policies, growth accounting/productivity analysis, national wealth accounting, satellite account construction, sustainability assessment, and measuring well-being and social progress.
2. Concept of human capital	Although some countries refer to the broad OECD definition of human capital, many countries prefer pragmatically to use definitions that have narrower scope, tending to focus on the economic/productive dimension.
3. Data sources and availability	Data sources used are diverse, including survey data, administrative data, census data, and others. Almost all data needed for making measures of human capital are available within the statistical system of each country.
4. Status and frequency of human capital estimates	Measuring human capital is carried out usually by either independent researchers or statisticians working with national statistical offices. Although most of the existing estimates are in the form of research results instead of official statistics, many countries measure human capital on a regular basis, most of them annually.
5. Satellite accounts	Only a few countries plan to construct satellite accounts for human capital in general and for the education sector in particular. Likewise, very few countries have assessed the possibility and potential implications of incorporating measures of human capital into the SNA.
6. Measuring approaches	Both physical indicators and monetary measures are often applied. Most countries choose only one approach, and the majority rely on monetary measures only, while a few other countries choose multiple approaches.
6.1 Indicators-based approach	For many countries, conventional quantitative indicators are still used and draw directly from education statistics, such as population distribution by education category, average years of schooling, etc. Only a few countries collect qualitative indicators such as those undertaken as part of the OECD PISA and PIAAC programs.
6.2 Monetary measures	Among monetary measures, the income-based approach is predominant over the cost-based and residual approaches.
6.2.1 Reasons for applying the residual approach	The main reason provided for utilizing the residual approach is its simplicity, despite conceptual drawbacks.
6.2.2 Reasons for applying the cost-based approach	The main reasons for utilizing the cost-based approach are data availability, applicability in the SNA, and lack of necessity for making assumptions about the future; while the main challenges are related to data availability. Some countries included in their estimates not just the costs incurred by educational institutions, but also expenditures by firms and private households. However, no countries have ever included non-market costs in their estimates of human capital based on the cost-based approach.
6.2.3 Reasons for applying the income-based approach	The main reasons for using the income-based approach are its consistency with economic theory and with the way in which other assets (such as natural resources) are measured in the SNA. This approach is also considered to be well-established and widely-employed, and to be suitable for constructing a fully-fledged human capital account with volumes, values, and prices as basic elements. Issues related to the methodology and data availability, rather than the concept itself, are regarded as the main challenges for applying this approach. Partly due to data limitations, almost all countries having applied the income-based approach limit their estimates to the working age population and to market activities only.

4.1.1 Results of the UNECE CES questionnaire on measuring human capital

Overall, out of the 70 CES countries, 46 answered the questionnaire, with 17 providing detailed answers. They are, among OECD countries, Austria, Canada, Finland, France, Germany, Israel, Italy, the Netherlands, New Zealand, Norway, Poland, Slovenia, the United Kingdom, and the United States; and, among CES non-OECD countries, Liechtenstein, Romania, and Ukraine. Highlights from countries' responses are presented in Table 1.

4.1.2 Representative studies using the cost-based approach

The cost-based approach to measuring human capital is practically similar to what has been conventionally applied to measuring the stock of fixed capital by the perpetual inventory method, i.e., the stock of human capital is measured as the accumulated value of all the expenditures occurring to its formation, which are considered as human capital investment.

The most well-known application of the cost-based approach is provided by Kendrick (1976) for the United States. Kendrick's estimates are more inclusive than most other applications of this approach, as they include the cost of child rearing, spending on education, and other expenditures considered to have educational value. In addition to these expenditures, Kendrick (1976) also includes the opportunity cost of student time, i.e., earnings forgone by students when studying. Following the same approach, Eisner (1978, 1985, 1988, 1989) estimated the value of the stock of human capital in the United States through a number of modifications to the U.S. national income accounts. Both Eisner and Kendrick included in their estimates of human capital formation the opportunity cost of students' time while in school, as well as the actual costs of education undertaken by both households (e.g., costs for tuition and educational materials) and governments (e.g., costs for salaries and investments of educational institutions). However, unlike Kendrick, Eisner excluded the costs of child-rearing from the investment in human capital.

As discussed in Section 3, applying the cost-based approach requires confronting several methodological challenges. One is how to distinguish between consumption and investment expenditures. Kendrick included in human capital investments all household expenditures related to child rearing to the age of 14, as well as half of household expenditures on health and safety, considering the other half as consumption.

Another challenge related to the implementation of the cost-based approach is choosing the depreciation rates when constructing the stock of human capital. Because of a lack of empirical evidence, Kendrick used for this purpose a modified double declining balance method, while Eisner used straight-line depreciation.

The cost-based approach to measuring human capital was also applied in Germany (Ewerhart 2001, 2003), and the Netherlands used the approach to measure firm-specific human capital (Rooijen-Horsten et al. 2007, 2008). Within the framework of the SNA, the cost-based approach was also used by the Statistics Finland to measure human capital in an empirical analysis of the relation between human capital and economic growth (Kokkinen 2008, 2010). In addition, Statistics Canada plans to apply the cost-based approach, together with the income-based approach that was already employed, in order to compare and reconcile the estimates from the two approaches.

4.1.3 Representative studies using the income-based approach

One of the main conclusions from the CES questionnaire responses is that several countries are currently applying variants of the income-based approach. By bringing together the influence of a broad range of factors (demography, mortality, educational attainment, and labor market aspects), this approach allows comparing the

TABLE 2

A list of selected national studies applying income-based approaches

Examples of national studies	Country	Motivation	Time range	Main data sources	Population covered	Market/ non-market activities
Jorgenson and Fraumeni (1989, 1992a, 1992b)	United States	New system of national accounts, output of education sector	1948–1984, 1947–1987	Rich data based on decades of research	Age 0–75	Both
Ahlroth et al. (1997)	Sweden	Output of education sector	1967, 1973, 1980, 1990	Level of living surveys	Age 0–75	Both
Ervik et al. (2003)	Norway	Output of higher education sector	1995	Register data	Age 20–64	Market only
Wei (2004, 2008)	Australia	Incorporating human capital into the SNA (stock/flow)	1981–2001	Census data	Age 18 (25)–65, labor force/whole population	Market only
Le et al. (2006)	New Zealand	Measuring human capital (stock)	1981–2001	Census data	Age 18–64	Market only
Gundimeda et al. (2006)	India	Accounting for human capital formation	1993–2001	Surveys of employment and unemployment, census of population	Age 15–60	Market only
Gu and Wong (2008)	Canada	Human capital contribution to national wealth account	1970–2007	Census/labor force survey	Age 15–74	Market only
Liu and Greaker (2009)	Norway	Measuring human capital (stock)	2006	Register data	Age 15(16)–67(74), labor force/whole population	Market only
Christian (2010)	United States	Measuring human capital (stock/ investment)	1994–2006	Rich data	Age 0–80	Both
Coremberg (2010)	Argentina	Measuring human capital (stock)/output of education sector	1997, 2001, 2004	Household perma-nent survey	Age 15–65	Market only
Li et al. (2010)	China	Measuring human capital (stock)	1985–2007	Household survey/ health and nutrition survey	Urban/rural, Age 0–60 (55 for female)	Market only
Jones and Chiripanhura (2010)	United Kingdom	Measuring human capital (stock)	2001–2009	Labor force survey	Age 16–64	Market only
Istat (2013)	Italy	Measuring human capital (stock)	2008	Various surveys	Age 15–64	Both

relative importance of these factors and drawing useful policy implications from the estimates.

Table 2 presents a list of national studies that have applied the income-based approach to measuring human capital. This list is meant to highlight the broad range of countries (13) for which these estimates exist, rather than offering an exhaustive list of the full range of studies based on the approach.

As shown in Table 2, data availability varies across national studies. For many countries, the data needed for applying the income-based approach are compiled by the researcher, with many assumptions made during the data construction process. In part due to this and differently from the original studies by Jorgenson and Fraumeni – most of the national studies listed in Table 2 focused on people of working age (typically based on exogenous age thresholds, e.g., 15 and 64) and market activities only.

These limitations reflect a pragmatic way to sidestep a number of conceptual and data issues that arise when applying the full Jorgenson-Fraumeni approach. Incorporating non-market activities into human capital estimates is bound to incur many imputations, and so attracts more controversy. Although it is data limitation that constrains the scope of estimation, focusing on working age population is sometimes considered as being more relevant for measuring a country's productive capacity (Wei 2004, Gu and Wong 2008, Greaker and Liu 2008).

Methodological modifications to the original Jorgenson-Fraumeni methodology were also made in some of the national studies. For example, to smooth the business cycle effects that affect the Jorgenson-Fraumeni approach (which relies exclusively on current cross-sectional information), Wei (2008) applied a cohort-based estimation method to simulate future earnings. In order to apply the data of educational attainment by quality credentials (rather than by calendar years), some assumptions were also made in order to overcome the difficulties that incurred (e.g., Wei 2004, Gu and Wong 2008, Greaker and Liu 2008).[20]

Results from these national studies suggest that the estimated value of the stock of human capital is substantially larger than that of conventional produced capital, even if the measures of the former are restricted to market activities. Measures of the stock of human capital based on the income-based approach tend also to exceed those based on the cost-based approach, a pattern that may reflect the fact that the former approach implicitly attributes the impact of on-the-job training and work experiences to formal education.

When regarding the output of the educational sector as human capital investment, the value of such investment is high compared to the gross fixed capital formation traditionally measured in the SNA. Considering educational expenditures as investment rather than consumption would significantly change our understanding of the extent of capital formation in any given year.

Estimates of the value of the human capital stock based on the lifetime income approach are sensitive to choices on key parameters employed in this approach, namely the real annual growth of labor income that is assumed to prevail in the future, and the rate used to discount future earnings. Growth rates of the human capital stock, as well as its distribution across different groups of people, are less sensitive to the choice of these parameters.

Towards the construction of the human capital account, despite many challenges ahead, several attempts have been made to compile the flow and stock values of human capital in a systematic way by applying the lifetime income approach (e.g., Wei 2008, Gu and Wong 2010b).

20 For more detailed discussions on the technical issues, besides the conceptual, methodological, and data issues, in national studies that applied the income-based, especially the lifetime income approach to measuring human capital, see Liu (2012).

4.2 International initiatives

Several researchers and international organizations have attempted to develop comparable measures of human capital. One example of current research in this field is represented by Barro and Lee (1993, 1996, 2001, 2010, 2013), for constructing an international dataset of educational attainment, school years, and schooling quality as proxies for human capital, based on census and survey information compiled by UNESCO and other sources.

Among international organizations, developing comparable measures of human capital has been a priority of the OECD. Much OECD work in this field has aimed at developing a better understanding of how teaching and learning outcomes can be improved in the classroom, and helping policy-makers to learn from each other's successes and failures. A large range of physical indicators is published in the OECD flagship publication Education at a Glance. Recently, the PISA has also attracted much international attention.

The OECD also has a long tradition in the field of measuring human capital beyond formal education. Earlier works include the investigation of further education and training and its impacts on the job market (e.g., OECD 1994). To deepen the understanding of the determinants of learning, attempts have been made to develop a framework for rethinking human capital information and decision-making; based on this framework, the OECD has analyzed obstacles to measurement, and suggested methods for further improvement in this area (OECD 1996).

In response to the growing interest in human capital, an OECD report in 1998 proposed an initial set of human capital investment indicators based on existing data. The report identified areas where significant gaps in internationally comparable data existed, and the cost of developing data collection for new measures and performance indicators (OECD 1998).

Building on the 1998 report, a subsequent report (OECD 2001) extended the OECD definition of human capital with a view to: 1) describe the latest evidence on investment in human capital and its impact on economic growth and well-being; 2) clarify the more novel concept of social capital; and 3) identify the roles of human and social capitals in realizing sustainable economic and social development. This report became an input into OECD projects on economic growth and sustainable development (OECD 2001).[21]

Since then, the OECD's work on human capital has continued along two lines. First, toward extending the measurement of students' competences in schools (PISA) to those of adults (PIAAC): In 2011, the PIAAC was launched with first results becoming available in 2013. The PIAAC program also links with the previous OECD work on the International Adult Literacy Survey (IALS) (see OECD AND STATISTICS CANADA 2000). Second, to identify the common methodology and data requirements for building human capital accounts: In cooperation with a number of national statistical agencies, a project was launched in 2009 by the OECD Statistics Directorate to compile monetary estimates of human capital for international and inter-temporal comparisons.

Liu (2011) summarizes the results from the OECD human capital project covering 15 OECD and one non-OECD countries over varying time periods from 1997 to 2007.[22] The results demonstrate the feasibility of applying the lifetime income approach to measuring human capital for comparative analysis, based on data currently available within the OECD statistics system. In addition, the estimated values of human capital

21 To communicate the findings from OECD research to a wider audience, one book of the OECD Insights series summarized the work on human capital undertaken by the OECD in the message that "how what you know shapes your life" (Keeley 2007).

22 The OECD countries are: Australia, Canada, Denmark, France, Israel, Italy, Korea, the Netherlands, New Zealand, Norway, Poland, Spain, the United Kingdom, and the United States, and the non-OECD country is Romania; later, estimates for another OECD member country (Japan) were added to the database (see Liu 2014). The detailed information on the country databases can be found at http://www.oecd.org/std/publications documents/workingpapers/.

are in line with those reported by a number of national studies.

Beyond the OECD,[23] many other activities on measuring human capital in the international arena have taken place. These include the following:

- The UNECE/OECD/Eurostat Working Group on Statistics for Sustainable Development has worked to develop a broad conceptual framework for measuring sustainable development with the concept of capital at its core, and to identify a small set of indicators that might be used for international comparisons (UNECE 2009). The forthcoming report of a new UNECE/OECD/Eurostat Task Force on measuring sustainable development will include a specific section on human capital measurement.
- The UNDP Human Development Index (HDI), which aims to illustrate the state of development of a society, is a composite index that combines measures of average achievements in a country in three basic dimensions of human development, i.e., health, education, and knowledge, and standards of living. The 2012 Human Development Report includes two measures of education and knowledge, namely school attainment, expressed in terms of the number of years of schooling, and school-life expectancy.[24]
- The EU KLEMS project has constructed a database (the EU KLEMS Growth and Productivity Accounts) for empirical research of economic growth (see O'Mahony and Timmer 2009). Although the primary aim of the EU KLEMS database is to generate comparative information on productivity trends, the data collected are also useful in other contexts. Thanks to its extensive country and industry coverage, potential applications of the database vary widely.
- The World Bank developed comprehensive wealth accounts including estimates of human capital for more than 120 countries, in order to answer the question "Where is the Wealth of Nations?" (World Bank 2006). Beyond the snapshot of national wealth at a point in time, the World Bank extended the accounting of wealth over the decade from 1995 to 2005 and provided the first inter-temporal assessment of global, regional, and country performance in building comprehensive wealth and achieving sustainable development (World Bank 2011).
- In 2012, the first UN "Inclusive Wealth Report", undertaken by the UN University - International Human Dimensions Programme on Global Environmental Change and the UN Environment Programme, presented estimates of inclusive wealth (the sum of manufactured, human, and natural capital) for 20 countries; in this approach, human capital is captured by measuring the population's educational attainment and the additional compensation over time of this training (UNU-IHDP and UNEP 2012).[25]

23 Other relevant streams of recent OECD works on human capital are the Social Outcomes of Learning project, the OECD Skills Strategy; work on intangible assets undertaken as part of the OECD work on New Sources of Growth; and the OECD Better Life Initiative. For more on these streams of work, please visit the following websites: http://www.oecd.org/document/9/0,3746,en_2649_39263294_33706505_1_1_1_1,00.html, http://www.oecd.org/dataoecd/58/28/47769132.pdf, http://www.oecd.org/dataoecd/60/40/46349020.pdf, http://www.oecd.org/document/0/0,3746,en_2649_201185_47837376_1_1_1_1,00.html

24 More information is available at http://hdr.undp.org/en/.

25 Basically, the approach applied for measuring human capital in the *Inclusive Wealth Report 2012* is also income-based, but it is different from the original Jorgenson-Fraumeni approach. More discussions on the differences are given in Chapter 4 of this 2014 report.

5. Main issues and challenges ahead

Despite the emerging trend of countries to apply the income-based, and in particular the lifetime income, approach to measuring human capital, several issues and challenges remain. These challenges relate to both data availability and methodological issues, both of which are discussed below.

5.1 Data availability

The data necessary for the income-based approach are often currently not available for some countries, or are not in a form suitable for direct use. Based mainly on the OECD experience in compiling monetary estimates of the stock of human capital (Liu 2011), several issues stand out:

- First, the quality and sources of earnings data cross-classified by different characteristics of workers vary significantly across countries. Data may refer to different earnings concepts (hourly and weekly earnings in most cases, annual and monthly earnings for some countries) and may include different elements of the remuneration packages of workers. In some cases, data on earnings refer only to the main job, while in other countries they may also cover secondary jobs and other remunerated activities. Finally, earnings data for different countries typically refer to different categories of educational attainment that may not be directly comparable, and may be collected as either point estimates or in the form of earnings brackets.
- Second, despite the great progress accomplished in collecting harmonized educational statistics, there remain issues with the quality of data on school enrollment and graduation rates, as definitions and classifications are not always comparable across countries. This is often due to differences in educational systems and in ways of counting students (e.g., students who repeat the year, students who graduate for a second time, etc.).
- Third, human capital estimates would ideally require data on survival rates broken down by education. While some national estimates exist, and they highlight large mortality differentials by socio-economic characteristics, these breakdowns are not available for all countries, and they are rarely comparable across countries.[26] For instance, mortality statistics by educational level are not compiled through common standards across OECD countries, and in several countries simply do not exist (OECD et al. 2011).

More generally, constructing estimates of human capital based on the income-based approach requires that data from a range of sources – e.g., earnings statistics, population census, labor force surveys, mortality records – be integrated and harmonized to meet the requirements of human capital accounting, which is still practically difficult.

5.2 Methodological difficulties

Besides data issues, several methodological challenges need to be addressed. First, most human capital estimates currently available rely on the assumption that cross-sectional earnings data are good predictors of future cohorts' earnings. However, there is ample evidence that cohort effects are typically large. This suggests that it would be appropriate to use longitudinal earnings data that disentangles age and cohort effects, and which makes it possible to account for cohort-specific factors.

26 The survival rates as constructed in e.g., Barro and Lee (2010) differ by educational attainment for some older age groups, and are differentiated by OECD vs. non–OECD countries.

Similarly, it would be important to separate wage premiums due to educational attainment from those due to adult-learning, on-the-job training, and other firms' characteristics, as failure to do so may lead to overestimates of the educational contribution to human capital.

With respect to labor market indicators (e.g., employment rates and earnings), it is also important to separate business cycle effects that distort comparisons (e.g., by depressing earnings or employment rates for different categories of workers during a recession).

A further difficulty when applying the lifetime income approach relates to the choice of some of the key parameters required by the method, such as the expected real growth of labor income in the future, the discount rate, and the price deflators used for temporal and country-comparisons.

While assumptions on these parameters are currently left to the discretion of researchers, their choice would ideally require further theoretical and empirical grounding. In other words, clear guidance in each of these fields remains needed. Similar challenges also confront the cost-based approach with respect to the choice of depreciation rates and price deflators.

Another challenge for developing monetary measures of the stock of human capital can be seen in the large discrepancies between estimates based on the income-based and the costs-based approaches. These discrepancies should be better understood and reconciled. One way to address this challenge would be to apply the two approaches simultaneously, which would offer an opportunity to identify the main factors accounting for the differences and to reconcile the two methods.[27] Satellite accounts could be used for such purpose, as they would allow for linking stock and flow measures of human capital in a fully-fledged accounting system consistent with the SNA.

As reflected by existing national studies and international activities, almost all currently available monetary measures effectively ignore the non-market benefits of human capital investments. This does not imply that non-market benefits are not significant or important, if compared with market benefits. It simply reflects the difficulties in developing estimations of them. Therefore, these current measures will tend to "under-estimate" the value of the human capital relative to an "ideal" norm that would include a monetary estimate of these non-market benefits.

6. Conclusions and recommendations

The concept of human capital has evolved over time, from a narrow scope focusing on cognitive knowledge, working skills, and the economic returns associated with them, to today's more comprehensive definition embracing a broader range of individual attributes and resulting benefits. The human capital concept defined by the OECD (2001) has come to be widely accepted.

However, implementing this comprehensive concept raises significant measurement challenges. The multi-faceted nature of human capital, the complex links between the various types of human capital investment, and the diverse benefits that it delivers make it impossible to find a one-size-fits-all measure of human capital. By necessity, the measurement of human capital must be undertaken step by step.

Currently, many countries use definitions of human capital that focus on the productive capacity of individuals. Even among the countries that refer to the broader OECD definition, most measurement initiatives focus on formal education and the economic returns for individuals, rather than to human capital in general and to all the benefits (economic and non-economic, private and collective) from

27 An excellent discussion on the possible explanations about the large divergence of the human capital estimates between the cost-based and the income-based approaches can be found in Abraham (2010).

human capital investment. Given the current state of knowledge, this seems to be a practical and reasonable point of departure.

Following from this narrower focus, measurement activities in this field have initially aimed to develop summary indicators providing simple proxies for human capital (e.g., average years of schooling, educational attainment). While the data requirements of such indicators are limited, so is the scope of these proxies. As a result, human capital measurement has gradually moved in the direction of quantifying the knowledge and cognitive skills of students and adults after they left school. In more recent years, the challenge of developing monetary measures of human capital in a systematic way has garnered increasing interest from independent researchers, national statistical offices, and international organizations.

All the approaches to measuring human capital reviewed in this chapter have both advantages and disadvantages. Depending on the purpose, different approaches may be applied individually or jointly to address different issues. However, the monetary measures generated from the cost-based and income-based approaches should arguably be designated a "core" status. One reason for the growing interest in monetary measures of human capital is that these measures can be compared with those for traditional produced capital covered by the SNA, the construction of which being a primary task of national statistical offices.

Even if limited in terms of the range of benefits considered, the policy implications of accounts with monetary measures for human capital are potentially great, as they imply that expenditures related to human capital formation should be considered as a form of investment rather than consumption, which is unfortunately not the case within the current framework of the SNA.

Based on country experiences and international initiatives in the field of human capital measurement, an international trend is emerging toward the income-based approach. Estimates based on this approach can be used to assess the relative contribution of a range of factors (demographic, education, and labor market) to the evolution of human capital, facilitating corresponding policy interventions.

Recent international experience also suggests the feasibility of producing this type of measures based on information already available within the national and international statistical systems (e.g., LIU 2011). However, the scope for improvements in terms of consistency and comparability of the underlying data, as well as the detailed methodological choices, remain significant.

Given the existence of large discrepancies between estimates based on the cost-based and the income-based approaches, it could be interesting to change perspective and consider the two approaches not as alternatives, but rather as complements of each other, viewed within a more comprehensive information system. Such a comprehensive system could be described by means of human capital (or educational) satellite accounts.

Constructing human capital satellite accounts linked to the SNA, rather than incorporating human capital measures directly into the core accounts of the SNA, is also justified by the following reasoning: human capital is presently out of the asset boundary, and extending the production and asset boundaries to incorporate it would fundamentally change the SNA (although steps in the direction of expanding the asset boundary have already been taken in recent years, for instance by treating research and development as a "produced asset").

The satellite accounts should be modeled along the lines proposed by e.g., Jorgenson and Fraumeni (1989). This would include direct links to the SNA through market labor services and output of the educational sector. At a later point, depending on the level of complexity, the choice of a more or less broad definition of human capital, and more or less exhaustive inclusion of the inputs and outputs associated to human capital investment, should be determined appropriately.[28]

Against this backdrop, the following recommendations can be made:

- Studies should be carried out to investigate in detail the discrepancies between estimates of human capital based on the cost-based and the income-based approaches, with the goal of better understanding, and eventually reconciling, such discrepancies.
- Initiatives should be undertaken to influence the type of data collected and harmonized internationally, so as to facilitate improving the quality of these monetary estimates of human capital for use in international and inter-temporal comparisons.
- Research should be encouraged to construct experimental satellite accounts for human capital as a mid-term goal, based on common methodologies and on agreement regarding the ambition of such accounts.
- Work should be pursued to estimate non-economic returns to human capital, with the objective of incorporating these estimates in more sophisticated types of satellite accounts in the long-term, and to incorporate human capital measures into the SNA in the future.

28 For more details on the rationale and feasibility of developing human capital satellite accounts with varying levels of complexity, please refer to e.g., Abraham and Mackie (2005) and Boarini et al. (2012).

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CHAPTER 4

Human capital: country estimates using alternative approaches

Barbara Fraumeni and Gang Liu

KEY MESSAGES

Human capital is critical to individual and societal well-being.

The educational attainment of a country's younger cohort is frequently higher than the educational attainment of the older cohort; high levels of youth educational attainment correlate to high potential for improved well-being and economic growth in the future.

Human capital indicators which depend solely on educational attainment information fail to capture the full potential of a country's population.

Human capital measures including information on present and future demographic trends, education, and wage or income components are essential for appropriate policy formulation and analysis.

1. Introduction[1]

The previous chapter outlines how human capital can be conceptualized, both generally, as well as with specific reference to the System of National Accounts (SNA), and introduces a taxonomy of how it might be measured. The chapter also reviews how national statistical agencies and other researchers have implemented different approaches to measuring human capital, and briefly discusses challenges related to such implementation.

This chapter presents country estimates of human capital based on comparisons of Barro-Lee educational attainment estimates and Jorgenson-Fraumeni (J-F) lifetime income estimates for 18 countries. In a previous chapter, inclusive wealth estimates for all categories of wealth are presented and discussed for a large number of countries. Inclusive Wealth methodology for human capital is described in this chapter.

As part of the 18-country comparison, which is the focus of this chapter, a gap analysis is undertaken using both Barro-Lee and J-F approaches. This gap analysis illustrates significant disparities between the younger cohorts (aged 25 to 34) and the older cohorts (aged 55 to 64). This chapter concludes by briefly discussing how human capital estimates can shed light on specific policy issues.

An analysis of country-level human capital measures shows that such measures are critical indicators, both of individual, as well as national-level potentials for growth and future well-being.

1 Many of the estimates in this chapter are from the work that was carried out when one of the authors (Gang Liu) led the human capital project at the OECD. Any remaining errors and omissions are the sole responsibility of the authors.

The authors gratefully acknowledge the research assistance of Abagail Kramer, who at the time was a graduate student in the Public Policy and Management masters program of the Muskie School of Public Service of the University of Southern Maine.

2. Barro–Lee, Inclusive Wealth, and Jorgenson–Fraumeni methodologies to measure human capital

Three methodologies are described in this section: The first, Barro-Lee, is an indicator-based measure, while the other two, Inclusive Wealth and Jorgenson-Fraumeni, are monetary measures.

2.1 Barro–Lee methodology

The most widely-used human capital proxy or indicator data set is that of Barro and Lee (2013a, 2013b). Average formal education attainment is reflected in this data set beginning at age 15, in five-year age increments, for the total population (for females, data is available for every five years from 1950 to 2010), for 146 countries. Population numbers are also available for each associated educational attainment estimate. Benchmark data is collected from census and/or survey information and compiled by UNESCO, Eurostat, national statistic agencies, and other sources.

Barro-Lee uses a variety of techniques to fill in gaps in observations and educational attainment subcategories, and to avoid mis-estimation of average years of schooling.

To fill in missing observations (as benchmarks are not available for all five-year periods) they begin by calculating the distribution of educational attainment among four broad categories: no formal education (*hu*), primary (*hp*), secondary (*hs*), and tertiary education (*hh*). Primary and tertiary are further divided into complete and incomplete; secondary is further divided into lower secondary and upper secondary.

Most missing observations are filled in with backward or forward extrapolation with an appropriate time lag. There are 12 5-year age groups (*ag*), from *ag*=1 (15-19) to *ag*=12 (70-74), plus one age group *ag*=13 (75 and over).

The forward extrapolation method assumes that the educational attainment distribution of an age group *ag* at time *t* is identical to that of the age distribution that was five years younger at time *t-5*.

EQUATION 1

$$hj(ag, t) = hj(ag-1, t-5)$$

for *j=u, p, s,* or *h* and *ag=3 (25-29)* through *ag=11 (65-69).*

As those younger than 25 are potentially still in school, a different methodology is employed.

Similarly, backward extrapolation assumes that the educational attainment distribution of an age group *ag* at time *t* is identical to the age distribution that was five years older at time *t+5*.

EQUATION 2

$$hj(ag, t) = hj(ag+1, t+5)$$

for *j=u, p, s,* or *h* and *ag=3 (25-29)* through *ag=11 (65-69).*

The net effect of this methodology is to hold an individual's educational attainment constant from age 25 through 64.

For older individuals, the probability of dying differs by educational attainment level. Accordingly, for the three oldest age groups: *ag*=11 (65-69), *ag*=12 (70-74), and *ag*=13 (75 and older), survival probabilities are estimated by educational attainment level. Highly educated individuals live, on average, longer than their less educated peers; this correction is necessary to ensure accurate estimations of average educational attainment for older age groups. For all younger age groups (*ag*=10 and below), it is assumed that survival rates do not differ by educational attainment.

The process for creating subcategories of educational attainment (complete and incomplete for primary and higher education; lower and upper for secondary school) depends upon the age level.

For primary school, Barro-Lee use country and age-specific completion ratio profiles to estimate the subcategories for *ag*=1 (15-19) and *ag*=2 (20-24). For *ag*=3 (25-29), the primary school completion rate is set equal to the ratio of the number of individuals who completed primary school, but did not enter secondary school, to the number of individuals who entered primary school. Backward and forward extrapolation and other methods are used to fill in any missing observations for *ag*=3 (25-29) and above.

When there are missing observations, secondary-school enrollees for *ag*=1 (15-19) are assumed to be incompletely educated at the secondary level, and higher-school enrollees for *ag*=2 (20-24) are assumed to be incompletely educated at the higher level.

Other estimation problems arise because some countries do not report the proportion of the population who have no formal education, but do report on the proportion of the educated population who have achieved primary, secondary, or tertiary level of education. Alternatively, the proportion of the population with no formal education, or has achieved at most some level of primary education, is often reported as a single number. Barro-Lee uses illiteracy rate, primary enrollment ratio, and/or data from other census years to resolve such inconsistencies.

Finally, estimations are made for average number of years of schooling for those aged 15 and above, and separately for each of the 13 age categories. For those aged 15 and above:

EQUATION 3

$$S(t) = \Sigma l(ag,t)s(ag,t)$$

where the summation is over all age groups, *l(ag,t)* is the population share of the group aged *ag* in the total population aged 15 and above, and *s(ag,t)* is the average number of years of schooling for age group *ag*.

The average number of years of schooling by age group *ag* is:

EQUATION 4

$$S(ag,t) = \Sigma hj(ag,t)Dur(j,ag,t)$$

where the summation is over educational levels *j* (*p, s* (incomplete, complete), *h* (incomplete, complete)), *hj(ag,t)* is the fraction of the group aged ag with the educational level *j*, and *Dur* is the duration of school attendance in years.

2.2 Inclusive wealth methodology[2]

The inclusive wealth (IW) human capital methodology follows that of Arrow, Dasgupta, et al. (2012a, 2012b, AD) and Klenow and Rodríguez-Clare (2005). In this report, country aggregates are determined for 140 countries. The country aggregates, separated by gender, which enter into the calculation are: average formal education attainment, average wage, total number of employed, total adult population, and average expected remaining working years.

The first step is to estimate human capital per capita. Following KLENOW AND RODRÍGUEZ-CLARE (2005), education is assumed to earn a market rate of interest, ρ, of 8.5 percent per annum. Human capital per person is:

EQUATION 5

$$h = e^{(Edu * \rho)}$$

where *Edu* is the average number of years of educational attainment in a formal setting (from Barro-Lee). As expected with an exponential function, human capital per person rises at an increasing rate with increases in the average number of years of educational attainment. Note that the human capital of a person with eight years of education is estimated to be almost twice that of a person with no education.

As all adults have human capital, even if they do not work, h is multiplied by the total number of adults in the country to determine total human capital. The number of adults in the country is defined as the number of individuals of age (*Edu*+5). As *Edu* varies by country, the age of someone who is considered to be an adult varies significantly by country.

IW assumes that the labor market is sufficiently competitive such that the marginal productivity of human capital can be assumed to be equal to the real wage rate, r. The shadow price for a unit of human capital is then calculated as the real wage rate, r, discounted over the expected number of working years remaining, T, for the average adult:

EQUATION 6

$$P_{HC} = \int_{t=0}^{T} r \, . \, e^{-\delta t} \, \mathrm{dt}$$

where δ, the discount rate, is set equal to 8.5 percent per annum as before. IW uses World Health Organization life tables and U.S. Census Bureau demographic data by country and gender to calculate the average expected remaining working years, T, across all individuals of working age. The real wage is computed as a country's average total wage bill divided by the total number of workers in the country, over the 1990 to 2010 time period. The expected number of working years remaining is estimated by contemporaneous (as opposed to expected future) age-gender participation and mortality rates. Labor market information, such as employment, wages, and labor force participation come from a variety of sources, including the International Labour Organization, the Conference Board, and the United Nations Statistics Division.

Country total human capital depends on the average educational attainment, real wage rate, and adult population. Total human capital is divided by the total population, regardless of age, to determine country level per capita human capital:

EQUATION 7

$$\frac{Human\ Capital}{Total\ Population} =$$

$$e^{Edu\ *\rho} \, . \, \frac{Population_{(5+Edu)}}{Total\ Population} \, . \int_{t=0}^{T} r . \, e^{-\delta \, . \, t} \, . \, \mathrm{dt}$$

The first term on the right-hand side of the equation is the human capital per capita expression from Equation 5; the third term on the right-hand side of the Equation is the shadow price for a unit of human capital expression from Equation 6. The age composition of the population, entering through the second term on the right-hand side of the equation, clearly impacts the above human capital ratio. Population estimates are from the Population Division of the United Nations Department of Social and Economic Affairs.

2 This section relies heavily on the appendix to Arrow et al. (2012b). Also see Arrow et al. (2012a).

2.3 Jorgenson–Fraumeni methodology

The J-F lifetime income approach applies the neoclassical theory of investment (Jorgenson 1967) to human capital. According to this theory, the price of capital goods depends upon the discounted value of all future capital services derived from the investments. On a per capita basis, this means that the value of the human capital of an individual can be determined from that person's discounted lifetime income.

The J-F methodology (1989, 1992a, 1992b) is modified, most notably by Liu (2011), to reduce estimation difficulty and time requirements; to deal with data availability constraints; and to reflect country-specific conditions. In addition, almost all country studies have estimated only market lifetime income because of the additional assumptions, time, and data needed to include nonmarket lifetime income as part of human capital.

The following sets of data for a J-F simplified approach (Fraumeni 2008) as implemented by Liu (2011) are required, except as noted for ages 15 through 64 and gender: 1) working age population; 2) survival rates; 3) school enrollment rates for ages 15 through 29 by single year, ages 30-34 and 35-39 by five year categories, and 40 and above; 3) educational attainment; and 4) annual earnings.

The simplified approach identifies three life stages.[3] The characteristics of these stages are dictated by typical life stages and data availability. In the equations that follow, the following notation is used:

mi: Expected lifetime market income per capita, discounted to the present
R: The adjustment factor applied to lifetime income
= (1 + real rate of growth on labor income)/ (1 + real discount rate)
sr: Survival rate
senr: Formal school enrollment rate and
ymi: Yearly market income per capita.

For subscripts:
a: Age
e: Highest level of education completed
enr: Formal education enrollment level
older: Equal to *a + 1*
s: Gender, and
school: Equal to *e +1*

The nominal market value life stage equations are as follows:

Stage 1: Work and school, ages 15 through 40 when an individual could be enrolled in school

For these ages, individuals can attend school and perform market work. It is assumed that dropouts do not later continue their education, that no grades are skipped or repeated, and that once enrolled, a student finishes that year of education. Market hours are valued at the average wage or income paid for the corresponding gender, age, and highest education level completed category. In stage 1, individuals earn income in the current year, and if they survive for another year, can earn the lifetime income of someone who is a year older than the individual's current age. The individual's future lifetime income is dependent upon whether they are enrolled in school or not. Finally, as is true for both stage 1 and 2, the income sum is adjusted by *R*, the factor reflecting a future real rate of growth in labor income and discounts the income sum back to the present.

EQUATION 8

$$mi(s,a,e)=ymi(s,a,e)+[senr(s,a,enr)*sr(s,older)*mi(s,older,school)+(1-senr(s,a,enr))*sr(s,older)*mi(s,older,e)]*R$$

Stage 2: Work only, ages 41 through 64 when it is assumed that an individual is not enrolled in school

For these ages, it is assumed that no one is enrolled in school, as insufficient data existed

3 Jorgenson–Fraumeni estimated nonmarket lifetime income for two more stages to include those too young to be doing market work. Their first stage (ages 0 through 4) is a no market work, no school stage. Their second stage (ages 5 through 15) is a no market work, school stage.

on students above the age of 40. Human capital therefore depends only on a person's expected future market income and whether the individual survives for another year.

EQUATION 9

$$mi(s,a,e)=ymi(s,a,e)+sr(s,older)*mi(s,older,e)*R$$

Stage 3: Retirement, age 65 and over

When only market lifetime income is counted in a J-F computation, the human capital of retired persons is zero. Because of data constraints, it is assumed that everyone aged 65 or older is retired.

EQUATION 10

$$mi(s,a,e)=0.$$

Calculations are done in a backwards recursive manner, starting from the oldest age group and continuing to the youngest age group. For example, for a particular year – say, 2000 – the computations start by setting the lifetime income of someone who is 65 equal to zero. If lifetime incomes are being computed by single year of age, the next calculation would be for a 64-year-old: Because the lifetime income of a 65-year-old is zero, the 64-year-old's lifetime income is equal to the income that person earns in 2000. All but the first term in Equation 9 drop out.

For someone who is 63 in 2000, there are two possible components to their lifetime income: income earned in the current year and, if they survive for another year, lifetime income of someone who is 64 in 2000. The 63-year-old's future lifetime income is adjusted for a one-year change in the real wage rate and discounted for the one year before the 63-year-old in 2001 receives the thusly adjusted income of a 64-year-old in 2000.

The sequence continues backwards, with each step reducing the age of the person for which the computation is made by one year. The future lifetime income of a 63-year-old, should they live until age 64, has already been adjusted for a one-year change in the real wage rate and discounted. Accordingly, for a 62-year-old, there is only a one-year real wage rate and discounting adjustment appearing in the equation.

It is assumed that the relative wage rates by educational attainment levels are determined by contemporaneous relative wage rates, survival rates, and enrollment rates. For example, the information regarding the probability that someone who is 20 in 2000 will enroll in school and survive until he is 21 in 2001, as well as the wage the person will earn in 2001 compared to someone who does not continue in school in 2000, is predicted by the information about someone of the same gender who is 21 in 2000, perhaps with one more year of school completed in 2000.[4]

Total nominal human capital is constructed by multiplying each stage's market income per capita by the population of the corresponding ages, which is then summed to determine total human capital across ages 15 to 64. For all stages except for stage 1, which involves possible school enrollment, a total stage population suffices. For stage 1, population by single year of age or by five-year categories for some ages is required.

Two different types of volume indices are constructed. Divisia (Tornqvist) temporal volume indices are constructed with a weighted growth rate to compare stocks of human capital over time. The weights are nominal human capital and the growth rates are population growth rates for the corresponding age/educational category. Spatial indices are derived by dividing nominal human capital by purchasing power parities (PPPs) to compare human capital in real terms between different countries at one point in time.[5]

3. Barro–Lee, IW, and J–F comparisons

There are several similar data constructs in each of the three approaches outlined in this chapter. Barro-Lee, IW, and J-F all contain information by

4 Because of the rapidly changing school enrollment rates in China, the probability that a Chinese student will enroll in school when they are one year older was allowed to increase. See, for example, Li (2012).

5 Liu (2011).

gender on population, educational attainment, and survival. However, the amount of detail and/or the level of aggregation differs.

For population, IW ultimately needs the least amount of detail as it uses only total population and adult population in its final equation (Equation 7). Barro-Lee publishes population by the five-year age categories it covers. J-F requires the most detailed population numbers for the first (school enrollment) stage, but its other categories require less population detail than Barro-Lee with a Liu (2011) simplified approach.[6] All three approaches also employ other population information to derive their final results.

Barro-Lee educational attainment data by five-year age groups is an input to the IW estimates. J-F educational attainment is interpolated between five-year age groups by Liu to obtain educational attainment by single year of age. Only J-F includes expected future education as an input to its calculations. All three approaches used similar data sources to determine survival rates.

IW does not need school enrollment figures to produce estimates of human capital. Barro-Lee use enrollment data to solve a number of missing data problems. J-F use enrollment data directly in its stage 1 work and school calculations. IW and J-F are distinctly different from Barro-Lee in that both require wage or income data.

The analytical power of IW and J-F as compared to Barro-Lee arguably comes from their inclusion of current and future expected income, as well as – in J-F – future expected education.[7] Both IW and J-F capture current income and future expected income based upon current age-gender labor participation, mortality rates, and wages or income. That J-F allows for future education, notably for younger individuals, is an important distinguishing feature compared to the other two approaches. Clearly, future investments in human capital through education, as well as the contribution of individuals to the economy through income generation, are relevant.

The next four figures illustrate comparisons between J-F and Barro-Lee for working age populations in 18 countries, to illustrate how different human capital perspectives can be depending upon what measure one uses. The comparisons are shown with J-F instead of IW because, in general, J-F will show larger variance with Barro-Lee than does IW, as J-F allows for future education. In addition, IW results are discussed in detail in another chapter.

First, in order to have a clear picture of the J-F ranking of countries, Figure 1 presents 2006 J-F human capital per capita estimates in thousands of nominal US dollars.[8] Per capita income, adjusted by a private consumption PPP (World Bank 2014), shows a wide variation: from US$71,000 for China to US$641,000 for the United States.[9] [10] Table 1 sorts the countries into broad lifetime income per capita categories.

Figure 2 shows that there is frequently little ranking correspondence between the average Barro-Lee educational attainment of a country

6 The original Jorgenson-Fraumeni estimates (1989, 1992a, 1992b) were done by single year of age through age 74, by single year of educational attainment, and enrollment through undergraduate college. The simplified approach is described in Fraumeni (2008) and implemented with modifications in Liu (2011).

7 Others may use Barro-Lee to derive estimates of income and future educational attainment, but Barro-Lee do not present such estimates in their database.

8 The J-F estimates are for all countries in 2006 except for Australia: 2001 and Denmark: 2002. As this is a spatial index, all countries' figures are adjusted by private consumption purchasing power parity from the World Bank (2014). Estimates for China are from Li (2012). Estimates for India are from Gundimeda et al. (2007). Estimates for all other countries are from the OECD Human Capital Project. The results for all project countries except for Japan are described in Liu (2011).

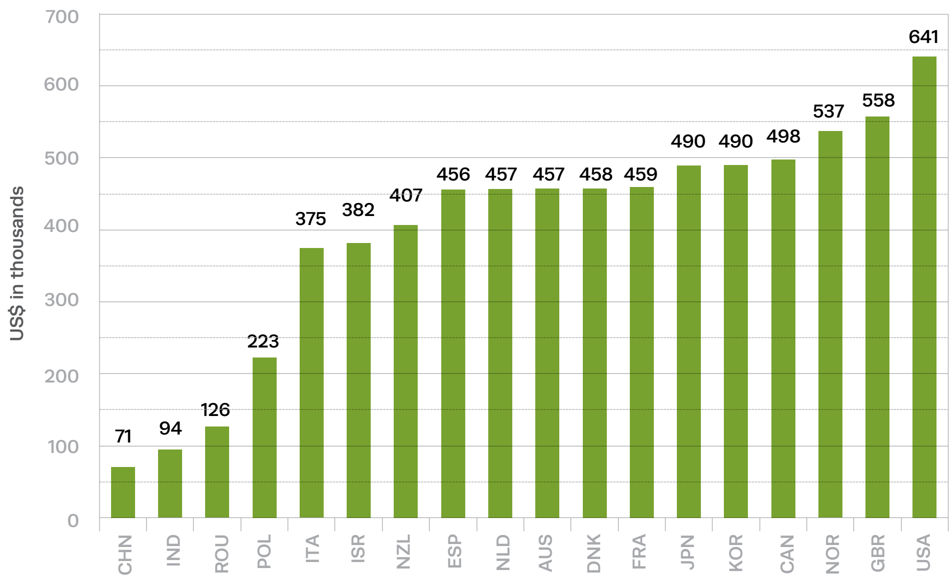
9 Returns to human capital depend on a number of factors not discussed in this chapter, such as the availability and use of nonhuman capital.

10 An alternative approach to adjusting country estimates by PPPs is to show comparisons based upon national currencies. Neither approach is perfect. As PPPs attempt to compare currencies based upon a representative market basket of goods, they are preferred. Results based on national currencies will show wide variations and differences, as do the PPP adjusted results.

FIGURE 1

International comparison of J–F human capital per capita, individuals aged 15 to 64, 2006

Abbreviations: CHN (China), IND (India), ROU (Romania), POL (Poland), ITA (Italy), ISR (Israel), NZL (New Zealand), ESP (Spain), NLD (the Netherlands, AUS (Australia), DNK (Denmark), FRA (France), JPN (Japan), KOR (South Korea), CAN (Canada), NOR (Norway, GBR (Great Britain), USA (United States).



and its nominal J-F human capital per capita. In addition, it shows that there is significantly more variation in human capital per capita than in average educational attainment.[11]

Reasons for this include differential returns to education and the age by education distribution of the working age population. The biggest pictorial "gap" between average educational attainments is for the countries in the low per capita lifetime income category. There are substantial gaps for other countries as well, e.g., for Israel and New Zealand, both of which are in the lower middle per capita income category. Great Britain is ranked second highest among the 18 countries in J-F human capital per capita, yet has the third-lowest average educational attainment. J-F databases provide a rich starting point basis to explore the reasons for these ranking and variation differences, as they include demographic information, as well as information on current income and expected future income.

Such an exploration is best augmented by an analysis of differences in a country's labor markets. It does not suffice to note simply that returns to education vary widely, or to know from J-F how relative wages differ across individuals with different levels of educational attainment or of different ages. A comparison of Barro-Lee and J-F results begs a host of interesting questions, the answers to which are critical for developing appropriate policy interventions. The comments that follow are speculative, and intended only to provide suggestions for further study.

Changes in educational attainment over time might provide a clue as to why aggregate measures of human capital differ. The next two figures illustrate changes in educational attainment between the younger working age population, who have most likely finished their

11 The United States is the ideal reference point for this graph as it has both the highest per capita income and the highest average educational attainment.

TABLE 1

Ranking of countries by J–F per capita lifetime income

Low	China, India, Poland, and Romania
Lower middle	Israel, Italy, and New Zealand
Upper middle	Australia, Denmark, France, the Netherlands, and Spain
Lower high	Canada, Japan, and South Korea
Upper high	Great Britain, Norway, and the United States

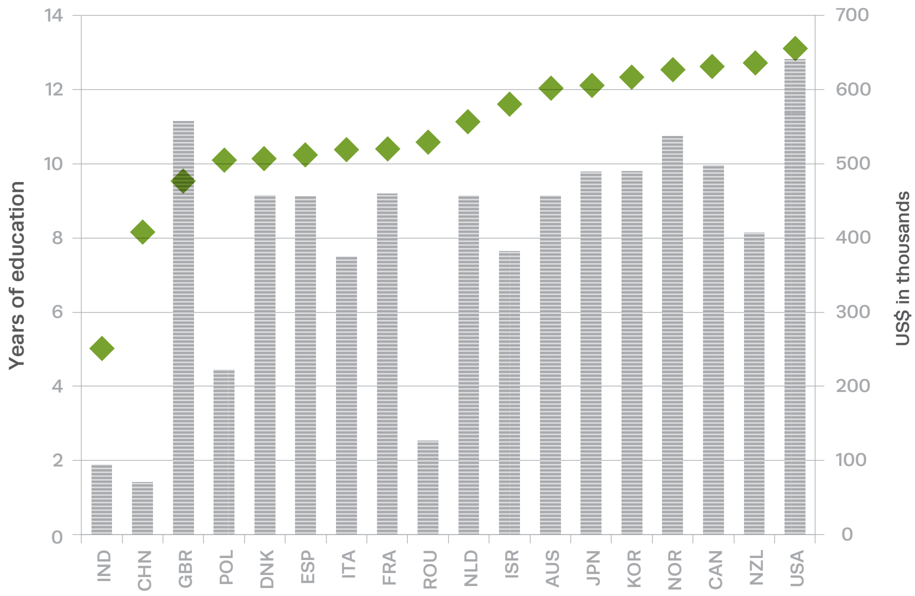


FIGURE 2

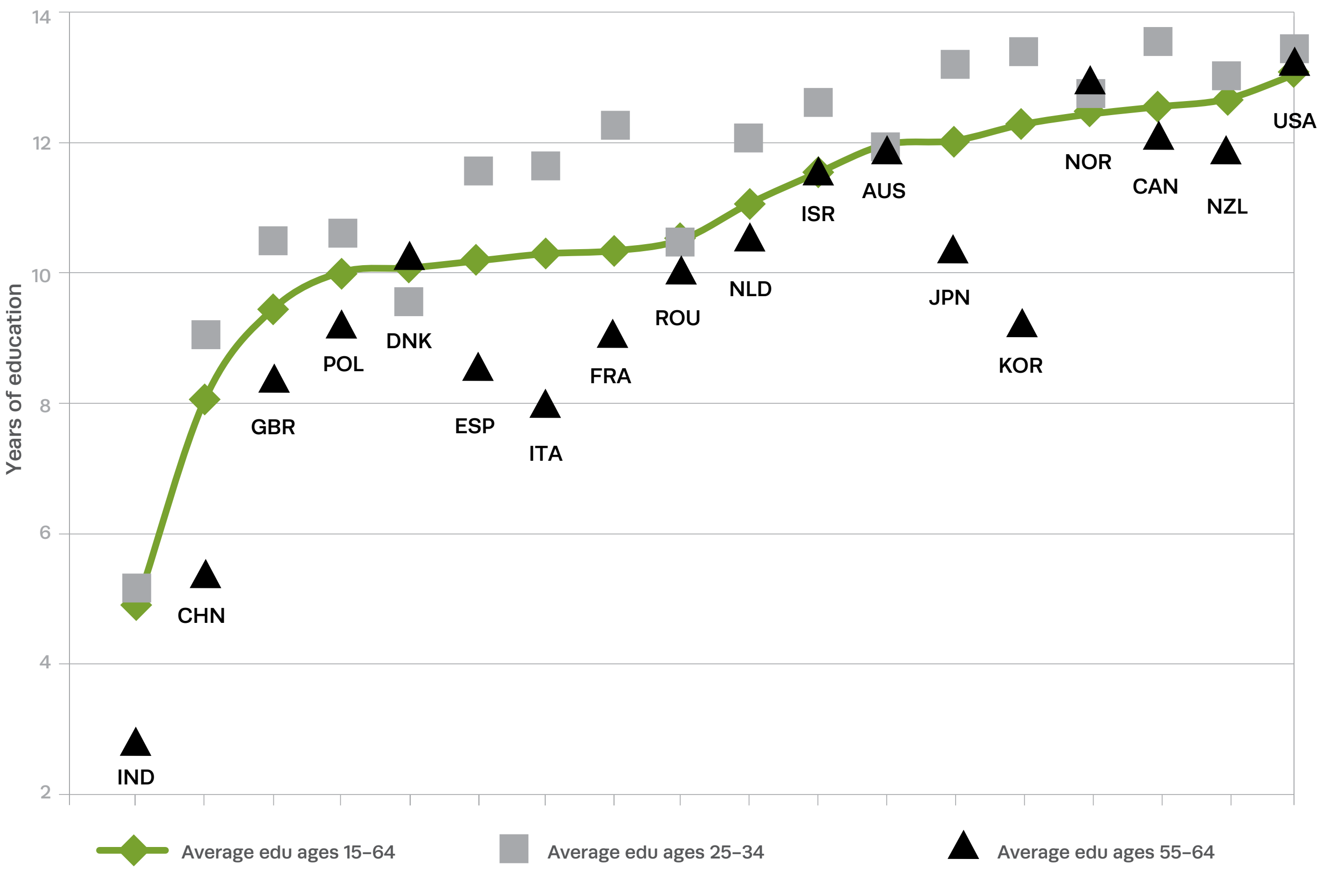
Average years of education 2005 compared with human capital per capita 2006, individuals aged 15 to 64

Key

- Human capital per capita (US$ in thousands)
- Years of education

FIGURE 3

Comparison of education attainment, 2005. Between ages 25–34 and 55–64, with ages 15–64 average comparison



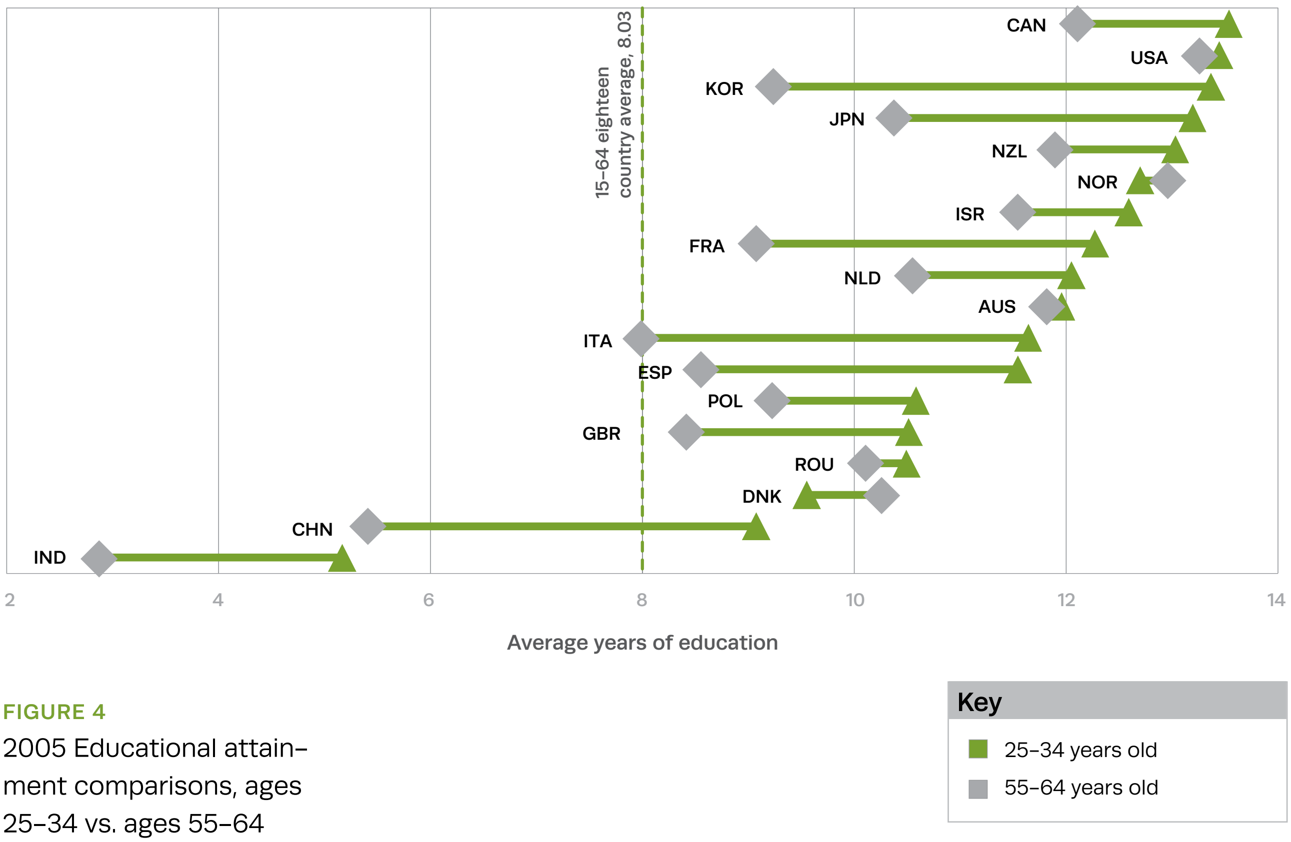


FIGURE 4
2005 Educational attainment comparisons, ages 25–34 vs. ages 55–64

education – those aged 25-34 – and the older working aged population – those aged 55-64.

Figure 3 plots the average educational attainment for the whole working aged population – those aged 15-64 (shown with a line) – versus the younger group (shown with diamonds), and the older group (shown with squares). It is not surprising that for all but two countries the younger group on average has a higher level of educational attainment than the older group. The two exceptions are Denmark and Norway. However, the average educational attainment of the younger and older group is almost identical for a number of countries: Australia, Norway, Romania, and the United States. The higher educational attainment of the younger group is expected to result in their higher future income. This is explicitly recognized in J-F, but only implicitly recognized in Barro-Lee.

Figure 4 illustrates the younger-older gap story in a way that makes it easier to see the size of the gaps. The 18-country average is weighted by population average; clearly the lower educational attainment of the two most populous countries in the world skews the average towards the lower end. As these estimates are for 2005, they should be little if at all impacted by the onset of the recession and the financial crisis.

One is tempted to conclude that the gap is small for countries for which there is little differential return to education – perhaps due to taxation. But this does not seem to be consistently borne out by Figure 4. It is well known that incomes, even by education categories, differ relatively little in Denmark and Norway. In the United States, by contrast, there are very substantial returns to higher education, yet the educational attainment gap is very small. Between the younger and older groups, there are very large differences in educational attainment in emerging China and South Korea; there are also very large differences in educational attainment in developed France, Italy, and Spain.

The final table and figure combine the information on the younger versus older educational attainment graph and the J-F human capital per capita. Table 2 shows the results in a cross-tabulation format; Figure 5 shows the results in a quadrant format. In Figure 5, the country markers are colored according to the quadrant in which they appear. The intersection of the gap axis and the human capital per capita axis occurs at a 1.25 years gap in educational attainment between the younger and the older individuals and a US$435,000 lifetime income per capita. In both cases, these values are approximately at the mid-point of their categories.

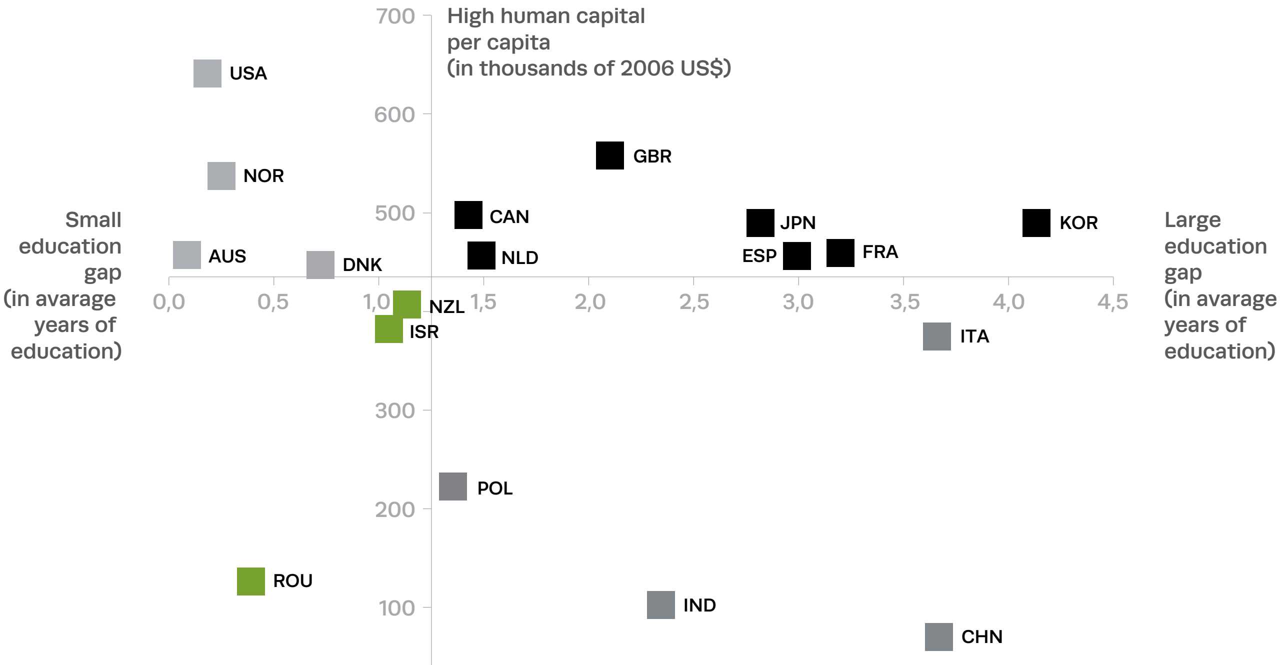


FIGURE 5

Cross tabulations of younger vs. older educational attainment, 2005 and human capital per capita, 2006

		Level of human capital per capita		
		Low	**Medium**	**High**
Size of education attainment gap	**Small**	ROU	AUS DNK	NOR USA
	Medium	POL	NLD ISR NZL	CAN
	Large	CHN IND	ESP FRA ITA	KOR JPN GBR

TABLE 2

Cross tabulations of younger vs. older educational attainment and human capital per capita

The two former Soviet Union countries (Poland and Romania) are in the small gap and low per capita human capital category. This may reflect the relative scarcity of economic institutions and their weakness in actual and expected returns to higher education. By contrast, the emerging country power-houses China and India are in the low per capita income per capita category, but are in the medium or high gap categories. Expectations about continuing future growth with an increasing reward to education may explain the differences between China and India on the one side and Poland and Romania on the other.

As previously noted, it is difficult to easily explain why France, Italy, and Spain have large gaps without the detailed income wage and income information in J-F accounts and an understanding of country-specific labor market conditions, but it is fairly simple to postulate why China and South Korea are in the large gap category.

The high per capita income countries are all highly developed countries, with the exception of South Korea. Between the table and the figure, it is fairly easy to get a sense of the cross-categorizations of the 18 countries, but they alone cannot answer why countries appear in certain cross-categories without additional information.

There is a significant clustering of countries around the gap axis in Figure 5. In the lower two quadrants, it is easy to see that China, India, Poland, and Romania are outliers, as their J-F income per capita is at least US$150,000 below that of other countries. In the upper two quadrants, Great Britain, Norway, and the United States could also be classified as outliers, but this is less clear, even though their J-F income per capita is at a least about US$40,000 higher than that of other countries.

BOX 1

Policy implications of human capital wealth analyses

Human capital wealth measures that combine demographic, education, and wage or income information provide a rich basis for policy analysis. Both the J–F and IW human capital measures include these three elements.

For instance, China is considering revising both its well known one-child, as well as retirement, policies. In fact, the Communist Party's Central Committee has already begun modifying the former (XINHUANET 2013). There is concern about the demographic pressures associated with a relatively small younger cohort together with a rapidly aging population, particularly in a country with a long tradition of the young supporting their elders.

At the 5th International Symposium on Human Capital and the Labor Market in December 2013 in Beijing, a discussion of both of these policies was central to presentations by two of the keynote speakers: Jiang Zhenghua and Li Haizheng. Mr. Jiang, who served as Vice-Chair of the Standing Committee of the 9th and 10th National People's Congress, is coordinating a large research project to consider changes in both policies. Although he referred to changes in the definition of elderly, rather than to changes in the retirement age, the connection between a change to the definition of elderly and a possible change in the retirement age is easy to make.[12]

12 In China, the normal mandated retirement age for a female is 55; for a male it is 60.

A recent article in China Daily USA (HE 2014) noted than an increase in the retirement age would substantially decrease social security deficits. In the same article, a World Bank expert concluded that raising the retirement age could be justified given China's life expectancy has now risen to 73 years. Dr. Li, in his presentation at the symposium, looked at the implication of a change in the retirement age with a J-F human capital measure (LI 2013). Raising the retirement age would do nothing to the average educational attainment of those beyond school years, but it would significantly change the human capital measures for China, as individuals could be earning substantial income beyond the current retirement age.[13]

As the younger cohorts in China (and elsewhere) are very likely to be more highly educated than the older cohorts (see Figure 4), demographic changes can be very important to the future well-being of any country. Policies which affect on birth rates, retirement age, access to education, and health care all will be reflected in the J-F and AD human capital wealth measures through their income measures.

Other policies of relevance to human capital wealth are those impacting internal and external migration and emigration. Migration and emigration affect both the size and geographical distribution of the population, which in turn affect wages and total income. Policies which restrict or facilitate mobility accordingly are reflected in J-F and AD measures of human capital.

Examples of immigration restriction include the policies of the United States and, more recently, those of Switzerland; an example of immigration facilitation would be the European Union policies allowing migration between member countries.

The immigration reform debate in the United States is complex, but many analysts point to the importance of allowing more highly-skilled individuals, particularly so-called STEM (Science, Technology, Engineering, and Mathematics) workers, and those foreigners with advanced degrees, to immigrate to the United States (TECH AMERICA undated). It is recognized that selected immigration can significantly increase the human capital of a country and stimulate economic growth.

A recent news article notes that the percentage of international students in the U.S. who are majoring in a STEM field in college has risen (BIDWELL 2014). At the same time, according to Rachel Banks, director of public policy at NAFSA, Association of International Educators, the percentage of all college students who are international students has not risen over the past ten years. In her opinion, this is because some countries, such as the United Kingdom, Australia, and New Zealand have more lenient immigration policies. If true, this shift in the geographic distribution of international students foretells possible improvements in the human capital position of these countries, and a possible decline in the human capital position of the United States. As the income return to higher education in the U.S. is clearly much greater than the return to a high school education, the impacts on Barro-Lee average educational attainment would be less than the impact on a J-F human capital measure.

These two examples are only illustrative; there are many other policies which can be analyzed using a robust set of human capital wealth accounts.

13 Currently individuals past retirement age in China may simply be switching jobs, although to a lower paying or more part-time position.

4. Conclusion

Human capital accounts can inform decision-makers and could be an important complement to national income accounts. These accounts, if fully explored, could facilitate improved understanding of both current and future economic growth, and help shape specific policies, such as those targeting the optimal mix of investments in human and nonhuman capital. Also, there are ample opportunities for future research to attempt to explain why countries significantly differ in their human capital.

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CHAPTER 5

Health capital

Kenneth Arrow, Partha Dasgupta, and Kevin Mumford

KEY MESSAGES

Health is an essential characteristic of human well-being.

Health capital is an important part of inclusive wealth.

The economic model of health capital presented in this chapter allows health to affect human well-being through three distinct channels: direct well-being, productivity, and longevity.

Most health capital services influence human well-being directly rather than through the production of goods and services that are counted in GDP.

In the absence of better estimates of the direct and productivity effects, gains in life expectancy should be used as the primary measure of health capital.

Annual gains in health capital in the U.S. are worth approximately US$10,000 per person.

1. Introduction

Attempting to measure human well-being without considering health would be a great oversight. Health is central to our happiness. Health affects our enjoyment of life, our productivity in employment, and our risk of death. Our desire for good health influences our decisions regarding eating, sleeping, exercising, and our demand for medical services. As shown in Table 1, total spending on medical care from both public and private source makes up an important and generally increasing share of national income in many countries.

The improvement in life expectancy at birth has been quite dramatic in most countries over the past 60 years (see Figure 1). Several studies, including Nordhaus (2005), Becker et al. (2005), Murphy and Topel (2006), and Jones and Klenow (2011), have shown that recent gains in life expectancy have been at least as important to human welfare as gains in income. The Inclusive Wealth Report 2012 treated health as a form of wealth by estimating the value of the improvement in life expectancy over a nineteen-year period. However, health capital was treated separately from other forms of capital because it was found that even modest gains in life expectancy outweighed other gains. Though understandable, this is not a theoretically-sound reason to exclude health capital from an inclusive measure of national wealth.

TABLE 1

Total health expenditure (percentage of GDP)

Country	1995	2000	2005	2010
Brazil	6.7	7.2	8.2	9.0
China	3.5	4.6	4.7	5.0
Germany	10.1	10.4	10.8	11.5
India	4.0	4.3	4.2	3.7
United States	13.6	13.6	15.8	17.7

Source: The World Bank (2013), World Development Indicators

2. Health as a capital asset

Health is a multidimensional concept. There is no single standard way to measure the health of an individual or a population group. A physician may examine a patient and measure health along several dimensions including mental health, severity of illnesses, nutrition, body mass index (BMI), risk of disease, and level of pain or discomfort. An individual may track exercise and eating behavior or rate his or her own subjective health along a scale of overall fitness. For a population group, a researcher may use life expectancy, infant mortality rate, availability of healthcare services, or prevalence of preventable diseases as indicators of the health of the group. Our term, health capital, refers to a satisfactory measure of the overall health of an individual or a population. It may be a single all-encompassing measure or perhaps a weighted combination of the health measures described above.

The question of whether it is appropriate to treat health as a capital asset it important. Doubts about treating health as a form of capital arise when one compares health to other forms of capital and notes the obvious differences. Economists generally describe capital as an input into a production function. We think of manufactured capital assets such as machines, equipment, buildings, roads, and ports that are used in the production of goods and services. Manufactured capital assets have value that is equivalent to their future marginal productivity. The productive services can be rented or the capital asset itself can be sold to another individual without destroying its value. Unlike inputs that are consumed as part of the production process, manufactured capital can be employed in the production process multiple times. Manufactured capital may depreciate over time, but it is not consumed in the production of goods and services. To summarize, economists generally think of a manufactured capital asset as (1) a durable object that could be sold to someone else, (2) an input in the production of goods and services, and (3) a store of value to achieve consumption.

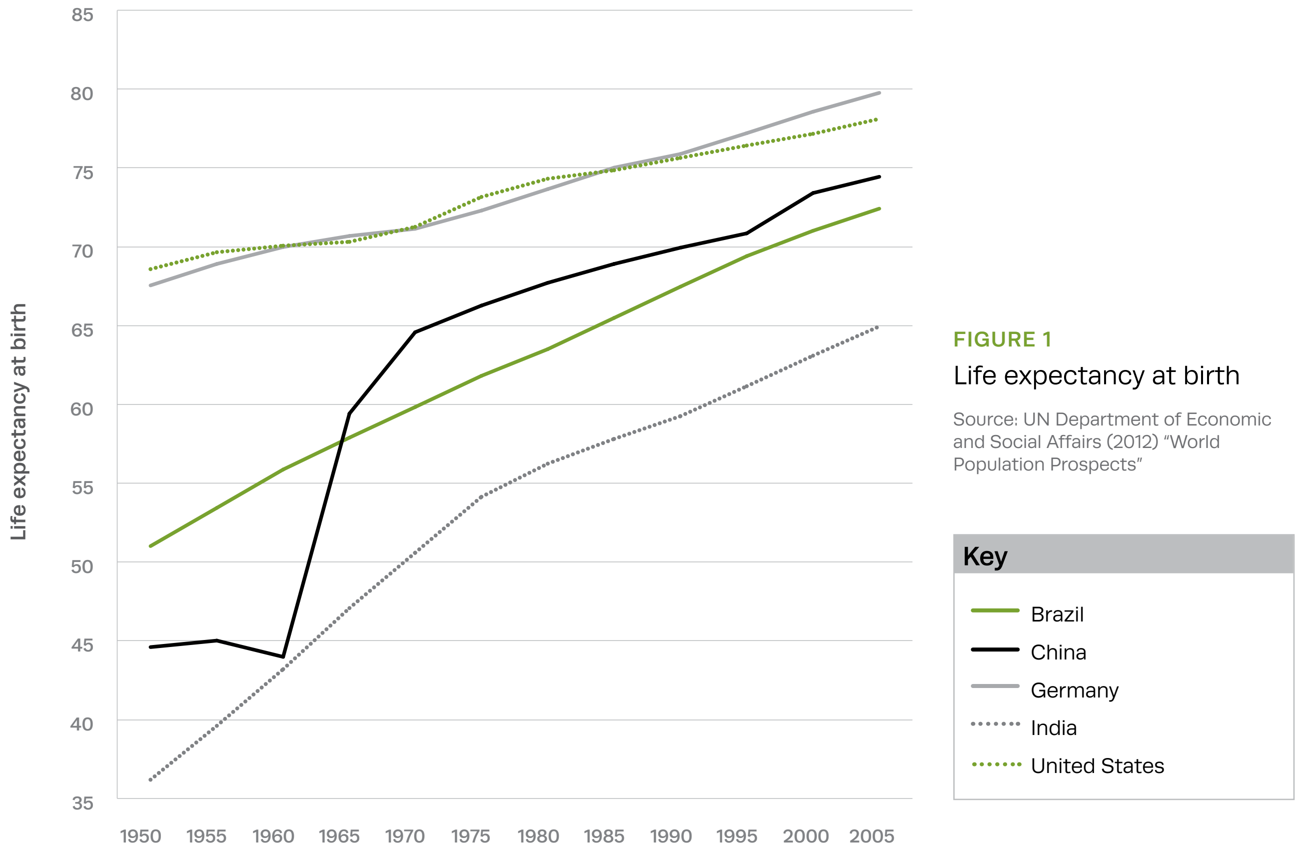


FIGURE 1

Life expectancy at birth

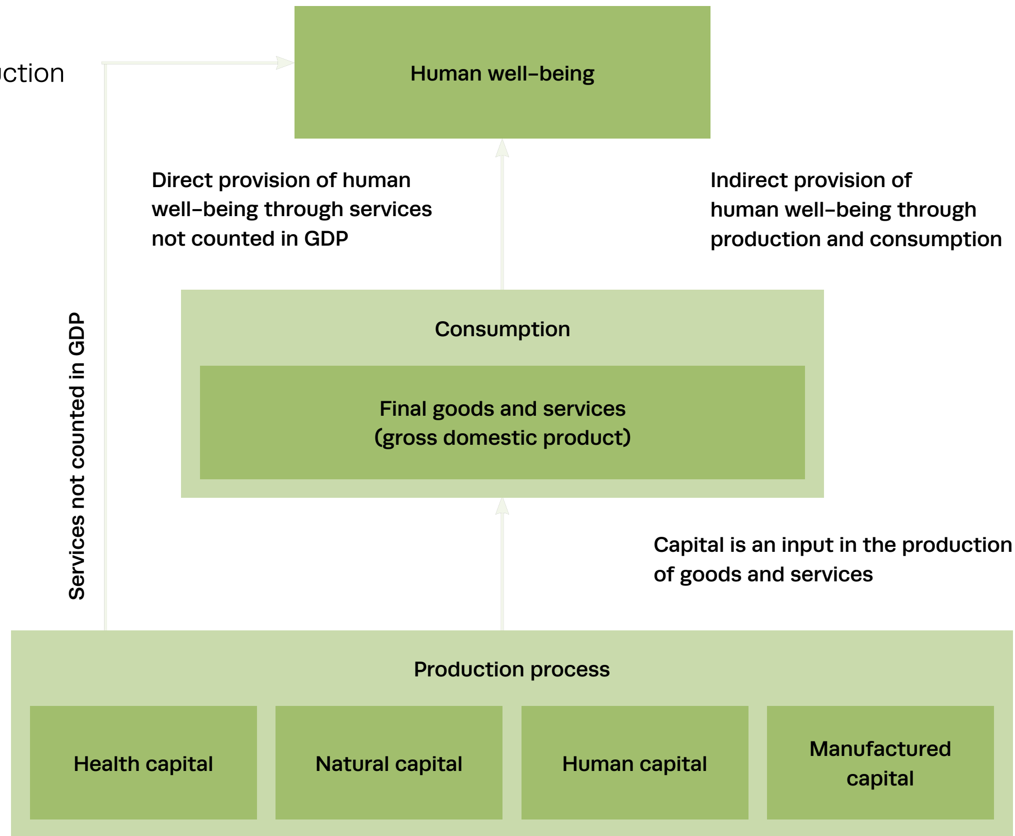
Source: UN Department of Economic and Social Affairs (2012) "World Population Prospects"

Like manufactured capital, health is durable. A person's health is relatively constant over time. Health depreciates, but it is not consumed as it provides current well-being. At times, health may depreciate rapidly due to some illness, similar to the risk of some catastrophe reducing the value of a manufactured capital asset. Unlike a manufactured capital asset, health capital cannot be directly purchased from a health-rich person. One cannot rent the well-being services that flow from health nor can one sell health to another individual. However, the ability to transfer a capital asset to another individual does not seem to be an essential characteristic of capital. The knowledge, skills, and abilities that make up what is commonly called "human capital" cannot be directly transferred from one person to another and this does not cause economists to question if human capital can be considered a capital asset.

Health is not commonly thought of as an input in the production of final goods and services. The evidence suggests that improvements in health do lead to productivity gains, particularly in low-income countries (Bhargava et al. 2001). The estimates suggest that large increases in health cause only small increases in GDP growth rates and there is little evidence for productivity gains from health in developed countries. However, health does provide health services – greater enjoyment of current consumption and longer life – directly to the individual. That these health services are not part of measured gross domestic product does not mean that they have no value. To the contrary, health is of great value to humans and is an essential characteristic of well-being. Our view is that health capital is similar to consumer durables (e.g., houses, consumer electronics, furniture, home appliances, and sports equipment) that provide well-being to consumers, but are

FIGURE 2

Use of capital in production



not generally direct inputs in the production of a final good or service that is counted as part of gross domestic product.

Figure 2 illustrates the point that capital assets can both directly and indirectly (through the production process) affect human well-being. Machines and business equipment primarily increase human well-being through the production process. Forests have both a direct influence on human well-being through ecological and recreational services as well as an indirect influence through the consumption of final goods for which timber is an input. Similarly, health capital has a direct influence on human well-being as well as an indirect affect through increased productivity. That health increases human well-being primarily through a direct channel rather than through the indirect production/consumption channel does not raise any concerns about its treatment as a capital asset.

To summarize, health is (1) durable and non-transferable, (2) both an input in the production of goods and services and the source of a flow of services which increase human well-being, and (3) a store of value to achieve the consumption of health services. Services from capital assets, which are not counted as part of GDP, including health services, have value. Therefore, the value of the capital asset itself is equal to the present discounted value of the future services. From the point of view of an economist, health is a form of capital. This chapter seeks to measure the stock of health capital, estimate its value, and measure the value of the change in health capital for several countries over a period of five years.

3. The value of health capital

We begin with a stylized model to illustrate the role of health capital in providing human well-being. We propose a rather simple two-period model as it is sufficient for providing general intuition about how to measure and value health capital. The model is an expanded version of the Arrow et al. (2013) model. We assume that the economic agent is alive in period 1 with certainty, but there is uncertainty about being alive in period 2. The agent's expected lifetime utility is given by

EQUATION 1

$$\text{Expected Lifetime Utility} = U(H, c_1) + \pi(H)\, U(H, c_2)$$

where H is health capital, c_1 is consumption in period 1, c_2 is consumption in period 2, and $\pi(H)$ is the probability of survival to the second period. We assume that the probability of survival depends on the amount of health capital where more health increases the probability of being alive in period 2, though diminishing returns imply that each additional unit of health capital has less of a positive effect on the probability of survival. The current utility (felicity) depends both on the level of health capital and the amount of consumption. There are diminishing marginal returns to both health capital and consumption. The utility function is the same in both periods and for simplicity we assume that the agent does not discount the future, though this could easily be relaxed.

The agent is endowed with financial wealth given by $W(H)$. We assume that an increase in health causes an increase in the agent's wealth. The mechanism we have in mind is that a healthier agent is more productive and earns higher wages. Alternatively, we could assume that a healthier agent is able to work more hours and thus has a higher income. However, to keep the model focused on health, we abstract from the labor-leisure decision and simply assume that the agent is directly endowed with wealth. Making wealth a function of health capital embeds the productive impacts of health in a straight-forward way. By assumption, there are diminishing returns to additional health capital. The increase in the agent's wealth caused by an additional unit of health capital is much smaller for a healthy agent than for a malnourished one.

The agent's lifetime budget constraint is given by

EQUATION 2

$$c_1 + pc_2 + h \le W(H)$$

where wealth can be spent on either consumption in period 1, consumption in period 2, or investing in health. In our notation, an investment in health is given by h and we assume that health capital, H, is increasing in h. We have normalized the price of consumption in period 1 to one. Survival to period 2 is uncertain, so the agent can purchase a contract granting consumption in period 2 at price p which is less than one. If the probability of survival is very low, the contingent price for consumption in period 2 would also be low. We will assume that the agent can purchase period 2 consumption at the actuarially-fair price of $p = \pi$.

We should consider the difference between an investment in health, h, and consumption, c. Purchasing a pain reliever, like Aspirin, should be treated as consumption. A short-term pain reliever provides a health service, but it has no effect on health capital, H, because the effect is temporary. The resulting reduction in pain increases current well-being, but the effect does not carry over into other periods. In this model, the primary characteristic of an investment in health is that it increases the stock of health capital. Therefore, many healthcare services and medicines would be categorized as consumption rather than health investment. A true investment in health would increase future health services.

The agent wants to maximize expected utility given by Equation (1) subject to the budget constraint given by Equation (2). With no discounting, the agent will choose to perfectly smooth consumption by selecting $c_1 = c_2$. Thus we can rewrite Equation (1) as

EQUATION 3

$$\text{Expected Lifetime Utility} = U(H(h), c) + \pi(H(h))\, U(H(h), c)$$

where consumption, $c = c_1 = c_2$, is the same in both periods and health capital, *H(h)*, is written as a function of health investment *h*. The first order condition with respect to health investment is given by:

EQUATION 4

$$\underbrace{(1+\pi)\frac{\partial U(H,c)}{\partial H}\frac{\partial H}{\partial h}}_{\text{Direct Wellbeing}} + \underbrace{\frac{\partial U(H,c)}{\partial c}\frac{\partial W}{\partial H}\frac{\partial H}{\partial h}}_{\text{Productivity}} + \underbrace{U(H,c)\frac{\partial \pi}{\partial H}\frac{\partial H}{\partial h}}_{\text{Longevity}} = \frac{\partial U(H,c)}{\partial c}$$

Equation (4) illustrates the trade-off between using wealth for consumption or health. The additional utility from an increase in consumption is given by the right-hand side of Equation (4). The expected-utility-maximizing agent invests in additional health up to the point where, at the margin, the value of additional health is equal to the marginal value of consumption. The value of additional health has three components: well-being, productivity, and longevity as given by the three terms on the left-hand side of Equation (4). We will examine each of these three components in greater detail.

3.1 Direct well-being

The first term on the left-hand side of Equation (4) is the direct utility from additional health capital. Consider a health investment that offers no increase in productivity and no increase in longevity. For example, a surgical procedure that offers long-lasting pain reduction, but does not improve the agent's ability to work nor does it offer any reduction in the risk of mortality. This hypothetical surgery's only effect is to permanently reduce the agent's chronic pain. The reduction in pain directly makes the agent better off and may also increase the agent's enjoyment of consumption. Because the pain reduction is long-lasting, the surgery is an investment which increases health capital. Given our assumption that the surgery has no impact on the agent's productivity or longevity, the entire marginal benefit of this investment in health is captured by the direct improvement in well-being given by the first term of Equation (4):

EQUATION 5

$$(1+\pi)\frac{\partial U(H,c)}{\partial H}\frac{\partial H}{\partial h}$$

The term $(1 + \pi)$ above represents the lasting impact of the investment in health as the increase in utility occurs in both period 1 and period 2. Surviving to period 2 is uncertain, so the increase in expected utility reflects that the agent will only be alive for period 2 with probability π. The rest of this expression is the additional utility or current well-being that the agent enjoys because the level of health capital is higher. It is of particular interest to note that the demand for health investment, *h*, will be larger if the probability of survival to period 2, π, is larger. The intuitive explanation is that long-lasting medical intervention that improves well-being is more valuable to those who expect to live longer. Holding other things constant, as mortality rates decline, the demand for medical services that offers only short-term improvements in well-being will also decline as individuals substitute towards medical services that offer long-term improvements.

We are not familiar with any empirical estimates of the consumption equivalent value of this direct increase in well-being. One approach would be to estimate the willingness to pay for a medical service similar to the hypothetical surgery discussed above. The key would be to identify treatments that have no effect on either productivity or longevity. Calculating the willingness to pay for any health intervention which also affects these other two components would produce upwardly biased estimates.

3.2 Productivity

The second term on the left-hand side of Equation (4) is the productivity gains from additional health capital:

EQUATION 6

$$\frac{\partial U(H,c)}{\partial c}\frac{\partial W}{\partial H}\frac{\partial H}{\partial h}$$

The health investment increases the stock of health capital which increases the agent's wealth. The agent values the additional wealth because it can be spent on additional consumption, c, the marginal value of which is given by the first term in the above expression. The assumption that wealth increases as health capital increases, with diminishing returns, is a simple way to represent the increase in productivity from health.

There is a strong correlation between income and health (see FOGEL 1994). We generally assume that the causal relationship is that additional income allows an individual to make health investments which increase health. However, there is strong evidence for a causal relationship running the other direction. An increase in health causes higher labor productivity through fewer lost workdays, greater physical energy at work, and greater mental focus and ability.[1]

Leibenstein (1957) first proposed that workers with low levels of calorie intake would have lower productivity. There is strong evidence that improvements in nutrition lead to productivity gains in agriculture for those with low levels of calorie intake (STRAUSS 1986). Similarly, there is strong evidence that an increase in birthweight, reflecting an increase in intrauterine nutrient intake, causes an increase in future labor market income (BEHRMAN AND ROSENZWEIG 2004). The evidence shows only productivity gains for low calorie intake. Thomas and Strauss (1997) find evidence only for a positive impact of additional calories below 2,000 calories per day.

Evidence for a causal effect of health on productivity in developed countries is weaker. Several papers have shown that increases in average life expectancy in a country lead to increases in GDP growth (see BLOOM, CANNING, AND SEVILLA 2004). However, we are not aware of convincing micro evidence in developed countries that worker productivity is increasing in health. The evidence that workplace wellness programs increase productivity is mixed. While these programs generally increase worker health as measured by increased physical activity, reduction in tobacco use, and decreased body mass index, there is little evidence of productivity gains (OSILLA ET AL. 2012). The strongest evidence seems to be that an exogenous increase in worker health reduces absenteeism (BAICKER ET AL. 2010).

3.3 Longevity

The defining characteristic of this simple model is that life expectancy is not fixed. We assume that an investment in health increases the probability of survival to the second period. It is clear from Equation (1) that an exogenous increase in the probability of survival, π, increases the expected lifetime utility. How much does the agent value an increase in the probability of survival to the second period? Note that the rate of increase in the expected lifetime utility when π is increased marginally is $U(H,c)$. This means that the value of the increase in the probability of survival depends on the living standard of the agent. An agent with better health and more consumption will place a higher value on an increase in the probability of survival.

The same point is clear from the third term on the left-hand side of Equation (4):

1 Jayachandran and Lleras-Muney (2013) point out that health indirectly affects productivity through education. As longevity increases, so does the return on investments in education. This encourages additional education which makes workers more productive. We do not consider this indirect relationship because improvements in education (even if motivated by increased longevity) are already included in inclusive wealth via the measurement of human capital.

TABLE 2

Estimated value of the average annual increase in life expectancy in the U.S.

Study	Time period	Value of increase
Nordhaus (2005)	1975 – 2000	US$52,000
Becker, Philipson, and Soares (2005)	1960 – 2000	US$2,000
Murphy and Topel (2006)	1970 – 2000	US$40,000
Jones and Klenow (2011)	1980 – 2000	US$60,000
Arrow et al. (2012)	2000 – 2005	US$11,400
Inclusive Wealth Report (2012)	1990 – 2008	US$7,000

EQUATION 7

$$U(H,c)\frac{\partial \pi}{\partial H}\frac{\partial H}{\partial h}$$

The marginal value of an increase in π depends on the utility the agent would realize in the second period. To express *U(H,c)* in dollar terms, economists divide by the marginal utility of consumption and call the resulting object the value of a statistical life or VSL (Ashenfelter 2006). It is important to note that economists do not claim that VSL is the value of life. Instead, one should think of VSL as the amount people would be willing to collectively spend in order to reduce the number of expected deaths by 1.

The value of a statistical life can be inferred from individual choices. For example, workers who wash the windows of skyscrapers face a higher risk of death and are paid more than workers who wash the windows of single-story businesses. The additional compensation from assuming the additional risk of death reflects the workers' willingness to pay to reduce mortality risk. There are many similar opportunities for economists to observe a group's willingness to pay for a reduction in mortality risk. In a survey of country-level VSL estimates, Viscusi and Aldy (2003) found that VSL is approximately equal to US$12,000 multiplied by GDP per capita raised to the 0.6 power. This implies a 2014 VSL of US$8.3 million in the United States, US$2.5 million in China, and US$315,000 in Malawi.

The large VSL estimates imply that investments in health that result in even a small reduction in mortality risk have great value. Many studies have estimated the value of the increase in life expectancy in the U.S. including Nordhaus (2005), Becker et al. (2005), Murphy and Topel (2006), Jones and Klenow (2011), Arrow et al. (2012), and the Inclusive Wealth Report 2012. Table 2 reports the estimated value of the increase in life expectancy from each study. The time frame for each study is different, so we report the total estimated increase in value divided by the number of years. This results in an average increase in value per year. Differences across studies therefore are due both to differences in methods but also in the time period studied.

The estimate of the value of the average annual increase in life expectancy by Becker et al. (2005) is far lower than the other estimates. The time period they considered did not have smaller gains in life expectancy, so the difference comes from their methods. Their model implies a value of a statistical life from the other parameters of the model. Rather than going to the literature for a VSL estimate, they calibrate the other parameters of the model and the resulting VSL is fairly small. The Nordhaus (2005), Murphy and Topel (2006), and Jones and Klenow (2011) studies use similar methods and find large estimates. The Inclusive Wealth Report 2012 follows the Arrow et al. (2012) methods. Both consider a more recent time period and find similar results.

The Arrow et al. (2012) approach is to calculate the expected discounted years of life remaining for each age- and gender-specific group in the population in each year. The population-weighted average of the group-specific changes in the expected discounted year of life remaining over the period is then multiplied by the value of a statistical life year (VSLY) for that country. The VSLY is the VSL divided by the expected discounted years of life remaining and thus represents a per-year valuation of the reduction in risk of mortality.[2] Note that population aging mechanically decreases the average expected discounted years of life remaining, but that the increase in longevity for the old have outpaced this mechanical decrease (see Appendix 1 for the details of this method). The Arrow et al. (2012) approach is straight-forward requiring only life expectancy data combined with an estimate of the VSL for the country. It makes no attempt to adjust the VSL for age or cohort effects as in Aldy and Viscusi (2008). In the model presented here, an agent with higher wealth should have a higher VSL. This is consistent with the cross-country VSL estimates. However, this also suggests that where the life expectancy increases occur within the wealth distribution within a country should matter in calculating the value of the improvement in health. Our method does not account for this.

Hamilton (2012) suggests that the Arrow et al. (2012) estimates are implausibly large and claims that this must be due to double counting. He correctly points out that VSL reflects the value of all good things that come with living, not only good health. He then argues that if we have already measured the value of natural, manufactured, and human capital, wouldn't it be double counting to then add the value of health capital as the VSL depends on the living standards which are themselves a function of the other forms of capital? This concern is understandable but incorrect. Living is complementary with consumption. Even if health offered no direct increase in well-being or an increase in productivity, health would still have value simply because it extends life and allows a person to enjoy living longer. The model presented here illustrates the important point that the value of health capital does and should depend on the level of well-being and thus by extension on the levels of the other forms of capital and on the state of technology. Note that the term $U(H,c)$ appears in the expression for the value of increased longevity from an increase in health. That utility term represents the value of all good things that come with living.

3.4 Combined value of health capital

The value of an increase in the stock of health capital is the summation of all three components: direct well-being, productivity, and longevity. Accepted empirical estimates of the first two components are lacking, so economists have relied on the third alone to estimate the value of health capital. This is fine, but it should be recognized that the resulting estimates are biased downward. The large value of health capital reported in this chapter is probably too small rather than too large.

An additional issue is how to measure health capital itself. Recall that there are various measures of health and not clear theoretical justification for selecting any particular measure. Restricting the value of health capital to the longevity component makes it easy to justify

2 There are alternative methods for calculating the value of a statistical life year (VSLY). Our method implies a constant VSLY for all individuals within a country but allows for differences across countries.

using expected discounted remaining years of life expectancy as the measure of the stock of health capital. However, assume that we wish to add the productivity component to the value of health capital. Also assume that we have a convincing estimate of the effect of some measure of health, say BMI, on productivity. With this estimated effect we can value the productivity gains or losses from a change in BMI. However, it would be incorrect to refer to this as the value of the change in BMI as this would only be the productivity component. It would also be incorrect to calculate the effect of a change in BMI on longevity and then use this to supplement our longevity valuation. That would be double counting.

The Inclusive Wealth Report 2012 and Arrow et al. (2012) decision to include total factor productivity (TFP) as a measure of technological progress introduces an issue here. TFP growth is included as growth in an additional form of technological capital or time capital. Suppose that a change in BMI causes an increase in productivity. This would be picked up in the TFP growth measure as coming from technological change, when in reality it was the result of an improvement in health. This suggests that it may be appropriate to exclude the productivity component from our valuation of health capital if TFP growth is included in the measure of inclusive wealth. The health effect on productivity should already be captured by the change in TFP.

4. Conclusion

Measuring health capital using only data on life expectancy seems appropriate given the measurement challenges and lack of empirical estimates for the direct welfare and productivity components of the value of health capital. That the value of the change in health capital is large is not surprising given the large willingness to pay for reductions in mortality rates. Health capital should no longer be relegated to the appendix when measuring inclusive wealth. It is likely the most important form of capital in producing human well-being. Health services primarily affect human well-being directly rather than passing through the production process to generate goods and services.

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APPENDIX 1:

Methodology for valuing the longevity component of health

This appendix provides a description of the methodology employed in Arrow et al. (2012) as well as the Inclusive Wealth Report 2012.

Let $f(t)$ be the density of age of death, $F(t)$ the cumulative distribution of age of death, and $f(t|t \geq a)$ the conditional density of age of death given survival to age a. We obtain an estimate of the number of people who survive to age t out of a starting cohort of 100,000 (column l(x) of life tables) for each year and each country. From this, we calculate the unconditional number of deaths by age and divide by 100,000 to give f(t), the density of age of death. From $f(t) = f(t|t \geq 0)$ we calculate $F(t)$:

EQUATION 1

$$F(t) = \sum_{a=0}^{t} f(a)$$

The conditional density of age of death is obtained from f(t) and F(t):

EQUATION 2

$$f(t \mid t \geq a) = [1 - F(a)]^{-1} f(t)$$

Future years are discounted at a constant rate d, assuming that the value of an additional year is independent of age. The health capital of an individual of age a is the discounted expected year of life remaining:

EQUATION 3

$$H(a) = \sum_{t=a}^{100} f(t \mid t \geq a) V(a,t)$$

where V(a,t) is given by:

EQUATION 4

$$V(a,t) = \sum_{u=0}^{t-a} (1 - \delta)^{u}$$

The total health capital of all individuals of age a in a country is calculated by multiplying $H(a)$ by the number of people of age a in that country, $P(a)$. Thus, the total health capital (measured in discounted life-years) of a country is:

EQUATION 5

$$H = \sum_{a=0}^{100} H(a) P(a)$$

The value of a unit of health capital is the value of a statistical life-year or VSLY. Thus, the value of the total stock of health capital is simply H multiplied by the VSLY.

Part III:

New insights

CHAPTER 6

Forest wealth of nations

Haripriya Gundimeda and Giles Atkinson

KEY MESSAGES

Forest ecosystems provide a huge range of tangible and intangible benefits for human well-being. These are of immense value and represent an important component of national and global wealth.

Demographic trends and economic growth are exerting increasing pressure on forest capital. Accounting more fully for this wealth, and how it is changing as a result of economic and social activity, is urgently required. The estimates in this chapter provide a tentative first step in this direction.

From a global perspective, in 2010 for the selected countries, forest wealth amounted to more than US$273 trillion. On the face of it this wealth, in absolute terms, seems concentrated in relatively few countries. However, for many other countries, forest capital remains an important component of national wealth. Many of these countries (although not all) have experienced alarming losses in forest capital over the past 20 years.

From an accounting perspective, these losses are frequently hidden from view. It is thus essential that nations pursue better accounting to understand quantity, quality, and distribution of forest wealth. Indeed, keeping forest wealth intact – and, moreover, investing in forests to reverse past losses – is an important pre-condition for sustaining development.

1. Introduction

Natural capital is widely recognized as an important component of the total wealth of a nation. Correspondingly, there have been considerable advancements in practical accounting for this natural wealth (see, for example, UNU-IHDP AND UNEP 2012, UN 2012A, WORLD BANK 2010, ONS 2014). This progress, however, has been incomplete. While a substantial amount of this work has focused on the non-renewable wealth within subsoil assets, far less remains known about renewable wealth, such as that within forest capital. There are exceptions (see, for example, BARBIER 2013, HAMILTON AND ATKINSON 2006); however, these are largely restricted to understanding forests as a store of timber value, for instance. Of course, this is only one such "ecosystem service" that forests provide. Reconciling practical efforts to account more comprehensively for total wealth is an important next step if wealth accounting is to remain relevant and useful.

In this chapter, we take a preliminary step towards incorporating some of these broader values of forest capital within a measure of inclusive wealth. Our approach is a deliberately rudimentary one: We define the value of the natural asset only in terms of the sum of the benefits provided by the stock of a unit, in this case land area of standing forest. While this gives a rough first approximation of the value of this wealth, it is important to recognize that it is an incomplete description of the value of the natural capital comprising this asset (see, for example, NCC 2014A). Yet it is a practical starting point, making use of emerging databases that have sought to synthesize the empirical record on the value of ecosystem services, and consistent with the land-based physical accounting units in existing UN efforts (UN 2012B).

While the results should be viewed as preliminary and partial, we nonetheless argue that these findings are illustrative and contribute to the process of understanding how natural capital contributes to total wealth. From a global perspective, in 2010 this forest wealth amounts to more than US$273 trillion (2005), which is 56 times the aggregate global GDP. On the face of it, this wealth, in absolute terms, seems concentrated in a relatively few countries. However, for many other countries, forest capital remains an important component of national wealth. Many (though not all) of these countries have experienced alarming losses in forest capital over the past 20 years. While this evidence requires further scrutiny than is possible here, it does strike at the heart of critical debates about the sustainability of development, and whether other components of wealth truly compensate for such losses in their entirety.

The remainder of this chapter is organized as follows: Section 2 reviews and discusses a number of issues relating to accounting for forest capital; Section 3 outlines the methods and data used; Section 4 sets out our results. Section 5 offers conclusions considering the preliminary nature of these results, and outlines some key caveats to our interpretation of the findings in the chapter.

2. Accounting for forest wealth

Forest capital produces a multiplicity of intermediate and final goods. These contributions are often overlooked, however, because they are largely "invisible". Not surprisingly, this has fed the critique of existing national income accounting systems as regards their inability to explicitly measure changes either in the productive capacity of forest resources, or the contribution of forest resources to human well-being. These include: (1) the contribution of forest capital as an input into production processes; (2) the broader values that society places on forest capital; (3) the benefits and services that forest capital provides beyond the production boundary and markets; (4) the impacts of current economic activity on forest capital; and, (5) changes in human well-being as a result of changes in forest capital.

Evolving work such as the UN's environmental-economy accounting framework (UN

2013a, 2013 b – henceforth "un") show that progress is being made on addressing these issues. However, it is clear that there remains much to do. In the first Inclusive Wealth Report (unu-ihdp and unep 2012, henceforth referred to as IWR 2012) the estimate of forest capital was based on valuing timber, non-timber forest products (NTFP), and carbon. In this chapter, we extend this earlier work by including a range of other ecosystem services. In doing so, we are faced with two broad challenges. The first is the description of the physical accounting units. The second is the valuing of these physical dimensions. The link between the two is in identifying both the flows of goods and services from these physical assets and the way in which these flows translate into benefits that people value.

Forest capital facilitates this link through complex biophysical structures and processes. This complicates any judgement about what the basic physical accounting units should be. In principle, this should be focus on the capital asset itself. However, in the current context, this is far from straightforward. Natural assets, through ecological production (and perhaps a mixture of human management and inputs from other assets), provide ecosystem goods and services which ultimately give rise to benefits of value to human populations. Importantly, the natural capital giving rise to such services is likely to be an assemblage of different assets including not only, say, land under forest cover, but also soils and associated natural processes and functions.

Thus, the exact contribution of forests ultimately to human well-being depends on many factors which can be construed as assets. These include ecological factors, such as the functional and process integrity of forest ecosystems. The contribution also depends on social arrangements, such as institutions and technologies. And while underlying natural functions and processes may remain the same, how the forest is valued by people can change over time. This in turn may have implications for natural processes, depending on how values change the way in which a resource is managed.

In this respect, the units of forest land area, our basic accounting unit for this chapter, is a limitation. That is, it is unlikely to satisfactorily reflect in full this combinatorial character of the natural capital in forests. Nevertheless, it remains a useful starting point for any practical response to challenge natural capital accounting (ncc 2014b). This emphasis, for much the same reason, is also the recommendation of the UN (2013), which proposes a set of major land-use categories as the basic accounting units for constructing ecosystem accounts. From this practical perspective, concerns about the fundamentals of natural capital might be captured, to some extent, by looking at the biophysical properties of these natural areas such as soil, biodiversity and so on (hamilton 2014). The Natural Capital Committee (NCC) (ncc 2014b) look at not only the extent or quantity of land area such as forest land, but also at its quality and configuration.

Robust accounting, therefore, is likely to require a detailed micro-investigation of land areas. By contrast, the approach we take is by its nature broad, and highly aggregated. As such, it should be seen as the start of a process to more accurately account for the value of forest wealth, rather than the end.

Our approach combines information about land area with the growing evidence base for establishing the value of benefits that are provided by ecosystem services held within these land units. For example, the pioneering Millennium Ecosystem Assessment (MA 2005) has categorized various important benefits provided by forests, including provisioning services (food, fuel, fibre, water, etc.), regulating, supporting, and cultural services. These have also been documented by other major initiatives, including The Economics of Ecosystems and Biodiversity (TEEB) and Wealth Accounting for Valuation of Ecosystem Services (WAVES). Forest vegetation and soils capture and store atmospheric carbon dioxide (CO_2) and therefore play a significant role in the global carbon cycle and have the potential to avert climate change. In the Reduced Emissions for Deforestation and Degradation (REDD), carbon storage is viewed as a stock variable while the carbon sequestration during growth and regrowth is treated as a flow variable.

Forests play a very important role in regulating stream flows, supplying fresh water by filtering pollutants, stabilizing soils, reducing erosion and sedimentation, and moderating impacts of extreme weather events and related hazards, such as floods, storms, and landslides. Forests improve air quality, and thereby human health, and provide a habitat for various flora and fauna – indeed they are crucial for maintaining biodiversity. Exact roles depend on the forest type – for instance, canopy levels and vareity. Currently, none of these regulatory and supporting contributions are recorded in the statistical system of forest accounting.

Forest ecosystems often have very high social and cultural values in terms of recreation, aesthetic, and spiritual worth. Forests often contribute to tourism, although these contributions are recorded as activities within the tourism sector, and hence effectively lost to forestry calculations. Some communities, such as the Bishnoi communities in India, attach high spiritual values to forests, and in others forests hold religious significance. In addition to all the above, forests act as safety net in times of crisis, providing some earning opportunities and subsistence consumption possibilities. It should thus be clear that forest wealth measures must be expanded to include the important role that forests play in providing regulating, supporting, and cultural services.

This includes the diversity in structure, composition, productivity, and age of the species. In case of forests managed for the purpose of timber (i.e., production forests), the decision to harvest a particular species is based on the rotation age, which varies with the species composition. If removals are lower than, or equal to, additions, the forests are sustainable. The removals can be carried out via clear-felling trees on large tracts of land or through selective harvesting of mature trees. In case of clear-felling of trees, as the land officially remains under forests, the forest stock does not decline; however, if forests are converted to non-forest purposes after clear-felling, the wealth in the converted sector increases and the forest wealth declines. If the quality of the forest deteriorates, the area under forests remains intact but the stock of timber, carbon sink, biodiversity, and ecological functioning may vary.

In addition, forests derive value from the land value, as well as its output values, which is dependent on the purpose for which land is managed, ownership, and other institutional factors. For example, plantations are managed for timber and non-timber forest products, while national parks or sanctuaries are managed for the purpose of protecting biodiversity and maintaining ecological functions. We have assumed in this chapter that the forests are managed for provisioning, supporting, regulating, and cultural values, and the extent of area set aside by each country differs depending on country-specific priorities and socio-economic conditions. A country rich in biodiversity may allocate a higher proportion of forest land for conservation and vice versa. A global resources assessment of the Food and Agriculture Organization of the United Nations (FAO 2010) classifies the forest land by management purpose – production, protection, multiple-use, or conservation (i.e., forest in national parks, nature reserves, and other protected areas).

In addition, these ecosystem benefits and services are often dependent on each other, hence simply aggregating values is impossible. For example, carbon sequestration depends on biomass which in turn depends on the soil quality and moisture levels. Similarly, the hydrological value of forests depends on the height of the vegetation, the interception of soils, and the evapo-transpiration potential of the leaves. Ideally, they should be modeled together. In the absence of detailed information, we assume that these values are additive and the value of forests is the sum of other direct and indirect benefits provided.

The key to wealth accounting, as opposed to more mainstream accounting in the physical realm, lies in capturing shadow prices. Shadow prices are the marginal values obtained by equating both the demand and supply side. In well-functioning markets, market prices are the best approximation of shadow prices. However, as we discussed, forests provide many ecosystem services which are well outside the production boundary and for which market prices do not exist. Because of the public good nature of these goods it is difficult, if not impossible, to correct market failures associated with forests. This difficulty in assigning prices leads to policy failures. To remedy this, several non-market valuation techniques have been developed to value the ecosystem services provided by forests (see MÄLER AND VINCENT 2005).

To value the asset we need to identify the descriptors of forests, which can be different depending on the forest service valued. For estimating timber values, growing stock at the beginning and end of the assessment period can be a better descriptor than the area. The shadow prices of the standing stock of timber depend on the distribution of age class in each time period, and how they change as this distribution is altered. Here, the shadow price has been estimated as the weighted net price of harvested timber (weighted price of harvested timber minus the harvesting costs), and the value of timber stock is growing stock multiplied by shadow price.

Along with timber, forests sequester carbon in forestland, as well as harvested products. The harvested timber moves out of the production boundary of forests and enters the forest product boundary. However, carbon is also embodied in timber and timber products. If the timber is used in making furniture, the carbon in it remains sequestered for a long period. However, if the timber is used in making certain short-lived products like paper, fuel wood, etc., the carbon is soon released through burning or processing into the atmosphere. In the case of production forests, the carbon moves out of the forests in the form of harvested wood but is ultimately sequestered when forests are regenerated. For protected forest areas, carbon fixation is permanent, as there are no anthropogenic disturbances and thus positive net carbon sequestration. Although old growth forests were once thought to be carbon neutral, a study published in Nature (LUYSSAERT ET AL. 2008) showed that the net ecosystem productivity of forests between ages 15 and 800 is usually positive, depending on climatic factors and the extent of nitrogen deposition. Various disturbances on forests, such as forest fires, pests, diseases, logging, conversion to other land uses, etc., can also release carbon into the atmosphere. The exact amount released depends on the extent and nature of the disturbance. The value of the forest carbon is the net carbon sequestered multiplied by the marginal social damage due to carbon emissions within its the geographical boundary.

Forests provide valuable non-timber forest products of extreme significance to specific communities, particularly in developing countries. Even in developed countries such as Sweden, forests provide significant benefits from the provision of non-timber forest products (NTFPs). In cases such as this, forest area can be a better descriptor, and as such the value of forests due to NTFPs is the present value of NTFPs (value of harvests minus cost of collection) multiplied by the area accessed by local communities.

The indirect use values provided by forests come primarily in the form of regulatory and supporting services, such as biodiversity maintenance, nutrient recycling, maintenance of hydrological cycles, watershed protection, waste assimilation, prevention of soil erosion, pollination services for agriculture, micro-climate stabilization, and so on. However, these values are very difficult to measure separately as they are often only provided as a system. At this point in time, the knowledge on these systems is limited and these values have generally been measured independently by researchers (compiled in the TEEB database, see DE GROOT ET AL. 2012). The best stock descriptors in this case would be the area underneath primary forest cover. Thus, the ecological value of the forest is the net present value of these services multiplied by the area under primary forests.

Forest ecosystems provide valuable recreational services, which are usually attributed to the tourism sector, with the exception of revenues generated directly by forest managers. There are costs associated with maintaining forests for such uses, which should be deducted from the recreational value. However, increasing forest area may not necessarily increase the recreational value by the same proportion. The recreational value of the forests is the present value of net benefit provided by recreation multiplied by the area providing recreational services. It should be noted that there are scarcity values for ecosystem services, and the forest ecosystem value can rise as the area decreases and ecosystems subject to non-linearity. One additional consideration is that some of these values of forest wealth are likely to be capitalized in other forms of wealth. For example, any pollination services or water provision ultimately attributable to the existence of forests boosts the value of agricultural land. Water regulation (perhaps via flood protection) might be reflected in the value of the produced capital protected by such services. Therefore, caution must also be applied, or at the very least caveats noted, in adding the value of forest capital to other components of total wealth.

Accounting for forest wealth clearly raises considerable issues. Interpreting the resulting accounting aggregates should also provide pause for reflection. On the one hand, if the sustainability of development is reckoned to be dependent only on changes in total wealth (per capita) over time, then what is happening to forest wealth should be viewed primarily in the context of what is happening to wealth overall. Broadly, this is the approach taken in IWR 2012. On the other hand, contributions in that same volume also emphasize the characteristics of natural capital which indicate that simply looking at overall trends in wealth is insufficient to determine whether or not development is sustainable. For example, if, as seems likely, the benefits provided by natural assets such as forests are non-substitutable, then any sustainability criterion based on wealth accounts should also be concerned about what is happening to these assets. Evidence of declining forest wealth should also prompt questions about whether these losses should be diminished or even reversed if, say, the decline in forest area has exceeded a certain threshold (see, for example, Pearce et al. 1996).

3. Methods and data

We take the land area officially designated as forest area as a (proximate) physical accounting unit for forest assets. We used the FAO (2010) definition of forestland "which refers to land spanning more than 0.5 ha with trees higher than 5 metres and a tree canopy cover of more than 10 percent and characterized by the absence of other predominant land uses." This particular classification includes both natural forests as well as plantations classified by management purpose – production, protection, multiple-use or conservation (i.e., forest in national parks, nature reserves, and other protected areas), as well as forest stands on agricultural lands like wind breaks, shelter belts, abandoned areas of shifting cultivation, and corridors of trees. However, this definition excludes trees established with the primary purpose of agricultural production, horticultural and agroforestry systems. This approach is broadly consistent with the United Nations framework for the System of Environmental and Economic Accounting Framework (SEEA) (UN 2013a-b) as well as, more closely, the aforementioned definition in FAO (2010).[1]

1 The SEEA further classifies forestland into primary forest, other naturally regenerated forest/planted forests, and timber resources, by whether these are cultivated and natural timber. Proper accounting treatment needs to be accorded depending on whether timber comes from planted forest or primary forest and naturally regenerated forests. While the distinctions are important for certain countries but unimportant for

To understand the changes in the value of forest capital stock, we need measurable physical stock descriptors. This could be the area under forest, the growing stock of standing timber that forests contain, the total biomass, net carbon sequestered and stored, the biodiversity the forestland holds, and so on. In fact, these descriptors are interrelated. If the measurable descriptor valued at constant shadow price at the beginning and end of the period remains constant or increasing, we treat this as investment, otherwise it is disinvestment.

Inclusive wealth is defined as the present discounted value of all capital assets, where these stocks are each valued in terms of their respective shadow prices at time "t". The value of forest capital thus at any given point of time is the present value of the future net benefits that can be expected over the life of the resources.

Formally,

EQUATION 1

$$V(F(t)) = \int_{t=1}^{T} e^{-r(t-n)} (VF_{db} + VF_{ndb})dt$$

Where:

$V(F)$ = per hectare value of forests.

VF_{db} = The per hectare value of direct net benefits derived from forests.

VF_{ndb} = The per hectare value of indirect net benefits derived from forests.

T = life of forests.

r = the discount rate.

n = the time period of assessment.

The direct benefits derived from forests might be provisioning services and recreational services directly consumed by the individual or the society. Indirect benefits include regulating and supporting services that may benefit the individual or society indirectly. As the species are ecologically interdependent, the ecological values may be interdependent on each other.

In what follows, we analyze data on forest area, growing stock and forest carbon for the period of 1990 to 2010 for a subset of countries which we have divided into low, middle, and high-income nations. The latter classification is based on income in World Development Report (WDR 2014). Country-level data on export quantity and value of round-wood from the FAO Forest Resources Assessment (2010) interactive database was used to compute the average price per cubic metre of timber for the years 1990, 2000, 2005, and 2010 for the selected countries for which data is available. The unit values are adjusted for cost of harvesting and then multiplied by the growing stock in production forest to obtain the value of forest timber wealth. The costs of harvesting takes into account the forest management type, proximity to markets, volume felled, type of species, equipment, harvesting practices employed, etc., all of which vary widely. We used average timber harvesting values based on the Global Timber and Forestry Data Project (GTAP) database, which ranged from 30 percent to 60 percent of price per tonne of timber depending on the country, the type of forest and the management regime.

Because market prices change over time, and we are seeking to understand what proportion of stock value changes due to physical changes in quantity and quality of the asset, we used the average net price per cubic metre of timber over the period of 1990 to 2010 in order to keep price constant. In reality, if market prices change due to scarcity they should be accounted for, but market prices can change due to other factors as well. Only the area under production forest is valued for timber, and as consistent fuel wood consumption and export data is not available for several countries, we could not obtain the value of fuel wood. However, the fuel wood consumed by local communities is assumed to come from twigs, branches, etc. and is included under the non-timber forest products.

The role of forests in mitigating climate change and the potential temporal and spatial damage that one metric tonne of carbon released today would cause is well established. A number of models are available to project future economic damages likely to occur due to climate change and the payments to

other countries, we treat forests as one entity at this stage.

be made now to avoid this in the future (see Intergovernmental Panel on Climate Change 2014) for some examples). The social cost of carbon, the global cost to all future generations caused by one tonne of carbon in a given time period has been estimated in several studies in the literature using different integrated assessment models (IAMs) (Nordhaus 2011, Hope 2011, Tol and Anthoff 2010).

These estimates of social cost of carbon (the incremental emissions), vary considerably. A recent study by Dietz and Stern (2014) suggested that in order to avoid warming of more than two degrees above pre-industrial levels (keeping the carbon dioxide emissions to a maximum of 425 to 500 ppm), a carbon price of US$32 to US$103 per tonne of CO_2 (2012 prices) should be implemented in 2015, raising the price from US$82 to US$260 in 2035 depending on how great the damage from climate change is expected to be. However, another study by Howard (2014) in a report produced for the interagency working group on social cost of carbon, updated the U.S. social cost of carbon from a central value of US$24 to US$37 per tonne of CO_2. Mendelsohn, Dinar, and Williamson (2006) argue that climate change will have serious distributional impacts across countries and is expected to affect poorer countries disproportionally due to differences in location and adaptation ability, wealth and technology. Hence, they argue for different social cost of carbon across countries. Nordhaus (2011) using the RICE (Regional Integrated Climate-Economy) model, estimated the social cost of carbon for different countries, which vary between 1.25 for Eurasia to 29.62 for Africa (2005 U.S. dollars for the year 2015) for a tonne of carbon in case of low discount rate regime (discount rate of 1 percent). It is clear there is an ongoing discussion on how to the estimate of marginal social cost of carbon.

As forest carbon is now traded on voluntary carbon markets, one could use the existing market price for carbon. Carbon is currently traded at around US$8 per tonne of CO_2 in the European Union's carbon market, and in U.S. markets it is traded between US$2 and US$5 (Hope 2014). However, carbon markets cover only a part of the total emissions, and were affected by the global economic downturn, in addition to politically-rooted market defects.

One could also look at the level of carbon tax imposed in various countries, using avoided tax as the value of carbon sequestered. However, in several countries carbon tax is levied with the intention of raising revenues rather than lowering carbon emissions, and so it is not appropriate to use tax rates. One could use a (hypothetical) global carbon tax, i.e., if countries were to internalize the social damages they cause because of carbon emissions, the potential benefit provided by forests could be used as one measure. According to Nordhaus (2011), in an optimized climate policy the social cost of carbon equals the carbon price or carbon tax.

We have used the social cost of carbon in this study, which is the additional cost caused by an additional tonne of carbon dioxide emissions. In our case, if forests sequester carbon, we have assumed that it is the avoided social costs. From a national accounting perspective, a country would account for the damages caused as a result of its emissions, rather than account for global damage. Thus, we estimated the total annual carbon sequestered and multiplied by the social costs given in Nordhaus (2011) for calculating the avoided damages by each country.

For estimating wealth due to other provisioning services such as NTFPs, supporting and regulating services, and recreational/tourism benefits of forests we use the TEEB data base (see de Groot et al. 2012). This is a departure from the earlier estimates of IWR (2012) which used the work of Lampietti and Dixon (1995). The study by Lampietti and Dixon (1995), estimated the benefits of NTFPs as US$190 per hectare for developed countries and US$145 per hectare for developing countries. These values were then multiplied with the forest area and the percent of forests accessible by the population (which was assumed to be 10 percent of the total forest area).

TABLE 1

Values of ecosystem services from the TEEB database considered for the study

Ecosystem service	High income (US$ /ha/yr in 2005 prices)	Lower middle income (US$ /ha/yr in 2005 prices)	Upper middle income (US$ /ha/yr in 2005 prices)	Low income (US$ /ha/yr) in 2005 prices
Non-timber forest products	0.23 (1)	4–61 (5)	0.3–1,558 (7)	13–238 (2)
Water provisioning	6–97 (2)	–	10–705 (2)	–
Capturing fine dust	10	–	–	–
Gas regulation	9 (1)	–	69 (1)	–
Water regulation	2	–	22–25 (2)	–
Erosion prevention	10	3–2,239 (9)	224 – 322 (2)	111
Biological control	9	–	–	–
Nutrient recycling	5	19	19–21 (2)	–
Pollination	5	46	13	–
Prevention of extreme events	8	92	–	–
Biodiversity protection	–	0.07–493 (7)	4–394 (2)	–
Genetic resources	–	–	8–148 (3)	–
Water purification	–	–	179 (1)	–
Recreation	3–7,770 (10)	1–872 (6)	1–1,846 (9)	1–197 (4)

Note: the values in parentheses indicate the number of studies using either the market-based approach or cost-based methods. The values indicated display the range of values given in the database.

Our estimations are based on the approximately 320 publications, 1350 data points from 300 case studies stored in the Ecosystem Services Value Database (de Groot et al. 2012). All the values were adjusted for purchasing power parity (PPP) expressed in 2005 US$. From this, this study considers selected forest ecosystem values (provisioning, regulating, and supporting) for different services and biomes. We dropped those values from the database considered benefit transfer; the final sample consisted of 350 values for forest ecosystem services, which were then grouped based on income, population, and biome – low-income, middle-income, and high-income countries – and by low and high density population. The values differed widely due to differences in valuation techniques. To be closer to exchange values, this study used only direct market pricing and cost-based techniques. Table 1 summarizes the range of values considered in this study from the TEEB database.

The values as can be seen from Table 1 are not uniformly available across countries. Where available we used the actual country estimates and, if not, used transferred values. Commonly, value transfer or function transfer is used by researchers for such calculations, and values can differ widely. For example, Costanza et al. (2014) used function transfer to estimate the global change in the value of ecosystem services, and earlier Costanza (1997) used value transfer. In that case, function transfer gave an estimate eight times higher than the value transfer for wetlands (Costanza et al. 2014).

This study takes a departure from the existing studies in transferring values. It makes use of a three-dimensional metric based on income group, population density, and biome. For each of these groups, we looked at the mean value per hectare of provisioning, regulating, supporting, and recreational services for a particular forest type. For example, if a low- income country has a combination of temperate and tropical forests, we used the local income country values for the respective ecosystems. The timber and carbon values were based on the actual country values. For other provisioning services, such as non-timber forest products and fuel wood, we used actual values where available and data from a similar country in a similar ecological zone when not available. The value has been expressed in terms of the value added by forestry in that particular country (with year 2005 fixed as numeraire). The coefficient so obtained is multiplied by the forest area of the respective country for which the value is being transferred, and the country's forestry value added. It is assumed this approach takes into account structural differences among the countries.

Such an approach can be justified as the standard normal variate of the countries classified by different income groups and population densities were distributed within one standard deviation from the mean. However, value added by the forestry sector alone is unavailable for many of the countries as it is aggregated under value added by the agriculture, forestry, and fishing sectors together. Hence, we used these estimates from the National Accounts Main Aggregates Database of the United Nations Statistics Division (NAS 2011) as a proxy.

For NTFPs, we assumed that only a certain percentage of forests is accessible, for which we used the GTAP data base. In addition, huge amounts of public expenditures are diverted towards maintaining forests. These expenditures were deducted from the gross benefits provided by forests. The global forest resources assessment of FAO (FAO 2010) study showed that in 2005, an average of US$7.31 per hectare of public expenditure is allocated to forests for maintenance. There are regional differences, with costs ranging from US$22.5/ha in Asia to US$0.26/ha in South America. These total costs could be apportioned to different benefits or deducted from gross benefits.

4. Empirical estimates of forest wealth

The world – and in particular developing countries – experienced accelerated economic growth over the study period of 1990 to 2010. The total GDP of the nations chosen in the study grew by 69 percent between 1990 and 2010, low- and middle-income countries experienced relatively higher growth, with GDP rising 66 percent to 547 percent cumulatively since 1990, while high-income countries grew between 20 and 66 percent. This growth however, would not have come without a trade-off in precious forest capital.

Figure 1 shows these apparent trade-offs between forest area and GDP change. It also illustrates that only high-income countries have managed to be in the positive quadrant, either due to tougher environmental regulations or to lower growth rate and population pressures as compared to less-developed countries. These countries also have less dependence on forests as source of livelihood, and thus managed a positive growth rate in GDP while maintaining forest capital base without compromising the asset for future generations – fitting our definition for sustainable growth. We noted a mixed trend for middle-income countries: some managed positive growth rates with an increase in forest area, while others were less successful. Low-income countries with higher concentrations of poor people clearly experienced growth at the expense

FIGURE 1 a: low income

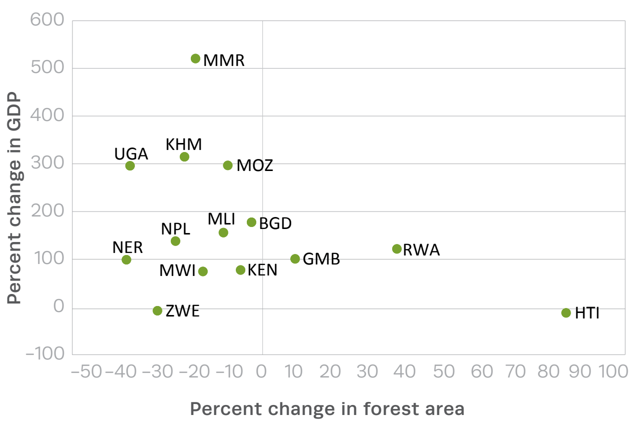

FIGURE 1 b: lower middle income

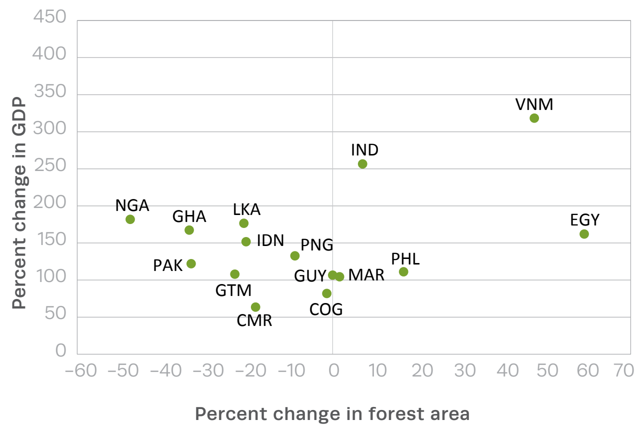

FIGURE 1 c: upper middle income

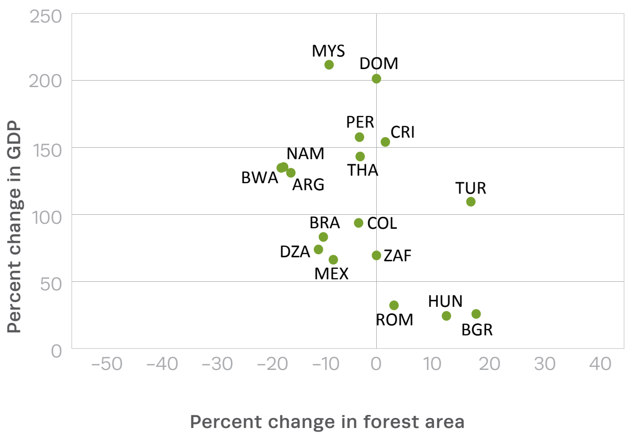

FIGURE 1 d: high income

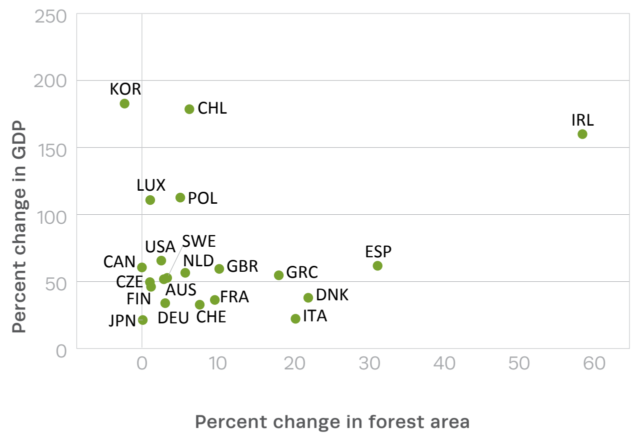

FIGURE 1

Growth (measured in GDP) vis-a-vis forest area (in hectares) accumulation in different countries, 1990–2010

of forest resources. This also shows that as nations become richer and more developed, natural capital often stabilizes as countries rely on other forms of capital.

Forest assets in physical units can often be stable even as the quality of forest cover deteriorates. There are several indicators of forest quality, such as biodiversity, micro climate, growing stock, etc., the current information on which, at macro level, remains incomplete. Assuming that the growing stock is a reflection of the health of the forest ecosystem, Figure 2 indicates a trade-off between economic growth and forest quality. Even in this case, we see that high-income countries continue to remain in the positive quadrant, while low-income countries experience GDP growth amid deteriorating forest quality. Middle-income countries, which had been in the first quadrant, have shifted to the second quadrant. None of the countries could manage to be in the first quadrant. The demarcated area did not change much as timber was logged and not restocked in these countries – not a sustainable practice.

FIGURE 2 a: low income

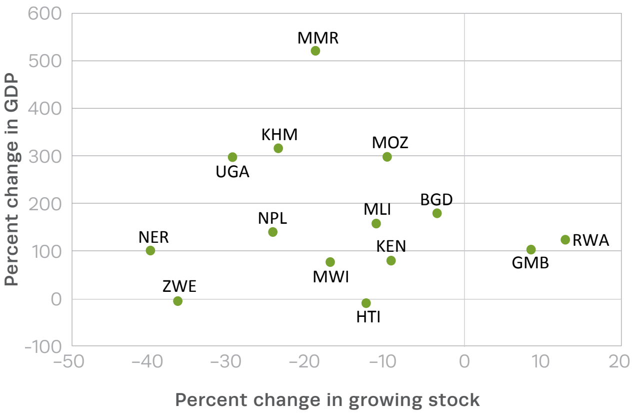

FIGURE 2 b: lower middle income

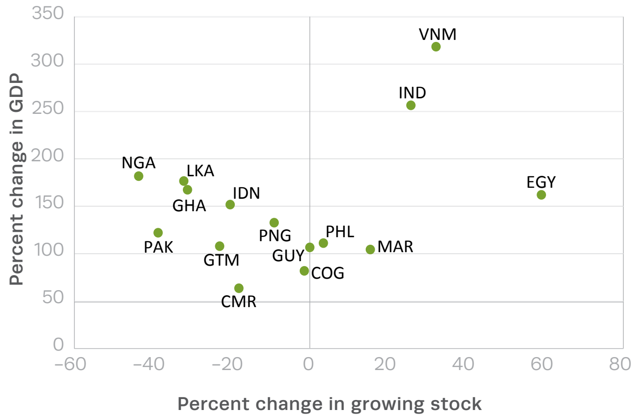

FIGURE 2 c: upper middle income

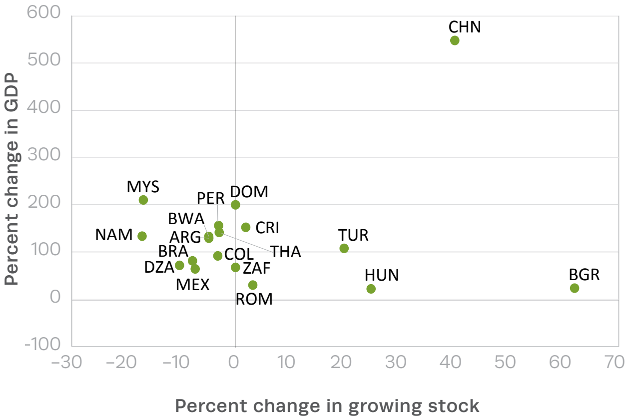

FIGURE 2 d: high income

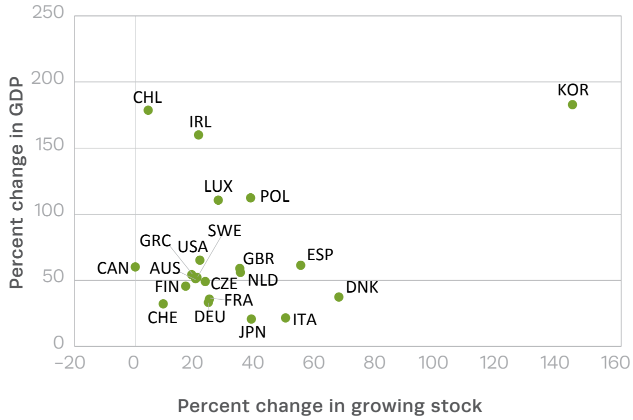

FIGURE 2
Trade-offs between economic growth and forest quality (measured by growing stock in cubic metres)

Figures 1 and 2 illustrate the changes in forest capital in physical units. The physical changes valued by respective shadow prices indicate the changes in forest wealth, which may vary significantly depending on the importance of forest ecosystem (see Figure 3).

With the exceptions of Rwanda and Gambia, most of the low-income countries depleted forest wealth while experiencing positive GDP growth,. Haiti experienced a decline in GDP while increasing forest wealth. Zimbabwe experienced declines in both GDP growth as well as forest wealth. The middle-income countries showed a mixed trend. India and China managed to be on the positive growth path while increasing their forest wealth, whereas Brazil and Indonesia are losing their rich forest capital. Most of the lower middle-income countries are growing at the expense of forest wealth. All the high-income countries in the sample have stabilized their forest wealth.

China, Brazil, India, Indonesia, USA, and Canada are the wealthiest countries in the year 2010 in terms of absolute forest wealth (see Table 2). Brazil has the second largest forest cover in the world, with some 56 percent of

FIGURE 3 a: low income

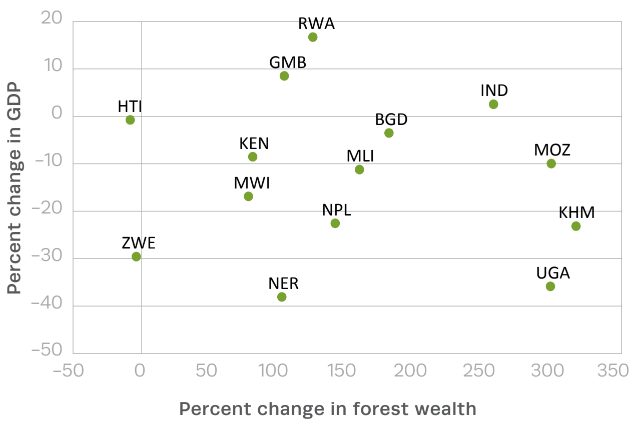

FIGURE 3 b: lower middle income

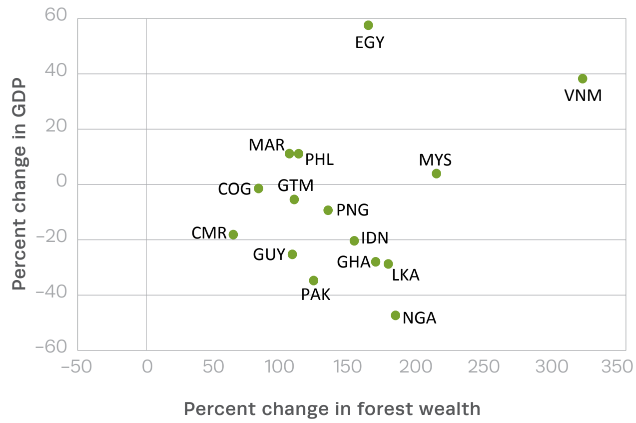

FIGURE 3 c: upper middle income

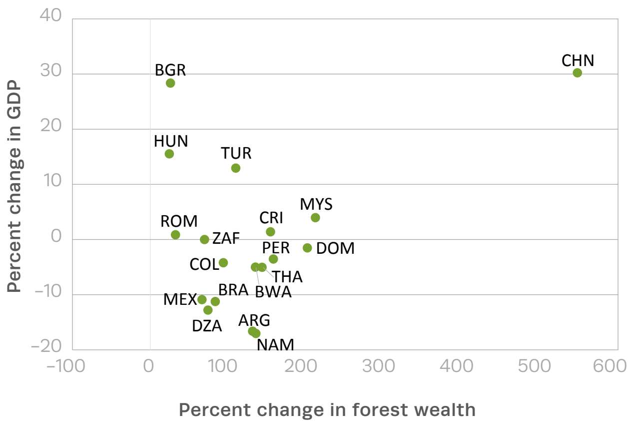

FIGURE 3 d: high income

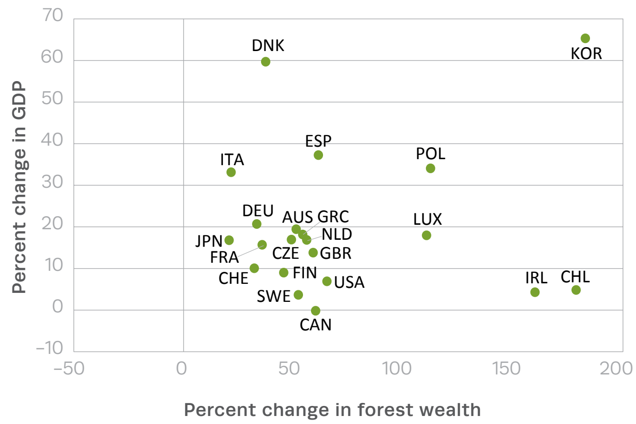

FIGURE 3
Trade-offs between growth (measured in GDP) and forest wealth

its total geographical area under forests, while China has only 18 percent of geographic area under forests. Perhaps surprisingly, in terms of forest wealth, China emerged at the top. This is because of the difference in prices of timber from these two countries (pointing out the limitations of the export price data and other values that we used in the study). The five largest nations in the world are thus leading in terms of forest cover (aside from Russia, which was not considered in this study).

Figures 4a and 4b show changes in wealth vis-à-vis changes in GDP for the two decades between 1990 and 2000 and 2000 and 2010. A ratio, for example, of -2 means forest wealth equivalent to two percentage points of GDP was lost in the process of increasing GDP by one unit. This ratio in general indicates the consumption of forest capital to create GDP. The decadal analysis shows that most countries had a negative ratio during both the decades 1990 to 2000, as well as 2000 to 2010. However, some countries with a negative ratio during 1990 to 2000 experienced a positive ratio from 2000 to 2010. India and China had increased their forest wealth between 1990 and 2000, but

TABLE 2: Absolute forest wealth and per capita wealth in the countries selected for the study

Country	Income group*	code	Absolute forest wealth (in 2005 U.S. billion dollars)				Per capita wealth (in 2005 U.S. thousand dollars)			
			1990	2000	2005	2010	1990	2000	2005	2010
China	2	CHN	53,169	60,243	65,652	69,246	47	48	50	52
Brazil	3	BRA	72,745	69,209	67,367	64,567	486	397	362	331
India	2	IND	37,811	38,112	38,899	38,776	44	37	35	32
Indonesia	2	IDN	17,186	15,454	14,734	13,488	78	71	69	68
United States of America	4	USA	19,560	20,195	20,497	20,915	96	72	66	57
Canada	4	CAN	12,827	12,965	12,822	12,805	463	421	397	377
Mexico	3	MEX	7,198	6,855	6,717	6,414	84	66	61	54
Mozambique	1	MOZ	4,048	3,843	3,737	3,645	298	210	178	152
Peru	3	PER	3,558	3,487	3,487	3,433	163	134	126	117
Congo, Republic	2	COG	3,173	3,150	3,137	3,128	1,331	1,008	886	761
Colombia	3	COL	3,079	3,029	3,004	2,950	92	76	70	64
Myanmar	1	MMR	3,202	2,863	2,722	2,596	76	59	54	50
Malaysia	3	MYS	2,354	2,708	2,563	2,448	129	116	99	87
Turkey	3	TUR	1,958	2,066	2,184	2,212	36	33	32	31
Nigeria	2	NGA	4,051	3,101	2,625	2,135	42	25	19	13
Argentina	3	ARG	2,397	2,218	2,138	1,999	73	60	55	50
Vietnam	2	VNM	1,093	1,346	1,453	1,512	17	17	18	17
Botswana	3	BWA	1,432	1,396	1,379	1,360	1,035	796	735	691
Nepal	1	NPL	1,672	1,391	1,295	1,295	92	60	51	48
Thailand	3	THA	1,270	1,243	1,228	1,207	22	20	19	18
Philippines	2	PHL	1,047	1,112	1,139	1,163	17	14	13	12
Cambodia	1	KHM	1,461	1,294	1,196	1,123	161	106	90	78
Zimbabwe	1	ZWE	1,455	1,240	1,132	1,025	139	99	89	78
Cameroon	2	CMR	1,179	1,075	1,021	965	98	67	56	47
South Africa	3	ZAF	958	959	958	958	27	22	20	19
Kenya	1	KEN	1,010	970	946	924	43	31	26	23
Finland	4	FIN	817	897	889	891	164	173	169	166
Mali	1	MLI	967	914	886	858	121	89	74	61
Sweden	4	SWE	761	770	780	788	89	87	86	84
Japan	4	JPN	638	715	742	746	5	6	6	6
France	4	FRA	537	575	608	622	9	9	10	10
Germany	4	DEU	441	496	512	532	6	6	6	7
Italy	4	ITA	365	426	456	486	6	7	8	8

* Note: 1 = Low income; 2 = Lower middle income; 3 = Upper middle income; 4 = High income.

Country	Income group*	code	Absolute forest wealth (in 2005 U.S. billion dollars)				Per capita wealth (in 2005 U.S. thousand dollars)			
			1990	2000	2005	2010	1990	2000	2005	2010
Papua New Guinea	2	PNG	529	506	493	480	127	94	81	70
Romania	3	ROM	449	449	451	453	19	20	21	22
Morocco	2	MAR	350	364	393	389	14	13	13	12
Chile	4	CHL	367	378	382	385	28	24	23	22
Guatemala	2	GTM	398	387	382	376	45	35	30	26
Uganda	1	UGA	572	469	417	367	33	19	15	11
Guyana	2	GUY	435	371	348	325	600	499	457	414
Malawi	1	MWI	372	342	325	309	39	30	25	21
Namibia	3	NAM	351	322	307	291	248	170	151	134
Ghana	2	GHA	397	340	314	286	27	18	15	12
Pakistan	2	PAK	418	348	312	273	4	2	2	2
Bangladesh	1	BGD	258	254	251	249	2	2	2	2
Poland	4	POL	185	213	231	248	5	6	6	7
Spain	4	ESP	174	226	227	240	4	6	5	5
Republic of Korea	4	KOR	83	110	123	138	2	2	3	3
Bulgaria	3	BGR	99	108	118	127	11	13	15	17
Austria	4	AUS	94	108	114	113	12	13	14	13
Czech Republic	4	CZE	89	97	101	104	9	9	10	10
Niger	1	NER	162	111	104	100	21	10	8	6
United Kingdom	4	GBR	85	90	93	96	1	2	2	2
Rwanda	1	RWA	74	45	76	87	10	5	8	8
Costa Rica	3	CRI	72	67	70	73	23	17	16	16
Algeria	3	DZA	77	73	71	67	3	2	2	2
Switzerland	4	CHE	51	54	55	57	8	8	7	7
Hungary	3	HUN	47	51	54	54	5	5	5	5
Sri Lanka	2	LKA	75	64	57	53	4	3	3	3
Gambia	1	GMB	45	47	48	49	50	39	34	29
Dominican Republic	3	DOM	41	42	41	41	6	5	4	4
Ireland	4	IRL	29	30	30	30	8	8	7	7
Greece	4	GRC	19	21	21	22	2	2	2	2
Netherlands	4	NLD	13	14	14	15	0.9	0.9	0.9	0.9
Denmark	4	DNK	7	8	10	11	1.3	1.4	1.9	1.9
Luxembourg	4	LUX	4	5	5	5	0.1	10.3	0.1	0.1
Egypt	2	EGY	4	5	6	6	10.0	0.1	9.7	8.9
Haiti	1	HTI	3	4	4	3	0.5	0.4	2.5	0.3

* Note: 1 = Low income; 2 = Lower middle income; 3 = Upper middle income; 4 = High income.

FIGURE 4 a

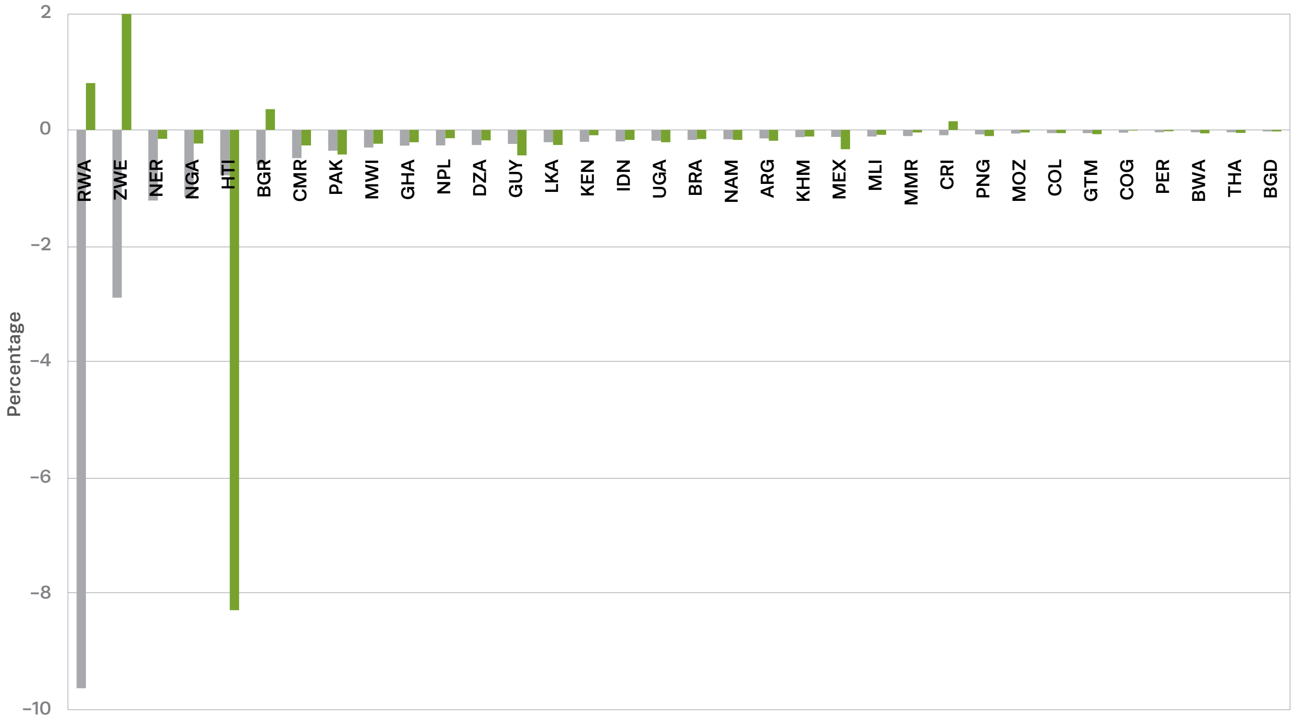

FIGURE 4 b

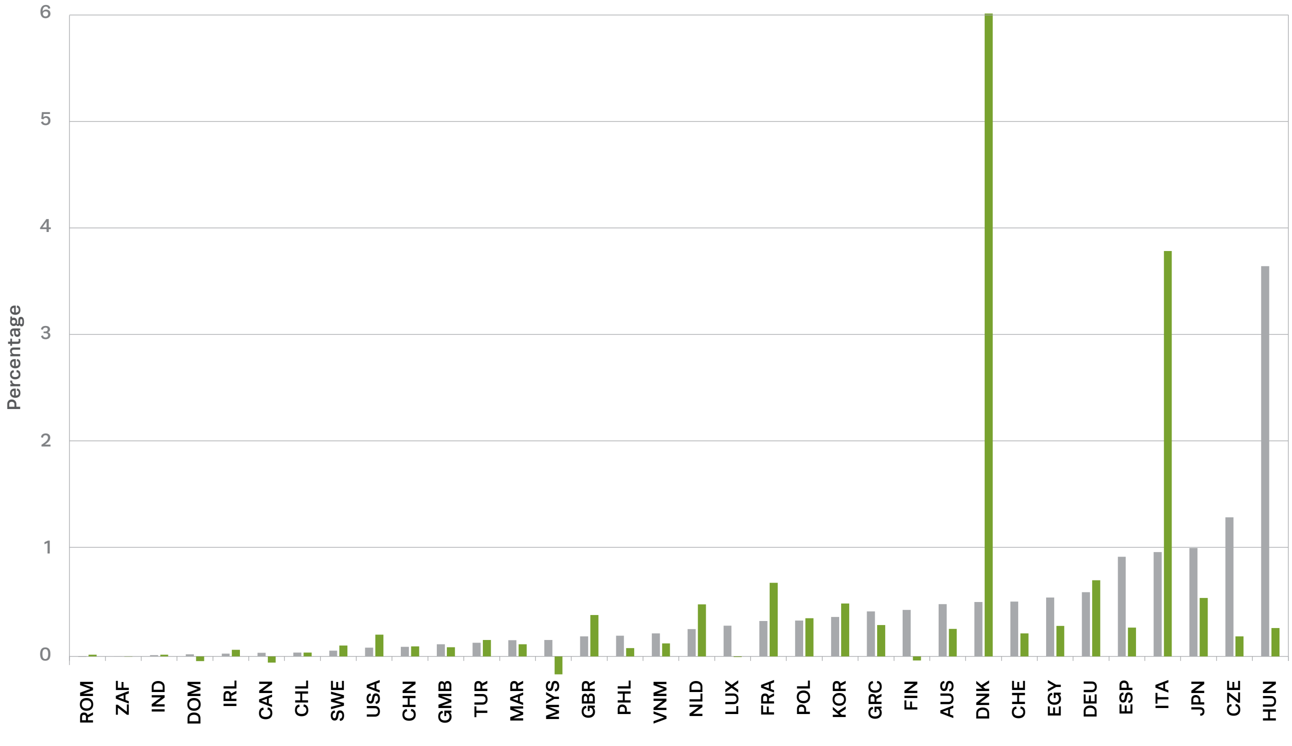

FIGURE 4
Decadal average change in wealth to change in GDP

Key
Average change in wealth to change in GDP, 2000–2010
Average change in wealth to change in GDP, 1990–2000

FIGURE 5
Composition of forest wealth in selected countries, 2010

the growth rate declined thereafter. The opposite happened in Vietnam and Cost Rica due to afforestation programs In Costa Rica especially, forest cover increased due to various payment-for-ecosystem service schemes. Brazil, which experienced decline in forest wealth during the period of 1990 to 2000, gained wealth between 2000 and 2010 due to active conservation policies, strict enforcement of forest laws and discouraging agricultural expansion in forest lands. Indonesia continues to lose forest wealth while growing GDP due to illegal logging and trade of timber, as well as deforestation for conversion to palm oil plantations. Some countries, including Romania, Bulgaria, and Haiti, experienced negative decadal growth during 1990 to 2000 while increasing the forest capital, while Zimbabwe experienced negative decadal growth during 2000 to 2010 while increasing the capital. The change in wealth to change in GDP ratio in rest of the countries is in the direction of the sign indicated. It is a matter of concern that of the 50 percent of the countries that experienced decline in wealth change to GDP growth ratios during 2000 to 2010, a majority are from low-income and lower middle-income countries.

The largest absolute declines in wealth occurred in Brazil, Nigeria, Indonesia, Nigeria, Myanmar, and Zimbabwe. China, the U.S., India, Vietnam, and Turkey gained forest wealth between 1990 and 2010. In China and Vietnam significant efforts have been made to reforest, leading to increased forest cover since 2000. There has also been a country-wide ban on logging in both. In China, the low productive agricultural lands were converted to forests under the Grain for Green Program (the largest national payment-for-ecosystem services scheme). India is pursuing a national goal of covering one-third of its geographic area with forest and tree cover through greening, and has implemented a ban on green felling since 1987. The U.S. and Turkey, like other countries, have embarked on massive afforestation programs, resulting in an increase in forest area and hence total forest wealth.

Figure 5 shows the contribution of different broad categories of services – provisioning, recreational, regulating, and supporting – to the total forest wealth in selected countries. We see that the percentage contribution differs but this is largely governed by the availability of

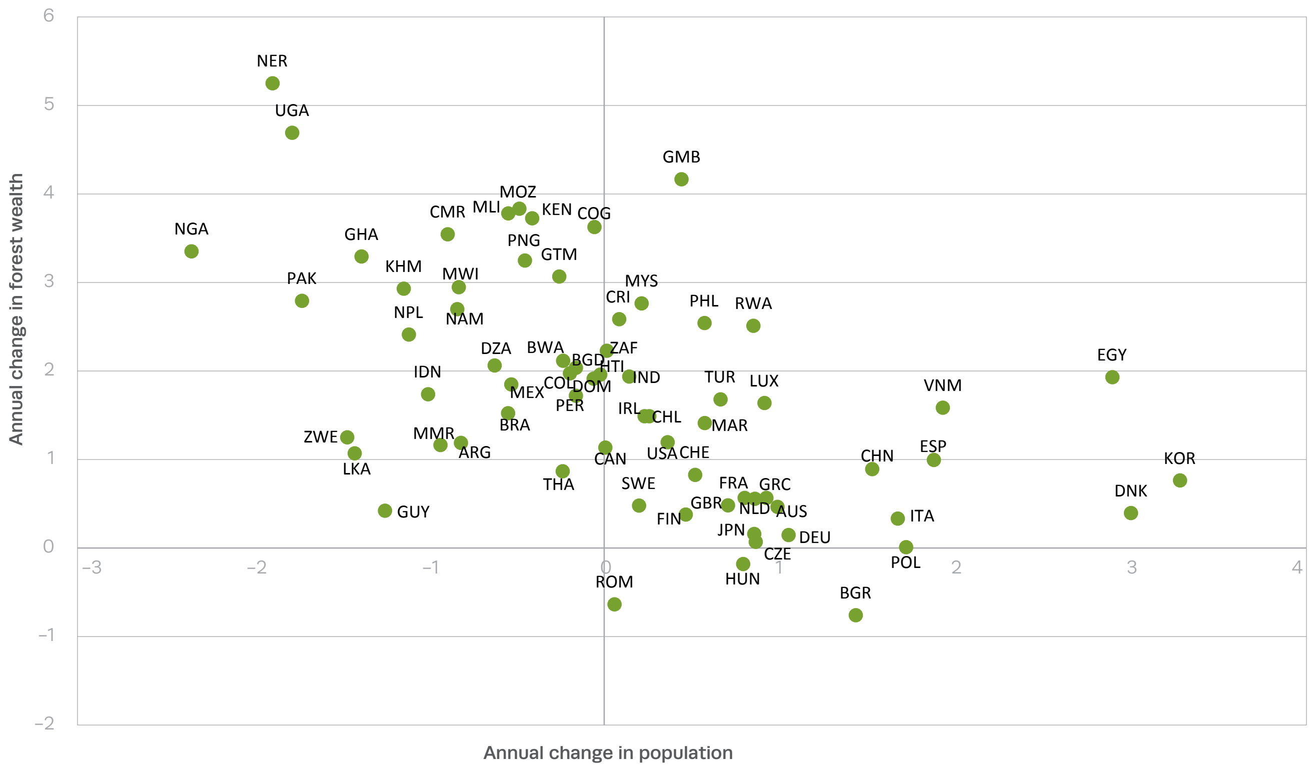

FIGURE 6
Relation between change in population and change in forest wealth (in percentage), 1990–2010

values and data. Moreover, we have not included all possible typology of values here due to non-availability.

It is important to analyze the reasons for decline in forest wealth in addition to changes in GDP. Population is likely one determining factor. Hence, per capita measures may be more important than absolute ones. Figure 6 shows this mixed trend: countries at the top in population growth rate, such as Niger, Uganda, Gambia, Mali, Kenya, Congo, Cameroon, Nigeria, and Ghana, have clearly depleted forest capital. These countries are dependent on forests for fuel, wood, and charcoal. Some of these countries – Nigeria, Ghana, and Gambia – are very rich in mineral resources. To sustain growth and avoid the vicious circle of poverty and environmental degradation, more investment in forest capital is required in countries with higher population growth rates and rich natural resources. During the period of 1990 to 2010, Botswana, Mexico, Thailand, Niger, and Costa Rica emerged as the top gainers in growth in per capita forest wealth. However, the countries which led in absolute wealth could not maintain per capita forest capital amid growing populations, with the exception of China.

In fact, only 22 percent of the countries have increased their per capita wealth since 1990, as seen in Figure 6. Clearly, the demographic pressure was high not only in lower-income and lower middle-income, but also in some high-income countries. What this means is that population growth has outpaced forest capital generation. From a standpoint of intergenerational sustainability, keeping per capita wealth constant is necessary.

Table 3 summarizes the trade-offs that the countries face between increasing growth vis-à-vis the forest wealth for the four classified groups, to facilitate the understanding of these per-capita growth rates: 1) Group 1 - Positive GDP growth and appreciation of forest capital; 2) Group 2 - Negative GDP growth and decline in forest capital; 3) Group 3 - Decline in GDP and increase in forest capital; and 4) Group 4 - Decline in both GDP and forest capital.

Table 2 illustrates lost forest wealth in selected countries. For the selected group of countries

TABLE 3 Changes in forest wealth and per capita capital vis–à–vis GDP growth

	Changes in absolute forest wealth, 1990–2010	Per capita changes in forest wealth
Growth in GDP while investing in forest capital	USA, China, India, Sweden, Japan, Finland, Egypt, Spain, Chile, France, Vietnam, Switzerland, Ireland, Denmark, Gambia, Rwanda, Netherlands, Germany, Czech Republic, Poland, Italy, Philippines, Romania, Republic of Korea, Morocco, Bulgaria, Greece, Austria, UK, Costa Rica, Hungary, Canada, Malaysia	China, Sweden, Japan, Finland, Egypt, Spain, France, Vietnam, Denmark, Netherlands, Germany, Czech Republic, Poland, Italy, Romania, Republic of Korea, Bulgaria, Greece, Austria, UK, Hungary
Growth in GDP while depleting forest capital	Brazil, Indonesia, Peru, Mexico, Colombia, Mozambique, Myanmar, Argentina, PNG, Republic of Congo, Cameroon, Thailand, Guyana, Nepal, Guatemala, Ghana, Namibia, Nigeria, Mali, South Africa, Botswana, Cambodia, Pakistan, Bangladesh, Algeria	Brazil, Canada, USA, Indonesia, Peru, Mexico, Colombia, Mozambique, Myanmar, Argentina, PNG, Algeria, Republic of Congo, Malaysia, Cameroon, Thailand, Turkey, Guyana, Nepal, Guatemala, Ghana, Namibia, Nigeria, Mali, South Africa, Botswana, Cambodia, Pakistan, Bangladesh, Philippines, Morocco, Costa Rica, Kenya
Decline in GDP as well as depleting forest capital	Zimbabwe	Zimbabwe, Haiti
Decline in GDP while increasing forest capital	Haiti	----

considered in the study, 2.87 percent of forest area has been lost since 1990. However, in monetary terms, we see a net positive change in overall forest wealth due to accumulation of timber (at the rate of 0.02 percent), accumulation of carbon in old growth forests, and improvement in the quality of forests in biodiversity-rich regions. While developed countries are maintaining their forest capital, most low-income and lower middle-income countries, in which natural resources are often a principal source of income for the poor, are losing forest capital,. At the same time, developing low- and middle-income countries are the prime drivers of GDP growth from 1990 to 2010. Thus, we see apparent difficult choices to be made between economic growth and forest capital. Because of the existence of lower limits to environmental degradation, there are thresholds beyond which the collapse of certain natural resources can be irreversible. Concerted effort is needed to recognize the significant amount of forest wealth that is lost as a result of these trade-offs, and efforts must be made to sustain natural capital for intergenerational equity.

5. Discussion and conclusions

This chapter has focused on estimating forest capital wealth in 68 countries using estimates on forest area, growing stock, and carbon, based on the FAO database and the ecosystem values published in the TEEB database. It was not possible to include all ecosystem services due to the non-availability of information. Therefore, these results provide only rudimentary, yet useful, estimates of forest wealth, and whether they are being managed sustainably. In addition, the estimates helps understand the exact contribution of forests, as well as the real beneficiaries of forest capital, and aid in decision-making by looking at whether investment in forest capital is adequate vis-a-vis other assets.

The results indicate at least two key messages. The first is that collating these ecosystem values within an accounting framework confirms that forest capital is often a significant component of total wealth. The second is that many countries appear to be losing significant amounts of this wealth. In effect, these countries are mining this renewable resource, likely due to a mixture of socioeconomic and demographic pressures. Whether or not these losses can be compensated by possible gains in other forms of wealth is a critical question. Because of the particular characteristics of forest assets and the often distinctive nature of benefits these stocks provide, this question is at least open to considerable debate.

Towards the beginning of this chapter, we were at pains to emphasize the preliminary nature of the empirical approach that we take in obtaining results for this number of countries. Having now outlined our findings, it is worth reiterating this message once more. In particular, our estimates are subject to an array of caveats which include (but are not restricted to) the following:

- Valuing ecosystem services: our coverage here is necessarily limited by the extent of the empirical record. While practical valuation of ecosystems has advanced tremendously, there remain – relatively speaking – substantial gaps. This raises a number of issues for using these data, not least reliance on transferring values between different countries.
- Quality of forest capital: while the evidence base for values makes clear that forests provide multiple ecosystem services, there is less routine modeling of the way in which these services are dependent on each other. For example, carbon sequestration depends on forest biomass, which in turn depends on properties such as the quality of soil and water moisture that the forest holds. This has a number of subsequent ramifications.
- Spatial diversity: while it is possible to talk generically about the benefits forest capital provides, more robust accounting needs to distinguish the spatial productivity of different forest assets. Consequently, a more "bottom-up" evaluation of land areas is needed. As such, the largely "top-down" approach taken here is only a placeholder for those more detailed efforts.
- Thresholds: it is clear therefore that forest capital accounting should ideally be based on a bedrock of metrics indicating the physical properties of the asset. This could also include knowledge of how far these ecosystems are from thresholds: i.e., some non-linearity after which (marginal) benefits provided are dramatically less. This is a matter of particular importance, for example, when evaluating changes in forest area (and, perhaps, changes in quality).
- Asset values: The value of a forest asset is essentially a forward-looking accounting magnitude, albeit based on what can be measured in the present. Yet, the stream of future services provided by this asset that will be valued in the future might depend on a number of factors, such as development outcomes (e.g., changing incomes per capita) and, indeed, the scarcity of the asset itself. Abbott and Fenichel (2014), for example, demonstrate a number of important complications in using (marginal) ecosystem benefits to value natural assets.

These are substantial conceptual and practical challenges. Not surprisingly then, natural capital accounting for forest assets remains a work-in-progress. In the interim, we argue that even rudimentary – but more comprehensive – values offer useful guidance, especially if the alternative is to assign (implicitly) a zero value to these elements. This holds only to the extent that these initial steps to assessing forest wealth across countries are used as the basis for further methodological progress rather than viewed as the end of the accounting process itself.

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CHAPTER 7

Challenges to ecosystem service valuation for wealth accounting

Edward Barbier

KEY MESSAGES

In recent years, substantial progress has been made by economists working with ecologists and other natural scientists in valuing some ecosystem goods and services.

However, difficulties in measurement, data availability and other limitations still preclude the valuation of certain ecosystem services.

There is often uncertainty associated with estimated ecosystem service values, and even more so with scaling up of local values to regional or national levels or updating these values annually, which poses problems for their use in wealth accounts.

In the absence of reliable estimates, the temptation is to use "second-best" estimates, or to transfer values from other locations; however, such methods should be used with caution and only under specific circumstances, at the risk of generating unrealistic values.

Progress in incorporating ecological capital in wealth accounts therefore requires developing more accurate methods of valuing ecosystem goods and services and applying them to a wider range of ecosystems.

1. Introduction[1]

The Inclusive Wealth Report 2012 recognized that ecosystems should be viewed as economic assets, as through their natural functioning and habitats they provide important goods and services to the economy (BARBIER 2012A, UNU-IHDP AND UNEP 2012). If ecosystems are to be considered capital assets – or ecological capital for short – then efforts to modify net domestic product (NDP) to include natural and human capital should account for the contributions of ecosystems, as well and depreciation of these assets (see Figure 1). Specifically, NDP should be adjusted to include two contributions due to ecological capital:

- the value of the direct benefits provided by the current stock of ecosystems; and
- any capital revaluation as a result of conversion of ecosystems to other land uses, with the "price" of changes in ecological capital reflecting the present value of the future direct and indirect benefits of ecosystems (BARBIER 2012A).

However, estimating these benefits poses many challenges. The most significant problem is that very few are marketed. Some of the products provided by ecosystems, such as raw materials, food, and fish harvests, are bought and sold in markets. But the majority of ecosystem goods and services are not, and thus do not have any market value. These include many services arising from ecosystem processes and functions that benefit human beings largely without any additional input from them, such as coastal protection, nutrient cycling, erosion control, water purification, and carbon sequestration. In recent years, substantial progress has been made by economists working with ecologists and other natural scientists in applying environmental valuation methodologies to assess the welfare contribution of these services. The various valuation methods employed are essentially standard economic techniques.[2]

Nevertheless, some of the non-marketed benefits of ecosystems are proving more elusive to value compared to others. Difficulties in measurement, data availability, and other limitations often preclude the application of standard economic valuation methods to certain ecosystem services. Consequently, there are gaps in in both geographic coverage, as well as scale of application. There is often uncertainty associated with estimated ecosystem service values, and even more so with scaling up of local values to regional or national levels. The latter issue especially poses a problem for wealth accounting, which requires aggregate values at the regional or national level. These must be replicated and updated annually, yet most valuations are for case studies in a specific location and time period.

Because of the difficulty in valuating these non-market benefits, only a handful ecosystem services have been calculated, and these estimates are often unreliable. If one or more valuation studies for a given ecosystem service exist, the correct estimate for wealth accounting purposes must still be chosen carefully. In the absence of reliable estimates, the temptation is to use "second-best" estimates, or to transfer values from other locations. However, such methods should be used with caution and only under specific circumstances, at the risk of generating unrealistic values. Finally, because for wealth accounting purposes ecosystem service values need to be aggregated to the regional or national level and replicated annually, it is also important to understand the specific challenges of "scaling up" values estimated only for a specific case study location and time period.

1 Research assistance provided by Sheikh Muhammad Eskander.

2 For example, Barbier (2007, 2011a, and 2011b), Bateman et al. (2011), EPA (2009), Freeman (2003), Hanley and Barbier (2009), Mendelsohn and Olmstead (2009), NRC (2005), and Pagiola et al. (2004) discuss how these standard valuation methods are best applied to ecosystem services, emphasizing in particular both the advantages and the shortcomings of the different methods and their application.

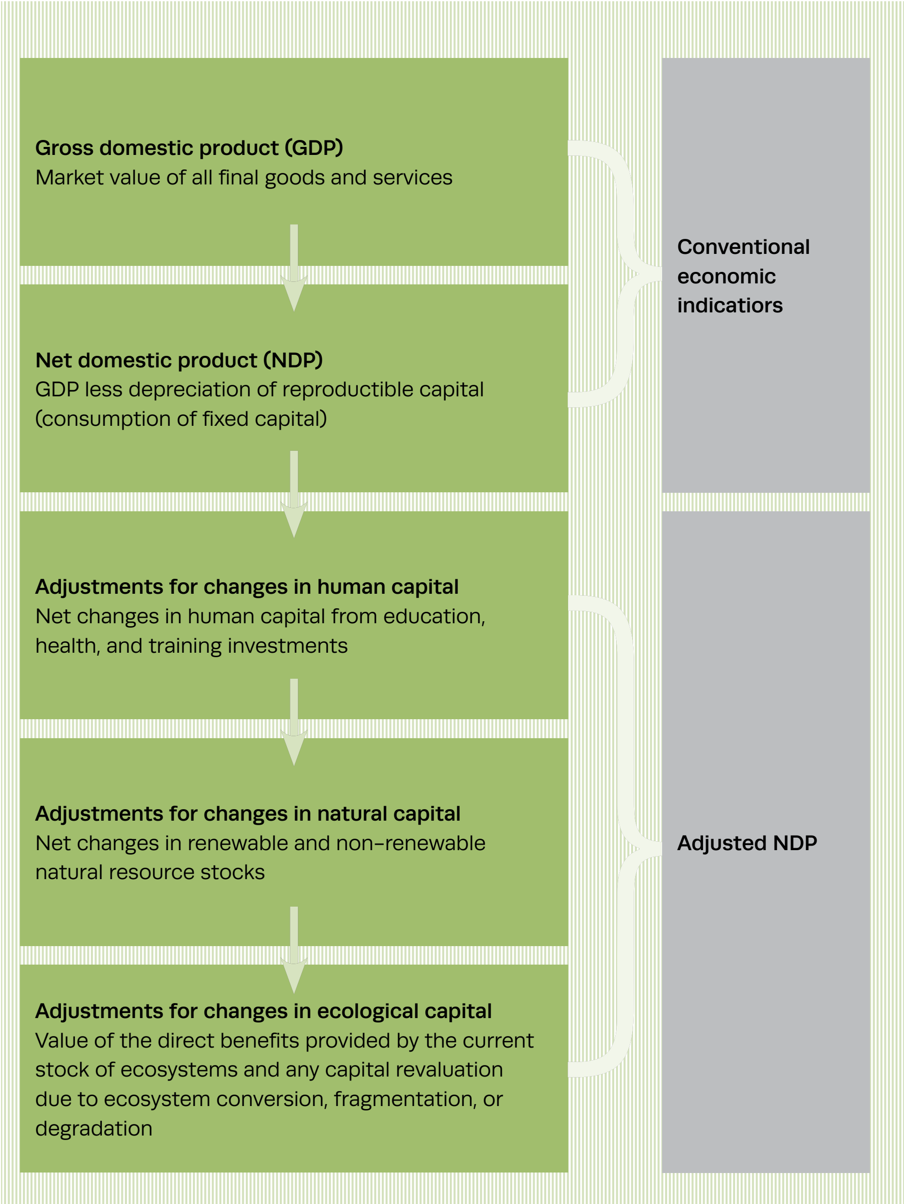


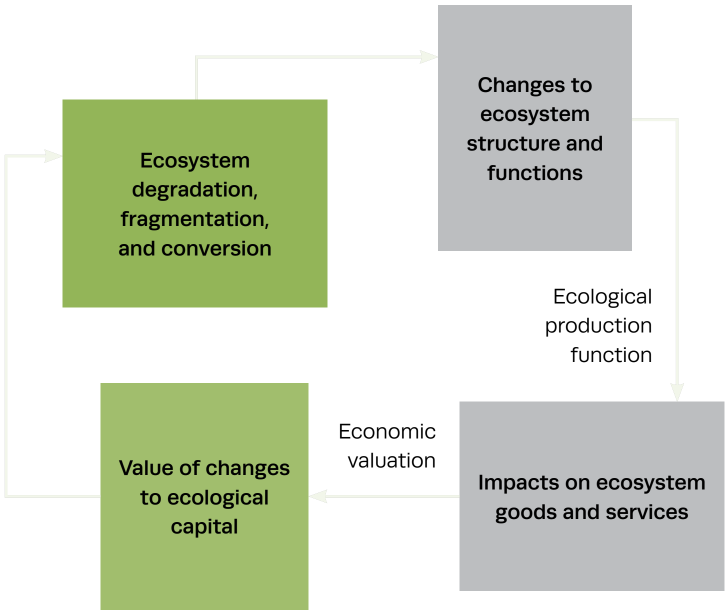
FIGURE 1
Adjusting GDP for reproducible, human, natural, and ecological capital

These challenges for applying ecosystem service valuation for wealth accounting are the focus of this chapter.[3] To facilitate the discussion, examples are drawn from one type of ecosystem – estuarine and coastal systems (ECEs). There is a growing literature of valuation studies focusing on the benefits of these systems, and policy-makers have expressed an interest in incorporating estuarine and coastal ecosystem services in national wealth accounts and environmental policy decisions (Börger et al. 2014, Richardson et al. 2014, UNU-IHDP and UNEP 2012). Thus, ECEs provide many examples of the challenges faced in valuing ecosystem services for wealth accounting.

3 A more general discussion of the rationale, methodologies, and challenges in valuing ecosystem services in a wealth accounting framework can be found in "Ecosystem Services and Wealth Accounting", Chapter 8 of the Inclusive Wealth Report 2012 (Barbier 2012a).

FIGURE 2

Valuing ecosystem goods and services and ecological capital depreciation



2. Valuing ecosystem goods and services

In identifying the ecosystem services provided by natural environments, a common practice is to adopt the broad definition of the Millennium Ecosystem Assessment that "ecosystem services are the benefits people obtain from ecosystems" (MEA 2005). Although this definition has been interpreted in different ways, a consensus is now emerging as to precisely what ecosystem services are and how they relate to ecological processes and functions.

First, a wide range of valuable goods and services to humans arise in myriad ways via the structure and functions of an ecosystem. For example, some of the living organisms found in an ecosystem might be harvested or hunted for food, collected for raw materials, or simply valued because they are aesthetically pleasing. Some ecosystem functions, such as nutrient and water cycling, can also benefit humans through purifying water, controlling floods, recharging aquifers, reducing pollution, or simply by providing more pleasing environments for recreation. These various benefits provided by an ecosystem via its structure and functions are what is meant by ecosystem services.

Second, although they are the source of ecosystem services, the structure and functions of an ecosystem are not synonymous with such services. Ecosystem structure and functions describe the components of an ecosystem and its biophysical relationship regardless of whether or not humans benefit from them. In contrast, as stated by EPA (2009), "ecosystem services are the direct or indirect contributions that ecosystems make to the well-being of human populations". Quantifying these contributions, or "benefits", in terms of human welfare is often referred to as valuing ecosystem services.

Figure 2 summarizes why quantifying and valuing ecosystem services is important for wealth accounting purposes. Human drivers of ecosystem change, such as pollution, resource exploitation, land conversion, species introductions, and habitat fragmentation, affect the structure and functioning of ecosystems. Assessing and quantifying this impact is important, as it alters the ecological production of ecosystem goods and services that benefit humans. These changes and alteration to ecosystems, especially through habitat degradation, fragmentation, and conversion, constitute the key ways in which ecological capital is "depreciated".[4] The role of economic valuation is to measure explicitly gains and losses in human welfare over time due to these changes. These values can then be used to estimate the direct benefits provided by the current stock of ecosystems, and any losses

4 In addition, the stock of ecological capital can be enhanced through restoration of degraded ecosystems or establishing new ecosystems through converting other land uses, in which case the objective of wealth accounting is to measure any resulting "appreciation" of ecological capitaldeon through such restoration activities. See Barbier (2011a) for further discussion, and Barbier (2014) for the specific wealth accounting methodology required, which is applied to the example of coastal wetland restoration in Louisiana, USA.

of the future direct and indirect benefits that occur when this ecological capital is degraded, fragmented, or converted to other land uses.

The biggest challenge to quantifying and valuing ecosystem services is inadequate knowledge to link changes in ecosystem structure and function to the production of valuable goods and services (Barbier 2011a and 2011b, NRC 2005, Polasky and Segerson 2009). This is certainly true for the various ecosystems found in coastal areas and estuaries, which are bodies of water and their surrounding coastal habitats typically found where rivers meet the sea.

The key habitats comprising estuarine and coastal ecosystems (ECEs) include marshes, mangroves, forested swamps, near-shore coral reefs, seagrass beds, oyster reefs, mud flats, barrier islands, and sand beaches and dunes. For many of these habitats, we often do not know how variation in ecosystem structure, functions, and processes give rise to the change in an ecosystem good or service, although we are starting to learn about some of these impacts. For example, in the case of coastal wetlands, the change could be in the spatial area or quality of a particular type of wetland, such as a mangrove, marsh vegetation, or swamp forest. The subsequent loss of habitat and vegetation may not only influence shellfish and other species that depend on the habitat but also reduce protection of shorelines and control of erosion. In addition, the loss of important wetland breeding and nursery habitat may influence a variety of valuable goods and services provided in neighboring marine systems, such as commercial or recreational fisheries. Alternatively, changes in ECE habitat could be due to variation in the flow of water, energy, or nutrients through the system, such as the variability in tidal surges due to coastal storm events, the influx of organic waste from onshore pollution, or the impacts of oil spills and other human-induced hazards.

Another problem encountered in quantifying and valuing ecosystem services is that very few are marketed. Some of the products provided by ECEs, such as raw materials, food, and fish harvests, are bought and sold in markets. Given that the price and quantities of these marketed products are easy to observe, there are numerous ways to estimate the contribution of the environmental input to this production (Barbier 2007, Freeman 2003, McConnell and Bockstael 2005). However, many other key ECE services arising from ecosystem processes and functions do not lead to observable marketed outputs. These include many services that benefit human beings largely without any additional input from them, such as coastal protection, nutrient cycling, erosion control, water purification, and carbon sequestration. In recent years, substantial progress has been made by economists working with ecologists and other natural scientists in applying environmental valuation methodologies to assess the welfare contribution of some of these services, such as coastal protection, carbon sequestration, and habitat-fishery linkages (EPA 2009, NRC 2005, Barbier 2011a, Barbier et al. 2011, Polasky and Segerson 2009).

Table 1 provides some examples of how specific ECE goods and services are linked to the ecological structure and functions underlying each service. It also cites, where possible, economic studies that have estimated the values arising from the good or service. The list of 94 studies included in Table 1 is only representative of the literature on economic valuation of ECEs; nevertheless, the table gives an indication of the range of valuation estimates available for specific goods and services, and is thus instructive.

As Table 1 indicates, most valuation studies for ECE goods and services are for tourism, recreation, education, and research; maintenance of fishing, hunting, and foraging activities; and,deon increasingly, storm protection. There are fewer valuation estimates of ecosystem services associated with regulatory functions, such as erosion control, flood protection, water pollution and sediment control, and carbon sequestration. There are no ECE valuations of maintaining temperature and precipitation. Such patchy coverage across different ecosystem goods and service is typical for other ecosystems as well. Again, this is in large part attributed to

TABLE 1

Examples of estuarine and coastal ecosystem services and valuation studies

Ecosystem structure and function	Ecosystem services	Valuation examples (94 studies)
Attenuates and/or dissipates waves, buffers wind	Storm protection	Badola and Hussein (2005); Barbier (2007) and (2012a); Barbier et al. (2008); Barbier et al. (2013); Barbier and Enchelmeyer (2014); Costanza et al. (2008); Das and Crépin (2013); Das and Vincent (2009); Kim and Petrolia (2013); King and Lester (1995); Landry et al. (2011); Laso Bayas et al. (2011); Mangi et al. (2011); Petrolia and Kim (2009) and (2011); Petrolia et al. (2014); Pompe and Rinehart (1994); Wilkinson et al. (1999). (19 studies)
Provides sediment stabilization and soil retention	Erosion control	Huang et al. (2007); Landry et al. (2003); Parsons and Powell (2001); Rulleau et al. (2014); Sathirathai and Barbier (2001). (5 studies)
Water flow regulation and control	Flood protection	Morgan and Hamilton (2010); Turner et al. (2004). (2 studies)
Provides nutrient and pollution uptake, as well as retention, particle deposition, and clean water	Water pollution and sediment control	Breaux et al.(1995); Byström (2000); Leggett and Bockstael (2000); Massey et al. (2006); Smith (2007); Smith and Crowder (2011); Turner et al. (2004);van der Meulen et al. (2004). (8 studies)
Generates biogeochemical activity, sedimentation, biological productivity	Carbon sequestration	Barbier et al. (2011); Luisetti et al. (2011); Mangi et al. (2011); Pendleton et al. (2012); Sikamäki et al. (2012); Thompson et al. (2014). (6 studies)
Climate regulation and stabilization	Maintenance of temperature, precipitation	(0 studies)
Generates biological productivity and diversity	Raw materials and food	Janssen and Padilla (1999); King and Lester (1995); Naylor and Drew (1998); Nfotabong Atheull et al. (2009); Pinto et al. (2010); Ruitenbeek (1994); Sathirathai and Barbier (2001). (7 studies)
Provides suitable reproductive habitat and nursery grounds, sheltered living space	Maintains fishing, hunting, and foraging activities	Aburto-Oropeza et al. (2008); Barbier (2003), (2007) and (2012); Barbier and Strand (1998); Bell (1997); Freeman (1991); Janssen and Padilla (1999); Johnston et al. (2002); Lange and Jiddawi (2009); Luisetti et al. (2011); McArthur and Boland (2006); Milon and Scrogin (2006); O'Higgins et al. (2010); Plummer et al. (2012); Samonte-Tan et al. (2007); Sanchirico and Mumby (2009); Stål et al. (2008); Swallow (1994); White et al. (2000). (20 studies)
Provides unique and aesthetic landscape, suitable habitat for diverse fauna and flora	Tourism, recreation, education, and research	Bateman and Langford (1997); Birol and Cox (2007); Brander et al. (2007); Brouwer and Bateman 2005; Coombes et al. (2009); Johnston et al. (2002); Kaoru (1993); Kaoru et al. (1995); King and Lester (1995); Kreitler et al. (2013); Landry and Liu (2009); Lange and Jiddawi (2009); Luisetti et al. (2011); Mathieu et al. (2003); Milon and Scrogin (2006); Othman et al. (2004); Pendleton (1995); Pendleton et al. (2012); Smith and Palmquist (1994); Smith et al. (1991); Tapsuwan and Asafu-Adjaye (2006); Turner et al. (2004); Whitehead et al. (2008). (23 studies)
Provides unique and aesthetic landscape of cultural, historic, or spiritual meaning	Culture, spiritual and religious benefits, existence and bequest values	Bateman and Langford (1997); Milon and Scrogin (2006); Naylor and Drew (1998); Subade and Francisco (2014). (4 studies)

the difficulty of determining how changes in ecosystem structure and function influence the ecological production of services, and that many key services are not marketed or directly related to some form of marketed economic activity and thus difficult to value.

3. Selecting valuation studies

Even if good valuation studies exist for one or more ecosystem services, one has to be careful to select the correct estimate for wealth accounting purposes. This often requires knowledge of the valuation technique used as well as the target population whose willingness to pay (WTP) for the service has been assessed. This issue can be illustrated with the example of the storm protection service of restored marsh in Louisiana, USA.

The number of economic studies that estimate the protective value of estuarine and coastal ecosystems has increased in recent years, especially for marsh and mangroves (see Table 1). Since Hurricane Katrina in 2005, the U.S. Gulf Coast, and especially the state of Louisiana, has been the focus of many estimates of ECE protective values. Most of these studies have focused on estimating the WTP for the post-Katrina coastal restoration efforts in Louisiana. The reported values for a few key studies are summarized in Table 2, which for comparison purposes, are presented in constant 2005 US$.

TABLE 2

Valuation estimates for the storm protection benefits of coastal restoration, Louisiana

	Valuation method and purpose	Year of estimate	Coastal area (ha)	Mean WTP (current US$)	Mean WTP (2005 US$)
Petrolia et al. (2014)[a]	Choice experiment survey of U.S. households for coastal wetland and barrier island restoration, southeast Louisiana	2011	94,547	$149 per household $181,220 per ha	$129 per household $157,341 per ha
Petrolia and Kim (2011)[b]	Contingent valuation survey of Louisiana households for preventing future coastal land losses, Louisiana	2009	181,013	$53 per household $628 per ha	$48 per household $571 per ha
Barbier et al. (2013), Barbier and Enchelmeyer (2014) [c]	Ex ante expected damage function estimate of reduced storm surge flooding damages to residential property, southeast Louisiana	2006	2.98	$41 per ha	$40 per ha
Landry et al. (2011)	Choice experiment survey of U.S. and Louisiana households for flood risk reduction from coastal restoration, Louisiana	2007	NA	$103 per household	$97 per household

Note: WTP = willingness to pay; ha = hectares; NA = not available.

a) One-time value, intermediate-scale restoration, consequential respondents only. The WTP per ha estimate is based on the value of the storm protection benefits of Louisiana coastal restoration to the estimated number of households in the U.S. of 114,991,721 in 2011 (Petrolia et al. 2014) population.

b) Annual value, based on a lower bound annual WTP for preventing future coastal wetland losses of $111 per household survey respondent, and households citing storm protection benefits as a top priority were 47.6 percent more likely to pay for preventing coastal wetland loss compared to all others.

c) Based on $99 per 0.1 increase in wetland-water ratio per m along a 5,961 meter (m) hurricane transect, and a $24 per 0.001 increase in bottom friction through in wetland vegetation along the same transect. The estimate here assumes that both benefits result from the creation of wetland of 2.98 ha (596.1 m by 50 m) along this transect.

Although all of the studies estimate the value of the same ecosystem service (storm protection), ECE habitat (restored salt marsh), and location (Louisiana, USA), there are important differences among them. With the exception of Petrolia et al. (2014), who estimate the marginal WTP of the U.S. population for coastal restoration in Louisiana, all values are for Louisiana residents. In addition, the studies differ in terms of which components of the storm protection benefits from restoring coastal wetlands are estimated.

As Kousky (2013) has pointed out, estimating the economic costs associated with natural disasters, such as storm surges or high-velocity winds, is difficult both conceptually and practically. For example, the range of costs include damages to commercial and residential property, infrastructure losses, emergency and clean-up costs, negative capital shocks to affected regions, mortality or illness, and altered risk perceptions (KOUSKY 2013). Over time, there may also be shoreline retreat as coastal residents and economic activity move inland, and even impacts on economic growth (HALLEGATTE AND GHIL 2008, KOUSKY 2014, LOAYZA ET AL. 2012, SMITH ET AL. 2006, TOYA AND SKIDMORE 2007).

However, a further problem for estimating the protective value benefits of ECE restoration is that these benefits must be assessed from an ex ante perspective, i.e., in anticipation of protection against future storm damages and economic costs. That is, as ECEs are restored, they are expected to reduce the likelihood, or risk, that an undesirable event, such as coastal flooding from storm surges, might occur. The WTP for increased wetland restoration is therefore directly related to the reduction in perceptions of the risk of bad outcomes occurring, such as mortality or illness, damages to property and other assets, and the disutility associated with risk exposure (i.e., risk aversion). As shown by Barbier (2014), these different factors mean that the overall marginal WTP by a representative coastal household for the storm protection benefits from restored wetlands comprises three components:

- the effect on the expected utility of the household from the change in the subjective probability that the storm occurs;
- the marginal benefit of the reduction in the exposure to the risks associated with the storm occurring,[5] and;
- the marginal benefit from the reduction in expected losses, such as to property, inflicted by any storm.

Different valuation methods can be employed to measure all three components simultaneously or, alternatively, one or more individually. This is reflected in the various studies listed in Table 2. For example, Petrolia et al. (2014) and Petrolia and Kim (2011) estimate the ex ante WTP for the full range of storm protection benefits of coastal wetland restoration, i.e., all three components simultaneously. In contrast, Barbier et al. (2013) and Barbier and Enchelmeyer (2014) calculate only the marginal benefit from the reduction in expected property losses from coastal wetland protection, whereas Landry et al. (2011) value the marginal benefit of the reduction in the risk of storm-related flooding.

From a wealth accounting perspective, some of these values may be relevant for accounting for the value of the "additional ecological capital" that is created when coastal wetlands are restored. In particular, the value of the storm protection service of restored ECEs, in terms of the likely reduction in property and other asset damages will already be reflected by changes in net domestic product (NDP), which takes into account changes in the value of these assets.

For example, in the U.S. national accounts, residential housing services are a component of personal consumption expenditure (PCE), and consequently part of gross domestic product (GDP). The rental value of tenant-occupied housing and the imputed rental value

5 For example, a reasonable assumption is that the household dislikes exposure to the risks associated with a storm, and that this disutility includes not only risk aversion but also the risk of possible injury, illness, or death if storm-related surge flooding or other damage occurs.

of owner-occupied housing are both part of PCE housing services, reflecting the amount of money tenants spend for the service of shelter and the amount of money owner occupants would have spent had they been renting. Deducted from the income generated from housing services are expenses such as maintenance and repairs, insurance, property taxes, mortgage interest, and any subsidies such as disaster relief payments, leaving a profit-like remainder of business income that is recorded as actual (for tenant-occupied housing) or imputed (for owner-occupied housing) rental income. As rental income measures income from current production, capital gains or losses resulting from the change in prices of existing assets are excluded. The services of non-residential dwellings and land owned by a business are included in its income from sales, and thus included in the accounting of income for the appropriate sector for each business.

In sum, if the expected damages avoided arise through protecting another economic asset, such as property, then there is no addition to wealth arising from this ecosystem service. To adjust NDP further for ECE protection values based on their indirect contributions in terms of protecting dwellings, buildings, and other property would therefore amount to double counting (BARBIER 2012B). On the other hand, if restoring estuarine and coastal systems involves a change in land use and values, then NDP should be further modified to reflect any resulting change in capitalized land values (BARBIER 2014).

The reduction in expected storm surge damages is only one component of the marginal WTP for any restoration. This ex ante WTP will also depend on avoiding or lowering the risks associated with the storm, which may be valued especially highly by more risk-averse households.[6] Valuations of flood risk exposure and reduction reveal that this WTP is in excess of expected flood damages, most likely reflecting disutility of risk exposure as well as mortality and morbidity risks (BROUWER ET AL. 2009, LANDRY ET AL. 2011, NAVRUD ET AL. 2012). Hedonic housing price studies before and after major U.S. hurricanes reveal that subjective risk perceptions, including risk aversion, influence housing prices as well as the purchase of flood insurance (BIN AND POLASKY 2004, HALLSTROM AND SMITH 2005, PETROLIA ET AL. 2013, SMITH ET AL. 2006).

To date, most studies of the protective benefit of ECEs do not estimate any resulting impacts on either the disutility from risk aversion or the risk of possible injury, illness, or death if the storm surge happens. One exception is Landry et al. (2011), who estimate that the average U.S. household is WTP $103 for coastal restoration to reduce flood risk in New Orleans (see Table 2). Some ex-post valuations have documented the role of ECEs, notably mangroves, in reducing storm-related deaths. For example, Das and Vincent (2009) estimate that, during the 1999 cyclone that struck Orissa, India, there would have been 1.72 additional deaths per village within 10 km of the coast if mangroves had been absent. Similarly, Laso Bayas et al. (2011) calculate that, during the 2004 Indian Ocean tsunami, mangroves, forests, and plantations situated between villages and the coastline in Acheh, Indonesia may have decreased loss of life by 3 to 8 percent.

Finally, as mentioned previously, it is also possible through survey methods to estimate the entire marginal WTP for storm protection benefits. For example, Petrolia et al. (2014) employ a choice experiment survey for different coastal wetland restoration programs in southeast Louisiana, which include different levels of protection afforded by restored wetlands (see Table 2). They find that the average U.S. household in their national survey is willing to pay US$149 for an intermediate increase in storm surge protection through coastal wetland restoration, but will pay only US$2 more for a further increase to high levels of protection. Similarly,

6 This may especially be a problem when ex post damages from past storms are used as the basis for measuring the ex ante WTP for expected damages (Barbier 2007, Freeman 1989 and 2003, pp. 243–247).

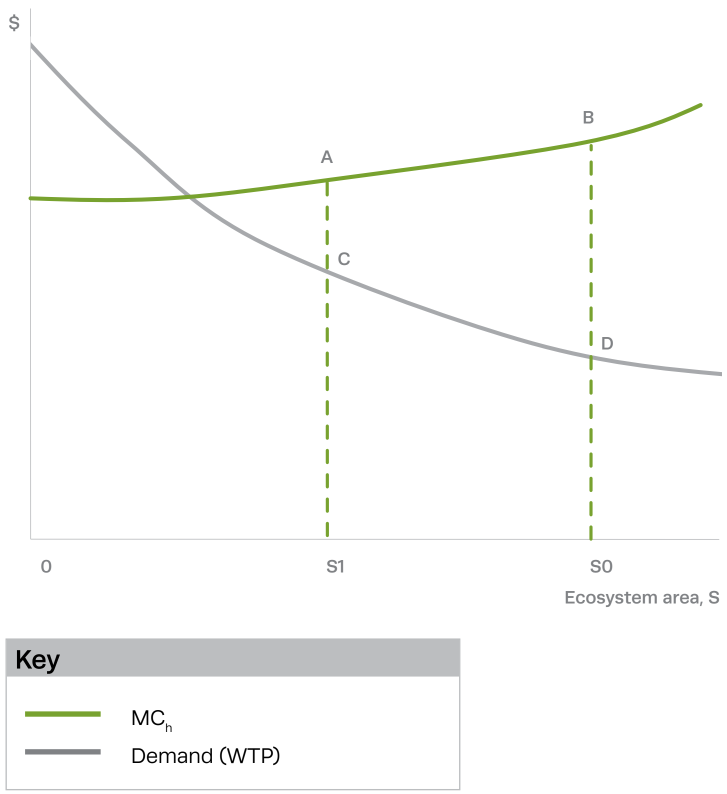
Petrolia and Kim (2011) estimate that a lower bound annual WTP for preventing future coastal wetland losses is US$111 per household survey respondent in Louisiana. As households citing storm protection benefits as a top priority were 48 percent more likely to pay for preventing coastal wetland loss compared to all others, one can infer that the overall storm protection benefits were $53 per household (see Table 2).

4. Second-best valuation methods

A common problem is a lack of reliable estimates of the value of ecosystem services that can be used for including the contribution of ecological capital into wealth accounts. In such circumstances, it is tempting to employ "back of the envelope" estimates as a substitute for the lack of reliable valuation studies. For example, in the case of estimating the value of the storm prevention and flood mitigation services of the "natural" storm barrier function of mangrove and other ECEs, the replacement cost method is often used as a shortcut valuation approach, as this method involves simply estimating the costs of replacing coastal habitat by constructing physical barriers to perform the same services (CHONG 2005, KING AND LESTER 1995, MANGI ET AL. 2011, SATHIRATHAI AND BARBIER 2001).

FIGURE 3

Replacement cost vs. expected damage function estimation of protective value



However, the replacement cost approach should be used with caution in estimating the value of an ecosystem service, such as storm protection. First, one is essentially estimating a benefit (e.g., storm protection) by a cost (e.g., the costs of constructing seawalls, groins, and other structures), and second, the human-built alternative is rarely the most cost-effective means of providing the service (BARBIER 2007, FREEMAN 2003, SHABMAN AND BATIE 1978).

Figure 3 illustrates the limitation of using the replacement cost method to estimate the protective value of an ECE. Assume that the ecosystem comprises a coastal wetland, such as a marsh or mangrove, of initial landscape area S0. The cost of the storm protection service provided by the ecosystem is "free" and thus corresponds to the horizontal axis, 0S0. However, suppose part of the wetland is lost or converted, and so the ecological landscape decreases to S1. The replacement cost method would suggest that the value of this loss in wetland area could be estimated by the cost of "replacing" the lost wetlands with seawalls, breakwaters, levies, and other human-built structures to reduce storm surge and waves.

In Figure 3, the marginal cost of an alternative, human-built coastal storm barrier is MC_h. Thus, the "replacement cost" of using the human-built barrier to provide the same storm protection service as the S0S1 amount of wetlands lost is the difference between the two supply curves, or area S0ABS1. However, this overestimates the benefit of having the wetlands provide the storm protection service. The true benefit of this ecosystem service is the demand curve, or total willingness to pay, for the service provided by S0S1 amount of wetlands less the

TABLE 3

Valuation of storm protection service of mangroves, Thailand, 1996–2004

Annual deforestation rate	FAO[a] 18.0 km^2	Thailand[b] 3.44 km^2
Valuation approach (US$)		
Replacement cost method:[c]		
Annual welfare loss	25,504,821	4,869,720
Net present value (10% discount rate)	146,882,870	28,044,836
Net present value (12% discount rate)	135,896,056	25,947,087
Net present value (15% discount rate)	121,698,392	23,236,280
Expected damage function approach:		
Annual welfare loss	3,382,169	645,769
Net present value (10% discount rate)	19,477,994	3,718,998
Net present value (12% discount rate)	18,021,043	3,440,818
Net present value (15% discount rate)	16,138,305	3,081,340

a) FAO estimates from FAO (2003). 2000 and 2004 data are estimated from 1990–2000 annual average mangrove loss of 18.0 km2.

b) Thailand estimates from various Royal Thailand Forestry Department sources reported in Aksornkoae and Tokrisna (2004). 2000 and 2004 data are estimated from 1993–1996 annual average mangrove loss of 3.44 km2.

c) Based on replacement cost method assumptions of Sathirathai and Barbier (2001).

Source: Adapted from Barbier (2007).

costs of providing protection. In Figure 3, this net benefit corresponds to area SoCDS1. Thus, the replacement cost method overestimates the net benefits of the storm protection service by area ABCD.

A more reliable method would be to estimate directly the net benefit of the storm protection service, or area SoCDS1 in Figure 3. As discussed in the previous section, one such method is the expected damage function (EDF) approach. If there is an increase in wetland area, such as through ecological restoration, then the value of this change is the total amount of expected flood damage losses avoided (Barbier and Enchelmeyer 2014, Barbier et al. 2013). If there is a reduction in wetland area, as shown in Figure 3, then the welfare loss is the total increase in expected flood damages resulting from a storm event (Barbier 2007). In both instances, the valuation would be a compensation surplus measure of a change in the area of wetlands and the storm protection service that they provide.

A comparison of using the expected damage function (EDF) approach described in the previous section and replacement cost method of estimating the welfare impacts of a loss of the storm protection service due to mangrove deforestation in Thailand confirms that the latter method tends to produce extremely high estimates compared to the EDF approach (Barbier 2007). The comparison of annual and net present values produced by the two methods is depicted in Table 3. But the expected damage function has its own limitations; for example, when households are risk averse, using ex post damage estimates can be a poor proxy for the ex ante willingness to pay to reduce or avoid the risk from storm damages (Barbier 2007, Freeman 2003, pp. 243-247). Nevertheless, because the EDF approach is a direct compensation surplus measure of a change in the area of ECEs and the storm protection service that they provide, it is a more reliable method of estimating the protective value of these ecosystems.

Shabman and Batie (1978) suggest that the replacement cost method can provide a reliable valuation estimation for an ecological service, but only if the following conditions are met: (1) the alternative considered provides the same services; (2) the alternative compared for cost comparison should be the least-cost alternative; and (3) there should be substantial evidence that the service would be demanded by society if it were provided by that least-cost alternative. Unfortunately, very few replacement cost studies meet all three conditions. One study that does estimates the value of using wetlands for abatement of agricultural nitrogen load on the Baltic Sea coast of Sweden (Byström 2000). The replacement value of the wetlands is defined and estimated as the difference between two cost-effective reductions of agricultural nitrogen pollution: one that uses wetlands for nitrogen abatement, and one that does not. The results show that the use of wetlands as nitrogen sinks can reduce by 30 percent the total costs of abating nitrogen pollution from agriculture in Sweden.

5. Transferring values

A second approach that is becoming more frequently employed to overcome the lack of reliable valuation estimates for ecosystems is benefit or value transfer. This method involves taking estimates of economic value from one site and "transferring" them to a similar location elsewhere (NRC 2005, Johnston and Rosenberger 2010, Plummer 2009, Richardson et al. 2014, Rosenberger and Stanley 2006, Troy and Wilson 2006). In the benefit transfer literature, the location from which the valuation estimates are taken is called the study site, because it is the site that has already been "studied" in some way to obtain the original valuation estimate. The location to which the estimates are applied is called the policy site.

Plummer (2009) reviews the extensive environmental economics literature on the limits to implementing benefit transfer, especially in the context of coastal and marine ecosystem goods and services. He concludes that the errors in applying this technique can be minimized provided that there is sufficient ecological and economic correspondence between the study and policy sites. Plummer (2009) suggests that "lack of correspondence" can be reduced when:

- the ecosystem at the study site is a good match for the ecosystem under consideration at the policy site (i.e., ecological correspondence), or;
- the respective populations of the study and policy sites do not differ considerably in terms of income levels, benefits derived from the ecosystem, preferences, employment and economic opportunities, household characteristics (e.g., occupation, education, number of adults and children, etc.), and other attributes that would cause wide variances in willingness to pay estimates between populations at the study site and populations at the policy site (economic correspondence).

In addition, Troy and Wilson (2006, p. 436), who have applied the benefit transfer method in valuing freshwater and coastal wetland benefits, also conclude:

"One of the biggest potential pitfalls in value transfer occurs when values are drawn from study sites that are situated in very different contexts than targeted policy sites. For example, to simply assume that the economic value of a freshwater wetland in one ecological region is going to be the same for a freshwater wetland in a wholly different region would be inappropriate."

The advancement in benefit transfer methods and modeling techniques, including the application of geographical information systems (GIS) and meta-regression analysis, means that there are more opportunities to use these methods as a way of extrapolating and transferring estimated ecosystem service values from one location, population, and time to other locations, populations, and periods. This is exemplified by a study that compares the importance of income and cultural differences in a coastal benefits transfer exercise in Ireland (Hynes et al. 2013). However, technique is not a substitute for reliability. If there is a lack of economic and ecological correspondence between study and policy sites, transferring values between the two sites through GIS and other methods will simply lead to inaccurate valuation estimates (Troy and Wilson 2006).

Similarly, there are potential drawbacks of applying benefit transfer through meta-analysis regression. This requires knowledge of the values of the independent variables for the policy site of interest, and assumes that the statistical relationship between the dependent and independent variables is the same between the study and policy sites (Richardson et al. 2014, Rosenberger and Stanley 2006). If one can statistically control for these differences in ecological and economic correspondence, this reduces the benefit transfer errors. In addition, there needs to be a sufficient number and variety of reliable policy site valuation studies to make the meta-analysis regression applicable in the first place. For example, as Table 2 shows, only a handful of ECE goods and services may serve this purpose. Unfortunately, benefit transfers may be less helpful in overcoming the lack of reliable estimates for the benefits associated with some important regulatory functions, such as erosion control, flood protection, water pollution and sediment control, carbon sequestration, and maintenance of temperature and precipitation.

6. Scaling values

Often for wealth accounting purposes, it is ideal to have aggregate values of ecosystem services at the regional or national level that can be replicated and updated annually. In contrast, most ecosystem service values, such as those listed in Table 1 for ECEs, apply to case studies in a specific location and over a specific time period. The problems associated with "scaling up" these values to the regional or national level, or applying past estimates to different and multiple time periods, demand serious consideration. Another problem involved with scaling is defining the population of beneficiaries for each service, e.g., how many people benefit from the storm protection service of a given mangrove forest. Simple approaches to scale temporally and spatially ecosystem values for wealth accounting should be used with caution.

A common approach to creating an aggregate benefit measure at a regional or national level is to take some average land unit value, such as US$ per hectare (ha) or acre, estimated for an ecosystem service at a specific location, and multiply this value by the total area of all similar ecosystems found within a region or country. However, using a simple physical index of area, such as ha or acres, to expand a value estimate to another scale violates basic economic principles, such as diminishing marginal utility, changing relative scarcity and substitutability, and thus will lead to large estimation errors (Bockstael et al. 2000, Bulte and van Kooten 2000, Richardson et al. 2014). The problem of this approach is summarized by Richardson et al. (2014, p. 3):

> "For example, the per-hectare fishery production value of a coral reef cannot simply be multiplied by the total acreage of coral reefs in a country, region or the world to calculate the total fishery production value of the country's, region's or world's coral reefs. The fish harvest lost with the loss of the one local reef may be compensated through increased fish imports from other areas or a switch to other foods. Such substitution possibilities generally decline with increasing spatial scale: the loss of a nation's, region's or the entire world's seafood harvest will have an increasingly nonmarginal effect on the relative scarcity and thus will increase the marginal value of a unit of seafood (and thus of the reef) because it will be much harder to substitute for than the loss of one reef."

Extending valuation estimates using a simple physical index of area may not even be appropriate for valuing entire ecological landscapes. Evidence suggests that the ecological production functions underlying some

ECE services vary spatially across habitat area (Aguilar-Perera and Appeldorn 2008, Barbier et al. 2011, Gedan et al. 2011, Koch et al. 2009, Peterson and Turner 1994, Rountree and Able 2007). In particular, storm protection and support for marine fisheries provided by coastal wetland habitats, such as mangroves and salt marshes, tend to decline with the distance inshore from the seaward edge.

Increasingly, valuation studies of ECE services are taking into account this spatial variability. In the Gulf of California, Mexico the mangrove fringe with a width of 5 to 10 meters has the most influence on the productivity of near-shore fisheries, with a median value of US$37,500 per hectare. Fishery landings also increased positively with the length of the mangrove fringe in a given location (Aburto-Oropeza et al. 2008). In Thailand, the values for storm protection service and support for offshore fisheries also vary spatially, with the benefits higher on the seaward fringe rather than further inland (Barbier et al. 2008 and Barbier 2012b). However, when the values for these services are assessed in combination with the benefits from controlling nutrient pollution across an entire coral reef-seagrass-mangrove seascape, both the seaward and furthest inland boundaries of the mangrove habitat have higher values than the interior of the system (Barbier and Lee 2013).

There are also limitations to transferring values estimated for one specific time period to other periods. One problem is that a valuation estimate may simply be outdated, especially if preferences or demand for a specific ecosystem service have changed considerably over time (Richardson et al. 2014). In addition, advances in valuation methodologies may mean that past benefit estimates based on less reliable methods are now less valid or reliable (Johnston and Rosenberger 2010). For example, as discussed above, through the 1990s, estimates of storm protection and erosion control services of ECEs mostly employed the replacement cost method, which tends to overestimate values (Barbier 2007, Chong 2005). In contrast, more recent estimates use improved valuation methods that more accurately measure willingness to pay for these services (see, for example, the studies listed in Table 2).

Finally, temporal variability in the ecological production of key ecosystem services may also affect the value of that service. For example, the coastal protection of the wave attenuation by vegetation contained in certain ECEs, such as mangroves, marshes, and seagrass beds, can vary if damaging storm events occur when plant biomass and/or density are low (Barbier et al. 2011, Koch et al. 2009). This is particularly important in temperate regions, where seasonal fluctuations of biomass may differ from the seasonal occurrence of storms. For example, along the U.S. Atlantic coast the biomass of seagrass peaks in the summer (April to June), and decreases in the fall (July to September), when storm events usually strike. In tropical areas, mangrove and seagrass vegetation has relatively constant biomass throughout the year, so the coastal protection service is relatively unaffected by seasonal or temporal variability. Nonetheless, the value of coastal protection of tropical ECEs is affected significantly when storm surge occurs during high or medium, as opposed to low, tides (Koch et al. 2009).

7. Conclusion

Significant progress has been made in recent years in estimating the values of key ecosystem services. This progress has sparked interest in using such valuation estimates to measure and account for the changes of ecological capital in wealth accounts. As shown in Figure 1, the methodology for extending adjustments to net domestic product (NDP) to allow for the contributions of ecosystems is straightforward. For example, employing this methodology, the Inclusive Wealth Report 2012 demonstrates how NDP in Thailand has been affected by annual mangrove loss that has occurred since the 1970s (Barbier 2012a). The three principle mangrove benefits are coastal protection, habitat-fishery linkages, and the collection of wood and non-wood products. The overall wealth benefits of these services was US$0.57 per person in Thailand in the 1970s, when large-scale mangrove deforestation first started, but only $0.28 per person by the 2000s, when deforestation had slowed considerably.

However, adapting valuation estimates of ecosystem goods and services for wealth accounting purposes poses some unique challenges. To facilitate and guide such approaches, this chapter has discussed many of these important challenges. Difficulties in measurement, data availability and other limitations can prevent the application of standard economic valuation methods to certain ecosystem services, such as coastal protection, nutrient cycling, erosion control, water purification, and carbon sequestration. Yet it is often these benefits that make the contribution of ecological capital so valuable. Consequently, efforts to incorporate ecosystems into wealth accounts frequently encounter significant gaps in the geographic coverage, scale of application, and reliability of the estimated ecosystem service values available from existing studies.

To overcome such gaps and produce aggregate regional or national ecosystem service values that can be updated annually, there is increasing interest in transferring and scaling up existing values, or to produce new values quickly through more expedient methods. As discussed in this chapter, such approaches need to be used with caution, as they are prone to problems of measurement error and bias.

In conclusion, there is no "short cut" substitute for the lack of reliable valuation studies for ecosystem good and services. Progress in incorporating ecological capital in wealth accounts is therefore ultimately tied to further progress in developing more accurate methods of valuing ecosystem goods and services and applying them to a wider range of ecosystems. Conducting additional and sound ecosystem valuation studies is the only dependable approach to addressing the gaps in geographic coverage and the scale of application that prevent incorporation of ecological capital in wealth accounting.

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CHAPTER 8

Using inclusive wealth for policy evaluation: the case of infrastructure capital

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KEY MESSAGES

Wealth accounting to date has focused primarily on the *assessment* of *past* performance in economies, by measuring changes to produced, natural, and human capital.

In order to use inclusive wealth for policy *evaluation*, we must estimate the impacts of a given policy on the trajectories of the capital stocks that comprise wealth.

Infrastructure is an important policy domain because proposed changes to current systems affect many, if not all, capital stocks, which results in capital stock interactions and trade-offs.

A *systems* view of policy evaluation is necessary in order to map and quantify these impacts and trade-offs; this can be managed using conceptual and mathematical models that capture integrated physical and economic processes.

To illustrate how one might conduct wealth-based policy evaluation, we use two infrastructure case studies – coal-fired power generation in China and the High Aswan Dam in Egypt. The case studies rely on integrated physical and economic models to quantify capital stock impacts of *past* infrastructure decisions.

Such models can be used to evaluate *prospective* infrastructure systems as well, although doing so requires careful consideration of future uncertainty. Scenario analysis is a useful and flexible method for incorporating uncertainty into wealth-based policy evaluation.

1. Introduction and motivation[1]

Inclusive wealth theory suggests that to sustain intergenerational human well-being, a society must sustain its productive base – the collection of its capital assets (DASGUPTA AND MÄLER 2000, HAMILTON AND CLEMENS 1999). The sum value of these capital assets, valued at *social prices* (also called shadow prices), is defined as the inclusive *wealth* of the society. Empirical work in wealth accounting has principally dealt with the *assessment* of past performance in various economies, by measuring changes to produced, natural, and human capital (ARROW ET AL. 2012, MUÑOZ ET AL. 2012). To conduct policy *evaluation* however, whether in infrastructure or other sectors, we must estimate the impacts of policy interventions on the future trajectories of the capital stocks comprising wealth. Wealth-based policy evaluation is equivalent to carrying out a *social* cost-benefit analysis (DASGUPTA 2009). In other words, if a policy were to increase the inclusive wealth of a society (valued at social prices), then the present discounted value of its social profits will be positive, making it acceptable (ARROW ET AL. 2003a).

Policies that can impact wealth at national scale often involve proposed investments in infrastructure. Infrastructure capital, a subset of produced capital, is commonly defined as the built civic assets essential for the functioning of an economy and society. Essential infrastructure sectors include electric power, water supply, agriculture production, and transportation, among others[2]. Infrastructure capital is typically planned, built, and managed in dedicated systems of assets (e.g., power grids, water networks, mass transit systems) and can be publicly or privately owned. These systems benefit society by supplying or transforming inputs in the form of electricity, clean water, food, and roads. Reliable access to these services facilitates economic production and consumption. However, these systems can also impact society negatively – through air pollution, greenhouse gas emissions, and the degradation of ecosystems – as a consequence of their productive activity. Furthermore, the benefits and costs of prospective infrastructure to human and natural capital differ in magnitude and timing, and can vary with technology. Thus, assessing the effects of proposed changes in infrastructure capital on the inclusive wealth – and ultimate well-being – of a society is not trivial.

The economics literature has largely focused on the effect of infrastructure on economic growth. For example, Calderon et al. (2014) use a "synthetic" measure of infrastructure, along with human and produced capital, to estimate a production function. Their synthetic measure includes physical quantities of roads, power, and telecommunications, in contrast to pecuniary measures such as spending or capital formation. Other studies have linked growth in infrastructure to total factor productivity through direct and indirect mechanisms (GRAMLICH 1994, ROMP AND DE HAAN 2007, STRAUB ET AL. 2008). Related work has assessed network effects and the non-linear impact of infrastructure services on productivity gains (HURLIN 2006, RÖLLER AND WAVERMAN 2001), as well as the mediating role of institutions (ESFAHANI AND RAMÍREZ 2003).

Infrastructure policy evaluation necessitates a different set of perspectives and methods than *ex post* assessment, which tries to establish a relationship between infrastructure investments in the aggregate and overall economic growth, typically at national levels and within rigid sectoral boundaries. Infrastructure planning traditionally occurs at different geographical scales (local, regional, national), varying temporal scales (near- to mid-term, long horizon), using sector-specific approaches (power networks are different from transportation networks), and firmly embedded in an institutional context (centralized, coordinated, or decentralized market-based

1 The authors would like to acknowledge the national science foundation and the center for complex engineering systems of MIT for partially funding this work.

2 For a list of what the U.S. Department of Homeland Security defines as critical infrastructure sectors, please see: http://www.dhs.gov/critical-infrastructure-sectors

projects). However, infrastructure planning increasingly emphasizes a systems view that reconciles time scales, cross-sectoral interdependencies, and spatial relationships (HALL ET AL. 2014). Integrating evaluation at the project level (a single, large multi-purpose dam), sector level (electric power generation), and systems level (interdependent water-energy system) with non-infrastructure capital stock linkages (human and natural capital impacts) is therefore at the frontier of infrastructure policy.

Inclusive wealth provides a framework for evaluating infrastructure through measured changes to capital stocks, the underlying drivers of development. Quantifying these impacts – for instance, the impact of coal-fired electric power on air quality and thus health and human capital – requires systemic understanding of the biophysical and economic processes that link the capital stocks in an economy and mediate their movement through time. Ekins (2012) developed a systems model of wealth creation by focusing on the role of each capital stock in the production process of an economy, and the capital feedback effects that occur as a result of production (in particular see Figure 1 in his paper). However, he draws less attention to the linkages that exist between each of the capital stocks, and the processes that influence their interactions. Finally, while previous work has laid the theoretical foundation for doing wealth-based policy/project evaluation (ARROW ET AL. 2003A, DASGUPTA 2009), to our knowledge it has yet to be operationalized for infrastructure.

To this end, we suggest a framework for evaluating prospective infrastructure interventions according to their impact on capital stocks at national scale. The framework builds on the welfare-theoretic foundations of inclusive wealth, thus while the chapter focuses on infrastructure, the framework is general to other policy domains. Application of the framework to specific infrastructure decisions can be carried out with integrated models that quantify the impacts and interactions between capital stocks. We demonstrate this with two case studies of infrastructure evaluation – power generation in China and the high Aswan dam in Egypt. We also discuss scenario analysis as a useful approach for incorporating uncertainty in evaluations.

2. A framework for evaluating infrastructure capital

This section develops a conceptual foundation for organizing wealth-based policy evaluation, followed by a mathematical formulation specific to infrastructure.

2.1 Mapping linkages between capital stocks: conceptual model

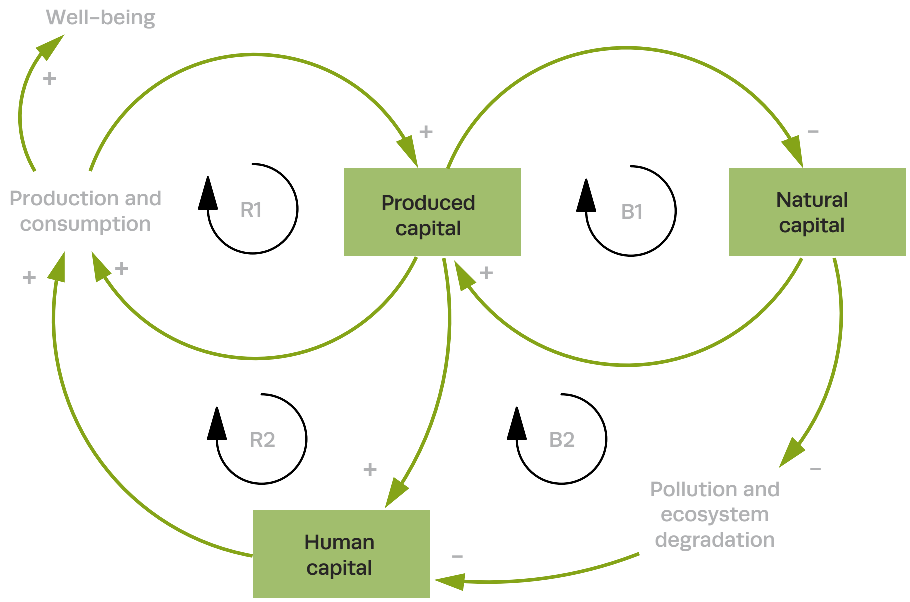
Conducting wealth-based policy evaluation requires analyzing factors not traditionally included in policy or project evaluation. For example, an evaluator contemplating construction of a hydroelectric dam generally confines the evaluation to the technical parameters of alternative design concepts and the narrow application of cost-benefit analysis (WORLD COMMISSION ON DAMS 2000). The evaluator is less likely to consider all of the extended and propagating impacts the dam will have on natural and human capital in the region. This relatively limited scope of evaluation neglects impacts, positive or negative, outside the small boundary of analysis. In contrast, wealth-based policy evaluation suggests a *systems view* of prospective policies to ascertain their full impact on the trajectories of all capital stocks. Figure 1 conceptualizes an economy as a dynamic system of linked capital stocks; because they are integrated a policy or perturbation affecting one stock will subsequently impact another through various channels.

Figure 1 consists of four interacting feedback loops that affect well-being via production and consumption. We assume, as is common in the literature, that well-being is a function of consumption, recognizing at the same time that well-being is derived from non-market goods and services and that consumption in

FIGURE 1

Inclusive wealth of an economy represented as a dynamic, interconnected system (stocks denoted in boxes)

Note: the "+" symbol at the head of an arrow means that a change in one direction (increasing or decreasing) at the tail will lead to a change in the same direction at the head. The "–" symbol at the head of an arrow means that change in one direction at the tail



an economy may not be equitably enjoyed. The first loop, R1, is a reinforcing loop, which means that an increase (decrease) in one variable will ultimately feed back to produce further increase (decrease) in that variable in the future, all else being equal. The reinforcing effect denoted by this loop is analogous to the neoclassical growth models, where economic output Y is a function of the stock of produced capital K, and some fraction of Y is reinvested to produce more K, thus increasing output further. Similarly, as production and consumption in an economy increase and fuel economic growth, the stock of produced capital will also grow. As this stock grows, it reinforces further production and consumption in the economy.

The second reinforcing loop, R2, operates via human capital. Human capital generally consists of the education, skills, core competencies, and health of both the working and total population in a society. As the stock of produced capital accrues, the stock of human capital also increases. Benefits of produced capital such as access to reliable electricity, better schools and hospitals, and modern technology and education enhance labor productivity. Furthermore, as recent macroeconomic literature suggests, enhanced human capital leads to more production and consumption (e.g., ROMER 1989).

The reinforcing loops R1 and R2 denote the mechanisms of economic growth studied most in the econometric literature. Scholars have attempted to derive empirical estimates of the elasticities of (produced) capital and labor (now called human capital) in various countries of the world. However, there is more to sustainable development than these reinforcing loops alone reveal.

Modern society depends heavily on natural capital – non-renewable and renewable resources and local and global ecosystems – to provide the goods and services we enjoy. Bringing natural capital into the picture introduces the notion of *balancing* loops, where an increase (decrease) in one variable will feed back through the balancing mechanism to decrease (increase) that same variable in the future. The balancing loop, B1, is the frequently-discussed resource depletion loop. Growth in the stock of produced capital leads to a decline in natural capital, eventually diminishing the resource-dependent produced capital. Technological progress (not included explicitly in the figure) dampens the balancing effect, and the timing and force with which this loop will impinge on a society is greatly debated. Furthermore, while the diagram aggregates stocks of produced and natural capital into single variables, scarcity and other market or regulatory pressures may drive substitution between assets. The extent to which produced capital can replace natural capital in production processes, or natural capital stocks can substitute for each other, again depends heavily on technological progress, and the social, economic, and political context of the nation.

The second balancing loop, B2, captures the impact of depleting natural capital stocks on human capital via pollution and ecosystem degradation. In other words, a country pollutes and degrades ecosystems by mining natural capital to develop its produced capital base. These deleterious effects, in whatever form they are manifest, decrease the stock of human capital predominantly through reductions in health, such as premature deaths, spread of infectious diseases, and increased morbidity. As the stock of human capital decreases, production and consumption in the economy also decrease. In some cases, reductions in natural capital may have an immediate impact on well-being, where, for instance, the physical presence of old-growth forests or sacred groves are a source of well-being in a society.

The relative strengths of the two types of loops affect the trend of development. If the reinforcing loops dominate the balancing loops, then development tends to be sustainable because produced and human capital grow faster than natural capital declines. In contrast, if the balancing loops dominate the system, development tends to be unsustainable, because as natural capital declines, it exerts downward pressure on human and produced capital[3]. Production and consumption could still be increasing in the latter case, particularly if quantified using measures like GDP (gross domestic product), which fail to capture many aspects of human well-being. Thus, while not explicitly indicated in Figure 1, it is important to recall the central tenet of inclusive wealth theory, namely that well-being moves in the same direction as wealth, the value aggregation of all capital stocks in an economy's productive base.

The figure also delivers another key *systems* intuition: produced capital, including its infrastructure assets, is a central driver of change in the other capital stocks. It facilitates gains in production and consumption, both directly and indirectly via human capital. Produced capital choices also drive resource depletion and the externalities affecting human health and well-being. Evaluating policies for the produced capital sector – whether in extraction, manufacturing, or infrastructure – therefore requires evaluation of impacts to *all* other capital stocks.

Thus while our framework focuses on infrastructure, it could be extended to include other forms of resource- and pollution-intensive produced capital, such as factories and heavy industry. Infrastructure, however, is unique in that every country needs some basic level of infrastructure, while goods derived from heavy industry can be imported. Thus, infrastructure planning and its effect on national sustainable development is a germane problem for every national government.

2.2 Measuring capital stock impacts of infrastructure: mathematical model

What are the impacts of a coal-fired vs. solar-powered electricity system on the stocks of human and natural capital, as well as production and consumption and well-being, over time? To answer questions like this one, we develop a framework that extends the formulation of Dasgupta (2009), Dasgupta and Mäler (2000), and Arrow et al. (2003b). We define $Y(t)$ as gross national product at time t, a measure of the output achievable given the produced capital stock $K(t)$, the human capital stock $H(t)$, the extraction rate $R(t)$ of a natural capital stock $N(t)$, and total factor productivity $A(t)$. Total

3 There is a third mode of behavior, whereby the negative effect of the balancing loops on the capital stocks exactly cancels out the positive effect of the reinforcing loops. In this case the rate of the change in the capital stocks will be zero and the system will be in steady-state. By inclusive wealth theory, this situation represents sustainable development.

factor productivity measures the residual proportion of output not explained by the inputs of production, capturing the effect of technological progress, the efficiency with which inputs are used, and institutional conditions. If we ignore that total factor productivity can be a function of investments in produced and human capital and the rate at which natural capital is extracted, then gross national product can be described as:

EQUATION 1

$$Y(t) = A(t) f(K(t), H(t), R(t))$$

Furthermore, we define the depreciation rate corresponding to produced and human capital as δ_K and δ_H respectively and investment in each as I_K and I_H. We assume that $N(t)$ is a renewable resource such that it grows according to a regeneration function $g(N(t))$ and declines according to the extraction rate $R(t)$. On timescales relevant to policy-making for sustainable development, we would assume no regeneration function for non-renewable resources. Aggregate consumption at time t is denoted $C(t)$, and we assume that [intergenerational] well-being is derived from the utility of that consumption. The rate of change for each capital stock is therefore:

EQUATION 2

$$\frac{dK(t)}{dt} = Y(t) - C(t) - I_H(t) - \delta_K K(t) = I_K(t)$$

$$\frac{dH(t)}{dt} = I_H(t) - \delta_H H(t)$$

$$\frac{dN(t)}{dt} = g(N(t)) - R(t)$$

We then modify the structure to account for the effects of infrastructure capital – an explicit subset of produced capital – on human capital (the same could be done for natural capital). Consider the example of a country's electric power system. A fossil-based power plant consumes some amount of non-renewable natural capital (e.g., oil, natural gas, coal) and converts it to usable electricity via a set of technologies and processes. The process generates some amount of pollution, which may negatively affect the surrounding communities. Well-being may decline directly as a result of simply seeing the pollution, but to illustrate the links between capital stocks we focus only on the impacts that pollution has on human capital. Thus we modify the equations according to the following:

EQUATION 3

$$\frac{dK(t)}{dt} = I_K(t) = \frac{dK^{IN}(t)}{dt} + \frac{dK^{O}(t)}{dt}$$

$$\frac{dH(t)}{dt} = I_H(t) - \delta_H H(t) \pm \delta_H^{IN} H(t)$$

$$\delta_H^{IN} H(t) = \frac{dK^{IN}(t)}{dt} \frac{\partial H(t)}{\partial K^{IN}(t)}$$

$$\frac{\partial H(t)}{\partial K^{IN}(t)} = f(K^{IN}(t))$$

$$K^{IN}(t) \equiv \langle a_1(t), a_2(t), \cdots, a_n(t) \rangle$$

Investment in produced capital is split between investments in infrastructure capital K^{IN}, which we'll assume for now is just in electric power, and other non-infrastructure produced assets K^{O}. For our purposes, we care only about changes to K^{IN}. Increases to human capital come from investment, education being the primary driver in the literature (Barro and Lee 2013, Klenow and Rodriguez-Clare 1997). Reductions come from the "normal" (or baseline) depreciation δ_H in human capital, which results from people naturally aging and dying. The net infrastructure-induced effect δ_H^{IN} on human capital could be positive or negative. For instance, while pollution has an obvious negative impact on human capital, infrastructure can also provide reliable access to lighting so that students can study at night.

Finally, the marginal effect of another unit of power generation on human capital depends on the attributes $a(t)$ of the electric power system. This vector of attributes defines the system's technology, efficiency, fuel source, environmental controls, age, etc. at time t.

An important concept in infrastructure capital is *inertia*. By inertia we mean that the underlying attributes $a(t)$ of the infrastructure capital stock cannot instantaneously change; there is a lag between an investment decision and its change to the system. Inertia is important because evaluating the merits of a proposed change to the infrastructure stock requires modeling the inertia of the system for projecting its evolution and subsequent impacts into the future. Consider again the example of a fossil fuel-based electricity system. The system is a collection of infrastructure capital assets, comprising different *vintages*. These vintages may be associated with different power production efficiencies, factor input requirements, and pollution emission levels. As a result, an electric power system with old, inefficient, and polluting assets will likely have a more damaging net effect on capital stocks than a newer, more efficient system. Furthermore, even if all new builds were from renewable sources, the inertia in the energy system means that in the absence of forced retirements many of the fossil-based assets will remain for decades – some coal power plants in OECD countries have been in operation for almost 100 years. Thus, in the absence of retrofitting, these plants will continue to pollute the air and degrade ecosystems.

The impact on human capital of pollution from infrastructure could manifest in several ways. Recall the equation for human capital used in the 2012 Inclusive Wealth Report (UNU-IHDP AND UNEP 2012, Annex 2):

EQUATION 4

$$H = e^{\rho A} \times Pop_{15+} \times \int_{t=0}^{T} \bar{r} e^{-\delta t} dt$$

Aggregate human capital H is the product of human capital per adult (determined by the market return ρ on educational attainment A), the adult population, and the average discounted labor compensation over an entire life's working period, T. Pollution from coal-fired electric power could either directly reduce the adult population via premature deaths, or it could decrease a life's working period through extended absenteeism at work. Importantly, the youth population is not represented in the human capital equation. Yet, premature mortality and respiratory disease for the younger population will have the largest impact on human capital decline if aggregated over an entire lifetime since the rate of return on that capital in the earlier years is higher (HECKMAN 2000).

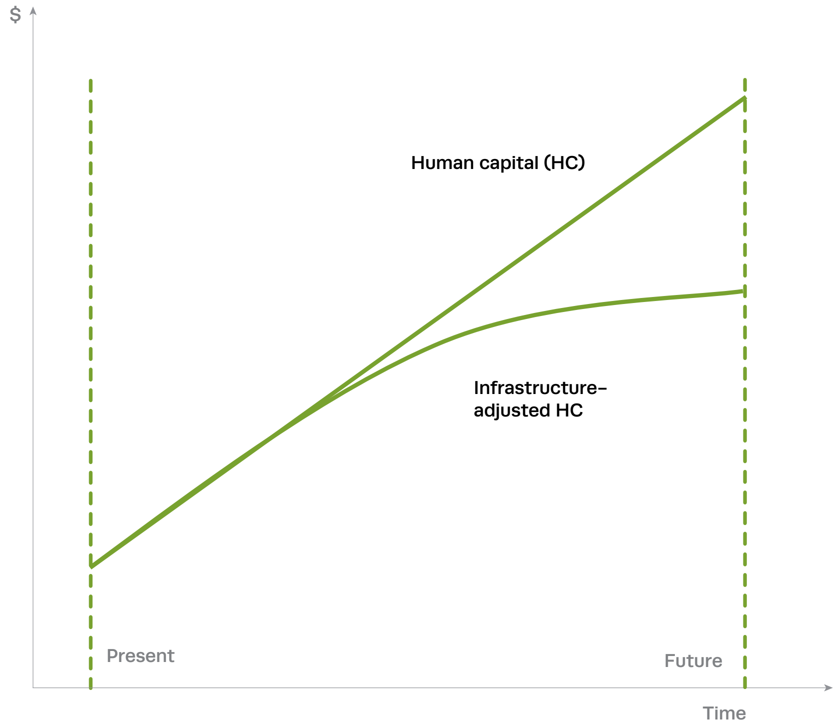
Double counting is another important issue. The "normal" depreciation of human capital must be clearly separated from the infrastructure-induced depreciation in the accounting exercise. If done appropriately, one could devise two trajectories of human capital, where the effect of infrastructure-induced decline is either included or not (Figure 2).

The two mechanisms through which infrastructure-induced impacts can decrease human capital have different implications for inclusive wealth. The direct effect of pollution on population through premature deaths is an impact on the physical *stock* of human capital. The indirect effect that shortens a life's working period is an impact on the *shadow price* of human capital; workers work less over time because of pollution-related illnesses, and wages are foregone due to premature deaths. While we focus on the human capital impacts of infrastructure in order to develop the framework, marginal impacts to natural capital could be measured in the same way – for instance, the ecosystem degradation effects of coal- vs. solar-powered generation.

3. Case studies of infrastructure policy

In this section we apply the framework outlined above to two case studies of *past* infrastructure decisions: (1) power generation in China and (2) the high Aswan Dam in Egypt. We summarize two studies that used counterfactual analysis techniques and integrated physical and economic models, and reanalyze their conclusions in the context of inclusive wealth. Integrated

FIGURE 2
Infrastructure-adjusted human capital may be lower than the baseline projection due to health-related reductions in the adult population and/or life's working period.



models are useful for wealth-based policy analysis because they provide a method for implementing the systems view in evaluation by capturing capital stock linkages and interactions (models focused exclusively on either the physical world or the economy cannot readily do this). We use the modeling results from these studies to evaluate whether or not inclusive wealth (and therefore well-being) increased or decreased as a result of the corresponding infrastructure interventions.

3.1 Air pollution and health impacts of power generation in China

China experienced rapid growth in produced capital over the period of 1990 to 2008 (Figure 3). Growth in produced capital is one of the primary reasons China's development was considered sustainable over this 19-year period; in fact China had the largest per capita growth rate in wealth across all 20 countries analyzed in the 2012 Inclusive Wealth Report, despite massive population growth (MUÑOZ ET AL. 2012). At the same time, this rapid development has led to increased pollutant emissions, mostly from the country's coal-fired power generation. Degraded air quality is one of the most prominent and visible environmental impacts of the electricity system, and China's development more broadly (WORLD BANK AND SEPA 2007).

We can quantify the impact of electric power infrastructure on human capital by retrospectively analyzing the impact that air pollution has had on Chinese health and economy. Matus et al. (2012) quantified such impacts stemming from ozone and particulate matter pollution between 1975 and 2005. They estimated mortality (deaths) and morbidity (disease) using concentration information coupled with health impact functions drawn from epidemiological literature. Using a computable general equilibrium (CGE) model, they incorporated medical costs as well as mortalities in the form of a labor shock. The model calculates welfare losses that accrue due to: (1) wages foregone from premature mortality and morbidity and (2) broader economic losses from reduced consumption and investment and labor input. While the authors call (1) welfare loss, this quantity is equivalent to the second two terms of Equation (4), namely

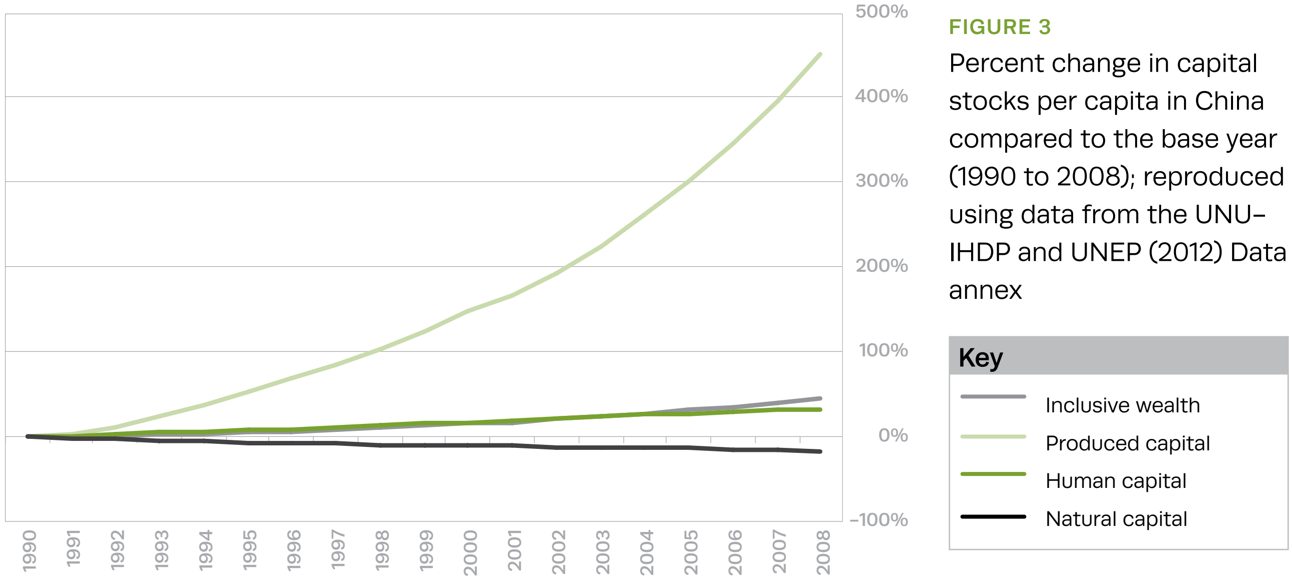


FIGURE 3

Percent change in capital stocks per capita in China compared to the base year (1990 to 2008); reproduced using data from the UNU-IHDP and UNEP (2012) Data annex

	Monetary value (billions of 1997 US$)	Share of total welfare loss (%)
Total welfare loss	69.0	100.0
Direct loss due to mortalities from chronic exposure	42.6	61.7
Mortalities that occurred in 2005	4.4	6.4
Loss in 2005 from prior year cases	38.2	55.4
Direct loss due to other health outcomes	6.7	9.7
Non-fatal health outcomes	6.5	9.4
Mortalities from acute exposure	0.2	0.3
Broader economic losses	19.7	28.6

TABLE 1

Decomposition of welfare loss in 2005; these estimates represent the difference between what historically occurred and what would have occurred under a cleaner infrastructure scenario. Reproduced with permission from Matus et al. (2012).

the reduction in working adults times foregone earnings, calculated dynamically over the 30-year time period. As Table 1 shows, the wages lost due to mortalities represented the largest share of welfare loss (61.7 percent), indicating that the human capital effects of air pollution in China far exceed other effects[4]. To then estimate the marginal effect of coal-fired power infrastructure on human capital – $\delta_H^{IN} H(t)$ from Equation (3) – one would need to relate ozone

4 In the broader economic losses (28.6 percent of total welfare loss), the reduced investment that occurred as a result of lower gross income reduced the produced capital stock. While not as large as the human capital impacts, this illustrates another important linkage, namely that marginal reductions in human capital can lead to less produced capital via less gross income.

and PM_{10} concentration changes to each marginal unit of new generation.

While health impacts from air pollution increased monotonically in China between 1975 and 2005, overall economic growth (production and consumption) increased at a faster rate. Thus, the welfare losses from air pollution actually decreased as a *percentage share* of total welfare over time. In the context of Figure 3 this result makes sense; produced capital (and importantly population!) grew faster between 1975 and 2005 than the decline in human capital caused by the air pollution of those produced assets (coal-fired power infrastructure being the primary air pollution culprit). Despite the large and growing impact on human capital, the analysis suggests that coal-fired power has facilitated a net increase in wealth in China over the past several decades.

To complete the full social cost-benefit analysis of electric power infrastructure, one would need to calculate the [social] *costs* of the alternatives in addition to the health-related benefits, something that the Matus et al. (2012) study leaves to future work. The analysis would also have to include *natural* capital stock impacts. This includes changes to the country's coal stock, but also impacts on groundwater quality, soil toxicity, and global climate change (a much trickier task since climate is a publicly owned natural asset). Finally, to evaluate proposed changes to China's electricity system we need to take account of the infrastructure systems that will be in place, the pace at which their marginal effects can change (via environmental retrofits or large-scale investments in renewable energy), and, therefore, their net impact on capital stocks over time. If the wealth gains to human and natural capital of a cleaner electricity system outweigh the wealth reductions stemming from higher costs, then a transition away from coal-fired power should be implemented in China.

3.2 The capital stock impacts of the High Aswan Dam in Egypt

> *The global debate about large dams is … complex because the issues are not confined to the design, construction and operation of dams themselves but embrace the range of social, environmental and political choices on which the human aspiration to development and improved well-being depend. … at the heart of the dams debate are issues of equity, governance, justice and power – issues that underlie the many intractable problems faced by humanity… The direction we must take is clear. It is to break through the traditional boundaries of thinking and look at these issues from a different perspective, … [one that] reflects a comprehensive approach to integrating social, environmental and economic dimensions of development.* (WORLD COMMISSION ON DAMS, 2000)

This is the case when analyzing the High Aswan Dam (HAD) in Egypt, completed in 1971, its purpose to convert the variable and uncertain flows of Nile River water (Figure 4) into a predictable and controllable supply stored in Lake Nasser. It also added 2,100 MW of power generation capacity to the electricity grid. Strzepek et al. (2008) conducted a retrospective study of the economic impacts of the dam, and compared these impacts to the counterfactual scenario of the dam never having been constructed.

The study connected a water resources systems model with a CGE model, which takes water availability as an input into various sectoral production functions (energy: hydropower; transportation: navigation; agriculture: irrigation). The sectoral impacts were estimated as a comparative static simulation using a CGE model of the 1997 Egyptian economy as the comparative year. The stable water supply scenario (with HAD) provided the CGE with the mean of the effectively constant historical releases of HAD from 1971 to 1999, while the variable flow scenario (without HAD) provided the CGE with

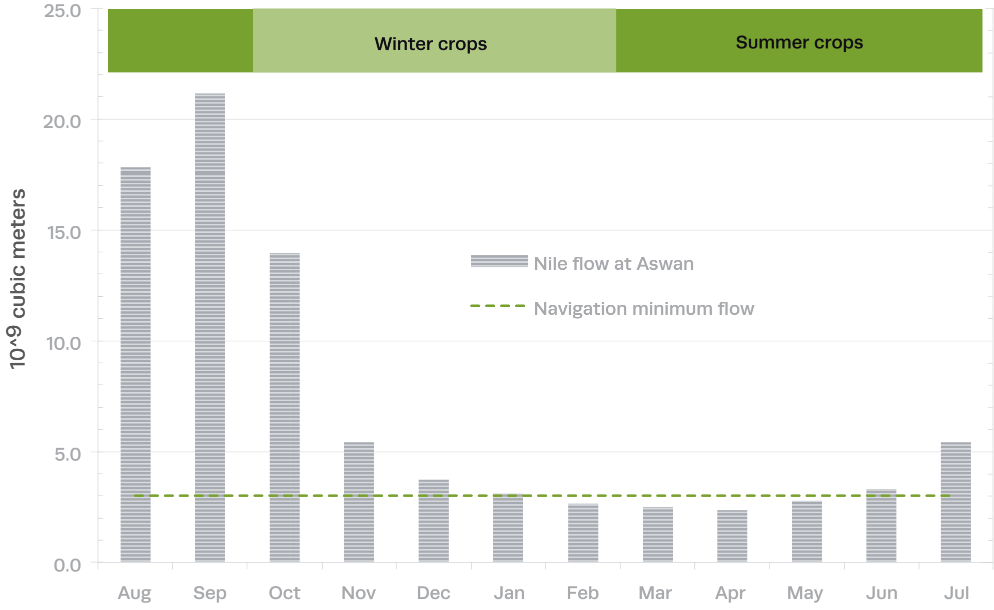


FIGURE 4

Mean monthly Nile flow at Aswan and growing seasons; the dam resulted in larger and more stable flows in the summer grow–ing season. Reproduced with permission from Strzepek et al. (2008)

an ensemble of 71 years of natural Nile flows that would have entered Egypt. Each year is run independently as a comparative static simulation, and a distribution of model outputs and statistics are calculated.

Interestingly, the study found that stable water supply led to farmers growing lower value crops in the summertime (e.g., rice), such that agricultural production in the summer growing season would have actually been higher without the dam. However, the HAD also facilitated double cropping of winter crops (e.g., wheat), which have lower irrigation requirements and higher market value. Furthermore, without the HAD years of low water flows would have generated negative shocks to the agriculture, energy, transportation, and tourism sectors, though during years of high flows the economy would not have been able to capture the additional benefits. Thus, after accounting for the risk premium of a stable water supply, the total annual net benefit of the dam was estimated to be EGP 7.1 billion (~ US$1 billion) to EGP 10.3 billion (~ US$1.5 billion), or 2.7 percent to 4.0 percent of 1997 GDP.

While Strzepek et al. (2008) provide a useful starting point for evaluating the dam, wealth-based evaluation needs to consider impacts of the dam on capital *stocks* in the Egyptian economy, not *flows* of production, and GDP. The dam is unique in that its construction represented a step change to infrastructure capital, as opposed to a marginal change. For the purpose of illustration, however, this doesn't really matter, as our central concern is approximating the capital stock impacts of the dam. Some of these impacts can be extracted from the integrated model of Strzepek et al. (2008), but further literature was consulted in order to get an inclusive assessment of positive and negative effects (Abu Zeid 1990, Robinson et al. 2008):

- Natural capital:
  - 1.2 million acres of new agricultural land owing to increased water availability in the Aswan area
  - Transfer of 1 million acres from seasonal to perennial irrigation
  - Collapse of Sardine fishery in the Eastern Mediterranean basin
  - Stability of water levels[5] in upstream canals (increase in boat tourism and protection from floods); drop in water levels downstream
  - Rising salinity, coastal erosion, reduction in fertility of Nile Valley

5 Valuing water stock changes is a challenge for a variety of reasons; for a review see Perry (2012).

- Produced capital:
  - — 2,100 MW of hydroelectric power capacity
  - — Establishment of fertilizer, iron and steel, sugar, plywood, milk, pulp, and paper industries
- Human capital:
  - — Population in Aswan area increased from 280,000 in 1960 to 1 million in 1990
  - — Increase in schistosomiasis near Lake Nasser resulting from permanent high water levels in canals.

Attributing a perfect causal link from the HAD to any of these impacts is a challenge: for instance, some of the population growth that occurred in the area may have happened without the dam. These impacts – some quantitative, some qualitative – also focus only on physical changes to capital assets. In other words, we need values attached to the changes in order to evaluate whether the dam led to a net gain in wealth, and these values should in principle capture all social benefits and costs to affected stakeholders. Still, while the list certainly indicates important trade-offs and distributive effects that occurred as a result of the dam – Mediterranean fishermen worse off, Aswan rice farmers better off, for example – evidence from the literature seems to suggest that, overall, the dam has led to an increase in the productive base of the Egyptian economy. After all, what if the 2,100 MW of clean hydropower generation were instead fueled by coal?

3.3 Synthesis of the case studies

In both of these cases we reassessed the findings of existing infrastructure studies in terms of their wealth implications. The use of integrated physical and economic models allowed us to capture some of the linkages between capital stocks and estimate subsequent capital impacts. In the case of air pollution in China, we analyzed the marginal impacts of coal-fired electric power infrastructure by linking degraded air quality with health impacts, and therefore human capital losses via premature deaths and foregone wages. For the high Aswan Dam in Egypt, we analyzed a larger set of capital stock impacts, rather than one specific pathway of linkages. While both evaluations could be expanded, the results suggest that integrated modeling can both quantify marginal impacts of infrastructure on individual capital stocks *as well as* approximate aggregate capital stock impacts. The scale and detail of the impacts that are measured will depend on the structure of the models and the nature of the integration.

We chose these cases to illustrate the use of integrated models for measuring capital stock impacts resulting from infrastructure interventions. Our approach represents a step toward the use of inclusive wealth as a framework for infrastructure policy evaluation. However, the cases do not represent the diverse practical circumstances, nor the managerial complexity, inherent in planning and delivering infrastructure projects (Lessard et al. 2014). Yet while the development considerations of a transportation corridor will certainly be different than a hydroelectric dam, we argue that integrated systems modeling applies generally and could be used across sectors and scales to estimate wealth effects. Other infrastructure case studies leveraging integrated models that could inform wealth-based policy evaluation include transportation in Mozambique (Arndt et al. 2012) and the U.S. (Schaefer and Jacoby 2005), energy in South Africa (Arndt et al. 2011), and multiple infrastructure sectors in the UK (Hall et al. 2014). Future work in these areas, among others, will help make inclusive wealth more credible as a framework for generating policy insight in infrastructure planning challenges around the world.

In our cases we also had the benefit of hindsight: the “historical” scenario in each was based on data and events that already occurred. The real challenge for policy analysis stems from the evaluation of *prospective* interventions. Central to this challenge is incorporating uncertainty while measuring the impact of interventions on capital stocks. Uncertainty is important because our assumptions about how the future will unfold affect which policies we choose, whether in infrastructure or other sectors. The following section discusses methods for incorporating future uncertainty in models to garner policy-relevant insight during the evaluation of prospective interventions.

4. Modeling and managing uncertainty in prospective policy evaluation

Inclusive wealth theory requires an assumption of how the future will unfold. In particular, assumptions about the evolving political economy (Dasgupta 2009), both under a business as usual (BAU) policy setting, as well as under alternative policies that perturb the BAU, will affect the trajectory of wealth. Yet the future is almost certain to unfold in unanticipated ways, contrary even to the forecasts of experts (Sterman 1991). Planning for the future must reconcile the reality of uncertainty and the need for thoughtful decisions today. In this section we discuss how various forms of scenario analysis can be used to inform wealth analyses and policy evaluation.

4.1 The sensitivity of oil wealth to price uncertainty

In general, when doing policy evaluation we should be concerned with the sources of uncertainty that will have the largest impact on the magnitude and variability of future wealth. Specifically, we need to identify and assess which uncertain parameters can lead to vastly different wealth outcomes through time. Consider the calculation of oil wealth, a form of natural capital, from the 2012 Inclusive Wealth Report (UNU-IHDP and UNEP 2012, Annex 2); we reproduce and build on this example to illustrate the sensitivity of oil wealth to price uncertainty using scenarios.

Oil wealth, *Ot*, in a particular year is the product of the stock, St, of oil reserves not yet extracted (measured in barrels) and the unit rental price (US$ per barrel). The rental price is the 19-year average of the inflation-adjusted market price of oil, *P* , over the horizon 1990 to 2008, net of the unit extraction cost *c.* The equations are below; dt is the GDP deflator; *Xt* is the amount of oil extracted.

EQUATION 5

$$O_t = (\bar{P} - c)S_t$$

$$\bar{P} = \frac{1}{19}\sum_{t=1990}^{2008}\frac{P_t d_{base}}{d_t}$$

$$S_t = S_{t-1} - X_t$$

The movement in oil wealth directly tracks the movement of the oil stock since the rental price is assumed constant at the 19-year market average. We know the oil wealth of countries over this time horizon with relative certainty, since we are using actual or realized price data and known stock values. But what if oil prices had evolved differently over the same horizon? In answering this question we can determine how sensitive oil wealth is to different counterfactual price paths that *could* have occurred in the same time period.

First, we simulate many possible paths using geometric Brownian motion (GBM), a stochastic process frequently used to model stock and commodity prices. The equations for the stochastic process and its effect on the oil price are shown below: μ is the percentage drift parameter; σ is the percentage volatility parameter; W_t is a Wiener process which introduces random variation in the price movement; R_t is the annual growth in oil price in a particular year. We use a discretized form of the GBM model to generate an evolution of oil prices, P_t, all from the same initial condition P_o (the price in 1990).

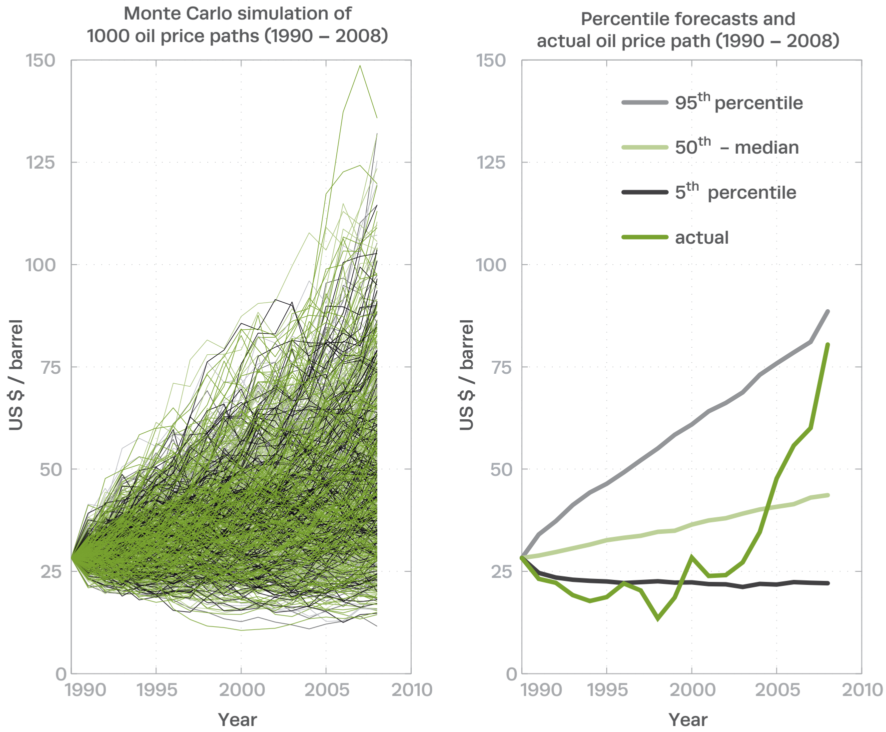
EQUATION 6

$$dR_t = \mu R_t dt + \sigma R_t dW_t$$

The chart on the left in Figure 5 shows simulation results for 1000 randomly generated oil

FIGURE 5

1000 oil price trajectories (1990 to 2008) modeled using GBM.



price scenarios, using values of three percent and ten percent, respectively, for the drift and volatility parameters. The chart on the right in Figure 5 collapses this information by plotting the 5th, 50th (median) and 95th percentile intervals of simulated prices. We compare this percentile forecast with the actual price path (thick black line) over the period from 1990 to 2008.

The region in the chart between the 5th percentile (lower dotted line) and the 95th percentile (upper dotted line) is the region that captures 90 percent of the price possibilities. In other words, we would expect to see 90 percent of the 1000 simulated price paths in this region at any given point in time. Note that not only was the actual price series quite far from the forecasted median result for most of the horizon, actual prices also fell below the 5th percentile level of our simulated results for about half the time. This underscores the point that future outcomes can be drastically different from reasonable forecasts.

We then assess the impact of prices on oil wealth, O_t, following the method above from the 2012 Inclusive Wealth Report. The simulation calculates $\overline{P}$ for all 1000 price trajectories and generates a wealth estimate for the oil stock for every year in the 1990 to 2008 horizon. The year-to-year changes in physical oil stocks are the same for all 1000 value estimates; only the price $\overline{P}$ differs.

Figure 6 represents the distribution of oil wealth in Saudi Arabia in the year 2008, the end of the time horizon. On the left, the histogram represents the range of wealth outcomes, weighted by their frequency. The Value at Risk or Gain (VARG) curve on the right represents the cumulative frequency of the oil wealth estimate. In other words, it conveys information about the total possibility of oil wealth falling above or below a certain wealth threshold. Using the particular GBM formulation discussed above, there is a 30 percent chance that oil wealth could have been below the actual value of US$2.23 trillion (where the red dashed line intersects the VARG curve). Correspondingly, oil wealth could have exceeded the actual realization by 70 percent for the year 2008.

We can use these simulation results when considering the impact of uncertain oil prices on future oil wealth. Across all scenarios, oil

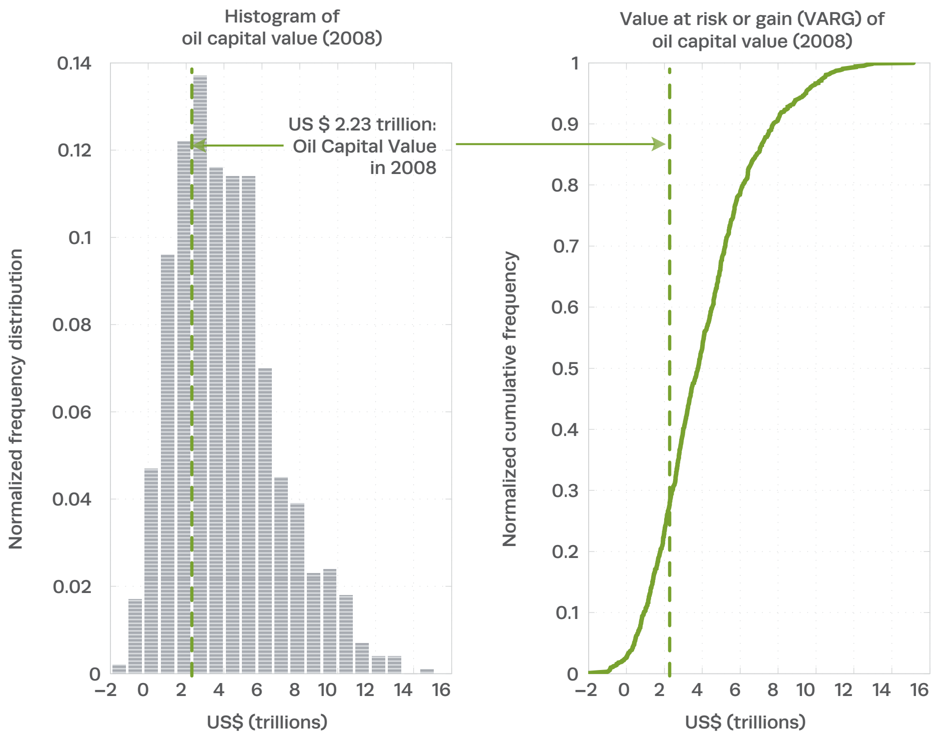


FIGURE 6
The distribution of 2008 oil wealth in Saudi Arabia under oil price uncertainty.

wealth *could* have ranged from negative US$2 trillion (cases where oil price is less than extraction cost) to positive US$15 trillion, even though these extreme cases are much less likely than the central estimate. The range of the simulated wealth possibilities is thus US$17 trillion with a standard deviation of US$2.7 trillion. Given that *total* wealth in Saudi Arabia in 2008 was approximately US$5 trillion under the baseline calculations in the 2012 report (Muñoz et al. 2012), our results show that future wealth in countries like Saudi Arabia will be very sensitive to the oil price trajectory. The same goes for other economies whose wealth estimates are tightly linked to fossil fuel prices. However, to conduct a similar analysis on future price trajectories (e.g., 2008 to 2026), the model would need to account for additional complexities not captured in the simple GBM formulation, for example, future extraction rates being a function of the evolving market price.

4.2 Using scenario analysis to inform policy choice under uncertainty

The previous analysis described a method for modeling oil price uncertainty. Each of the 1000 price paths represented a particular state of the world that could have unfolded. For planning and evaluating investments in infrastructure, or evaluating policies more generally, we need to understand how policy choices may fare across these alternative futures. Such scenario-based planning techniques for managing uncertainty have frequently been employed in multiple domains[6].

Generally, the aim is to provide an analytical platform for identifying, assessing, and

6 While the discussion in this chapter is general, scenario analysis for managing uncertainty and doing long-term planning is a rich field, both topically and methodologically. Some key sources include Wack (1985), van der Heijden (1996), Nakicenovic et al. (2000), and Raskin et al. (2002). For a more recent survey of studies and techniques, see Chapter 4 of KPMG (2012).

choosing among near-term policies based on their long-term performance under conditions of deep uncertainty (LEMPERT ET AL. 2003). For wealth-based policy evaluation, long-term performance can be construed as the extent to which development is sustainable; that is, how fast or slow and in what direction wealth is moving. The conditions of uncertainty could include manifestations of the oil price, as discussed above, the onset of ecological tipping points[7], or numerous other social, economic, or environmental circumstances that are difficult to predict. Finally, near-term policies could represent investments in renewable energy or public transit systems in the case of infrastructure, but also social or environmental policy like universal healthcare or a carbon tax.

A conceptual framework for using scenarios to inform near-term policy choice is shown in Figure 7. Whereas in the case studies of Section 3 we evaluated just two scenarios (historical and counterfactual), many more could potentially be evaluated using this framework. These could include additional policies (smaller or larger Aswan dams, different locations along the Nile; stricter or more lenient air quality thresholds in China) as well as different futures (upstream Nile water resources development; different population or economic growth rates in China). These additional scenarios would in turn affect the capital stock interactions and thus the marginal impacts of the associated infrastructure. For example, the marginal (and total) effect of coal-fired power on human capital in China will depend on where the population lives, how fast it grows, and the pace of electricity and health technology progress.

A key element of this scenario approach lies in evaluating policy *robustness*. A robust policy will perform *reasonably well* over the space of plausible futures. This is in contrast to an *optimal* policy, which performs best under a particular set of future conditions. Lempert et al. (2003) summarize the distinction well: "… the best response to deep uncertainty is often a strategy that, rather than being optimized for a particular predicted future, is well-hedged against a variety of different futures". Since sustainable development demands evaluation of policies over multiple decades, the probability of any particular set of circumstances manifesting is exceedingly small. Thus, the search for policy robustness is warranted, and one could argue, more desirable than optimality.

Scenario analysis and similar methods often seek to incorporate more than one value function, or objective (e.g., KEENEY AND RAIFFA 1976), during evaluation as well. In contrast, most of the work in inclusive wealth uses the discounted utility of future consumption as the sole value function of intergenerational well-being[8]. This may be appropriate so long as the shadow prices for each capital stock are correct, but this is a challenge in practice (SMULDERS 2012). Furthermore, when evaluating policies – particularly those in infrastructure – it is likely that the various stakeholders involved will be differentially concerned with the impacts to capital stocks. Some may be dedicated to minimizing the loss of natural capital (independent of the benefits that may accrue elsewhere) and others with maximizing the gains to human capital. In the case of the High Aswan Dam, Mediterranean Sardine fishermen sought to minimize the loss to downstream fish stocks while Aswan rice farmers sought to increase the development of upstream agriculture stocks, competing objectives as it were. Different capital stock impacts are therefore reflective of different – and often competing – value functions

7 Natural systems can exhibit "tipping points", which are thresholds across which ecosystems – and possibly dependent socioeconomic systems – exhibit qualitatively different behavior (Lenton et al. 2008). Examples include coral-reef bleaching, eutrophication of lakes, desertification of once arable land, and loss of the tundra permafrost (Lenton et al. 2008, Scheffer et al. 2001), among others.

8 Ekins (2012) discusses why focusing only on consumption is problematic and reviews other contributors to well-being not widely recognized in the literature.

amongst those affected by the proposed policy change.

In principle, robust policies will perform reasonably well across all of these value functions, in addition to all futures. Searching for policy robustness, however, requires that the resultant outcomes from alternative policies be made explicit, such that trade-offs in impacts across capital stocks and affected stakeholders can be assessed during evaluation. When presented with this trade-off information, policy-makers would be forced to reveal their inherent valuations of the capital stocks upon selecting a policy.

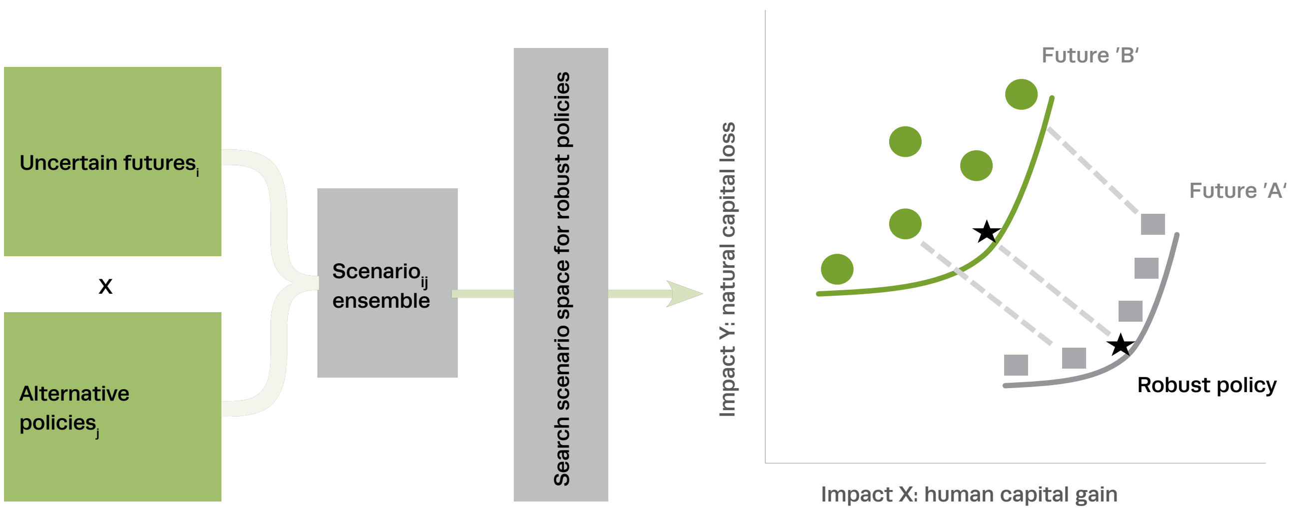
In summary, scenario analysis provides a flexible approach for incorporating future uncertainty and different value functions into policy evaluation. It is particularly appropriate given the long time scales, complex interactions and multi-stakeholder nature of sustainable development planning. In practice, scenario approaches are implementable either in a simulation or optimization framework, the difference being that an optimization framework requires weighting each of the value functions (and the metrics that comprise them) *a priori* to derive optimal policies. Given the diversity of metrics potentially relevant to stakeholders and policy-makers (including the capital assets but also other socioeconomic indicators), as well as the numerous sources of long-term uncertainty in the calculations, a simulation approach is likely to be more illustrative of the trade-offs inherent in policy evaluation.

5. Conclusion and future work

All of the recent work in wealth accounting has focused on assessing the past performance of economies. This chapter contributes to the literature by focusing instead on policy evaluation, in particular how policies impact the trajectories of capital stocks over time. Our focus is on infrastructure capital – a subset of produced capital – because infrastructure choices affect many, if not all, of the capital stocks in appreciable ways, and every national government must plan and manage infrastructure systems. We argue that a systems view of the linked capital stocks in an economy facilitates fuller accounting of wealth impacts. And with the aid of conceptual and mathematical models, we can better capture these systemic linkages to quantify potential impacts.

FIGURE 7

Wealth–based scenario analysis should search for near–term policies that will perform reasonably well across the landscape of plausible futures and values.



Our framework for evaluating policy impacts, while specific to infrastructure, is general to the broader exercise of policy evaluation. The key element of the framework lies in quantifying the marginal effects of increasing (decreasing) one capital stock on the others. In the case study of air pollution in China, we analyzed the marginal impacts of coal-fired electric power assets by linking degraded air quality with health impacts, and therefore human capital losses via premature deaths and foregone wages. In the case of the high Aswan Dam in Egypt, we analyzed a larger set of capital stock impacts instead of one specific pathway of linkages. Both cases employed counterfactual analysis techniques and integrated physical and economic models. While more comprehensive wealth accounting is needed in each, results indicate that coal-fired power in China and the dam in Egypt have led to (or at the very least facilitated) a *net increase* in wealth in the respective countries. The analyses also provided preliminary validation for the use of integrated models in doing wealth-based policy evaluation.

Evaluation of prospective policies, whether in infrastructure or other sectors, requires explicit consideration of future uncertainty. This is because assumptions about how the future will unfold – e.g., the evolution of market (or shadow) prices, ecological tipping points, and other socioeconomic factors – can influence projections of capital stock trajectories and therefore our conclusions about whether development will be sustainable. Scenario analysis techniques are useful for modeling and managing uncertainty to inform near-term policy decisions. Furthermore, a thorough scenario approach to wealth-based policy evaluation will consider not just multiple futures, but also evaluate policies based on multiple value functions, whereas inclusive wealth theory currently just focuses on one (the discounted utility of future consumption). Moving forward, evaluation of prospective infrastructure policies will need to leverage integrated models in a way that allows exploration of many futures, many impacts, and thus many scenarios.

There are numerous areas for future work in policy evaluation using inclusive wealth. On a methodological level this includes the following: making total factor productivity a function of infrastructure investment; improved accounting for the positive as well as negative marginal impacts of infrastructure on the other capital stocks; and modifying current models to better estimate the wealth effects of policy interventions (most still focus on the impacts to GDP, not wealth). While the case studies employed particular types of integrated models, we use the term broadly to include any model that captures linkages across the produced, natural, and human world. Such models, regardless of the level of detail, are useful for quantifying the capital stock impacts of alternative policies.

Another area for future work is in conducting additional case studies from various countries of the world in different policy domains. As we demonstrated in the China and Egypt case studies, previous work using integrated models can be usefully reanalyzed in the context of inclusive wealth. Case study analysis can then be made more compelling by examining additional scenarios and their associated wealth impacts.

Methodological modifications and the analysis of additional case studies will go a long way toward furthering the policy-analytic potential of the inclusive wealth framework. This will be beneficial for the practical efforts of the inclusive wealth community, namely, informing the development and implementation of policies commensurate with long-term sustainable development.

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Annexes

ANNEX 1

The inclusive wealth conceptual framework – inclusive wealth and well-being

We begin by drawing on a revised definition of sustainable development (Dasgupta and Duraiappah 2012).

DEFINITION 1

By sustainable development we mean a pattern of societal development along which (intergenerational) well-being does not decline.

We therefore state that intergenerational well-being *V(t)* is

EQUATION 1

$$V(t) = \int_t^{\infty}[U(\boldsymbol{C}(t))e^{-\delta(\tau-t)}]d\tau \quad , \quad \delta \geq 0$$

where *C(t)* denotes a vector of consumption flows at time *t* and δ the discount rate.

Hence *U(C(t))* denotes utility (the satisfaction that one enjoys from consuming goods and services) flow at time *t*. This flow of goods and services can range from material goods to services nature provides such as aesthetic gratification or spiritual values, among others.

At any point in time, one can measure how stocks of assets evolve or vary. In doing this one is able to determine the productive base of an economy. Formally, we create an economic forecast by assuming a resource allocation mechanism.

Let *K(t)* denote a set of vector stocks of capital assets at time *t*. Then for a given *K(t), C(t), U(C(t))* and together with (1), we can write

1 Equations in this section are adapted from Arrow et al. (2012) and Dasgupta and Duraiappah (2012)

EQUATION 2

$$V(t) = V(K(t), M, t)$$

where *V(t)* denotes intergenerational well-being at *t, K(t)* denotes a set of vector stocks of capital assets at time *t* and *M* denotes an evolving political economy. The proof whereby inter-temporal welfare *V(t)* will be non-decreasing at time t if and only if the rate of change in inclusive wealth or inclusive investment is non-negative at time *t* (Pearce and Atkinson 1995, Dasgupta and Mäler 2000).

Differentiating *V(t)* with respect to *t* in Equation (2), we obtain:

EQUATION 3

$$d\mathbf{V}(t) = \frac{\Delta\mathrm{V}}{\Delta t} + \sum_i[(\Delta\mathrm{V}(t)/\Delta\boldsymbol{K}_i(t))(d\boldsymbol{K}_i(t)/dt] \geq 0$$

Equation (3) illustrates the criterion for sustainability. In other words it shows the sustainability of an economy's development.

Let *ΔV(t)* represent a small change in *V(t)*, and $\Delta K_i(t)$ represent a small change in capital asset *i* at time *t*. Using Ddoneefinition 1 together with Equation (3), we obtain the shadow price of asset *i* at time *t*. The shadow price reflects the marginal value contribution to intergenerational well-being for a unit change in the respective capital asset.

EQUATION 4

$$P_i(t) \equiv \frac{\Delta\mathbf{V}(t)}{\Delta\boldsymbol{K}_i(t)} \qquad for\ all\ i$$

Let *Δt* represent a small passage of time following *t*. To measure inclusive wealth we represent *Q(t)* as the shadow price of time that is

EQUATION 5

$$Q(t) = \Delta V(t)/\Delta t$$

Q(t) is the shadow price of time as a result of changes in social well-being brought about solely by the passage of time. These are caused by exogenous changes taking place in the economy (e.g., changes in international trade prices over which a country has no control or technological changes that a country enjoys without having been responsible for them). Inclusive wealth therefore treats time as a surrogate for these exogenous events.

Using Equation (6) below we can construct an aggregate index of a country's stock of capital assets by using the shadow prices as weights. This index of a country's stock of capital assets is known as the Inclusive Wealth Index.

EQUATION 6

$$\mathbf{W} = \mathbf{Q}(t)t + \sum_i P_i(t)\boldsymbol{K}_i(t)$$

where $P_i(t)$ refers to shadow prices of capital assets $K_i(t)$. Institutions are reflected in the $P_i(t)$'s via *M* (DASGUPTA AND DURAIAPPAH 2012).

An important relationship or linkage exists between changes in inclusive wealth at constant prices and intergenerational well-being (ARROW ET AL. 2012). To show this formally, let Δ denote these changes.

EQUATION 7

$$\Delta\mathbf{V}(t) = \left[\frac{\Delta\mathbf{V}(t)}{\Delta t}\right]\Delta t + \sum_i \left[\frac{\Delta\mathbf{V}(t)}{\boldsymbol{K}_i(t)}\right]\Delta\boldsymbol{K}_i\,(t)$$

By using Equations (4) and (5) we can express equation 7 as

EQUATION 8

$$\mathbf{V}(t) = \mathbf{Q}(t)\Delta t + \sum_i P_i(t)\Delta\boldsymbol{K}_i\,(t)$$

From our equations derived, (6) and (8) are equivalent stating that the change in well-being is equal to the change in wealth and this is equal to the change in the capital asset base or productive base of a nation.

The productive base of a country

The inclusive wealth of a country as illustrated by Equation (6) is typically the total value of the different capital assets a country owns. The typical capital assets commonly known are produced capital, human capital, natural capital, and social capital. As Figure 1 shows, the way the different capitals are used is to a large extent determined by the evolving cultural and social norms. Similarly, the constituents of human well-being are also determined by evolving cultural norms. The weights society places on these different capital assets are determined by the relative shadow prices of each capital asset category and its respective elements.

Figure 1 also shows that waste produced by the economic system flows back into the ecological system and can cause degradation to these systems, which result in a decline in some of the ecosystem services they provide, which in turn form part of the natural capital asset base. These negative externalities are captured through damage functions on the overall productive base of a country. Damages caused by climate change are an example of such an impact on the inclusive wealth of a country.

The framework developed for the inclusive wealth accounts makes a fundamental difference from many previous studies on natural capital and life supporting systems found in the natural sciences literature. For example, a recent article in *Nature* on planetary boundaries (ROCKSTROM 2011) points toward natural systems as the key to life-supporting systems, and goes on to identify critical thresholds and tipping points beyond which no changes should occur. We, on the other hand, take a different approach, whereby we suggest that in addition to natural systems, there is also a need for a critical level of human and produced capital for human well-being. We argue that critical levels of each capital asset must be identified as a system working in a holistic framework toward the end goal of improving human well-being. Therefore, in addition to critical levels of natural capital, we argue for critical levels of human

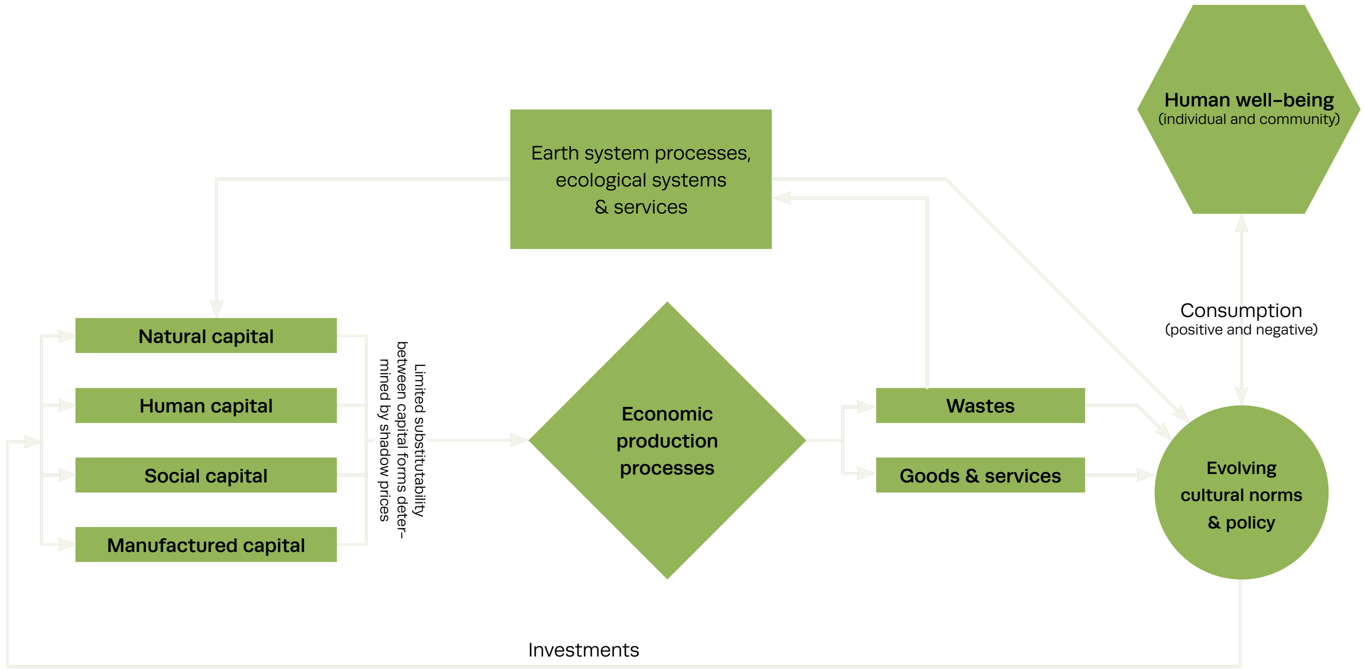

FIGURE 1
The productive base and human well-being
(Source: UNU-IHDP and UNEP 2012)

and produced capital necessary for achieving a minimum level of well-being and maintaining those for the present and future generations.

Types of capital assets

The list of types of capital assets can be substantially long and in many cases difficult to account for and value. In this paper, we focus on the three main categories of capital known to be relatively large (compared to other forms of capital) and for which relatively good data is available from which to compute changes over time

Produced or manufactured capital (roads, buildings, ports, machinery, equipment) In common parlance, including national accounts, this category essentially represents the entirety of the list of capital assets. When national income accountants and international organizations speak of investment, they usually mean the accumulation of reproducible capital. Reproducible capital is frequently called "manufactured capital."

Human capital (education, skills, tacit knowledge, health) This category is embodied in people. Human capital is not transferable without cost from one person to another. Education, skills, and health are ends as well as means. They have intrinsic worth, but are also of indirect value (investment in human capital raises a person's productivity).

Natural capital (local ecosystems, biomes, subsoil resources) Natural capital refers to stocks of nature which produce a range of ecosystem services. Ecosystem services are the benefits ecosystems provide for human well-being. Today it has become broadly accepted that nature should enter explicitly in economic calculations.

There has been much research over the past few decades on social capital. In the inclusive wealth framework, the role of social capital comprised of institutions, culture, and religion are treated as enabling assets: they enable the allocation of goods and services. The present discounted value of social well-being as a function of today's stocks of capital assets reflects the role of this social capital in the allocation of resources (DASGUPTA 2014).

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ANNEX 2

Methodology

This annex elaborates upon the methodological and data issues regarding the wealth accounts presented in Chapters 1 and 2. We focus here on the three capital forms (human, produced, and natural capital), as well as the three adjustments to these asset categories: carbon damages, oil capital gains, and total factor productivity.

1. Human capital

For human capital calculations, we followed Arrow et al. (2012) and Klenow and Rodríguez-Clare (1997). According to the method employed in these works, human capital per individual (*h*) can be defined as a function of educational attainment (*Edu*) and the additional compensation over time for this training, which is assumed to be equivalent to the interest rate, (ρ), which was fixed at 8.5 percent in this case. Additionally, the amount of human capital per person is assumed to increase exponentially with the interest rate and the average educational attainment per person – consistent with an economy in steady state. Thus it is obtained that:

EQUATION 1

$$h = e^{(Edu.\rho)}$$

Edu is represented by the average years of total schooling per person and is obtained from Barro and Lee (2010), where data are presented every five years for our time period of study (i.e., 1990, 1995, 2000, 2005, and 2010). This implied that we were forced to use linear interpolations for estimating the years of total schooling on an annual basis. There were, however, no estimates for Nigeria in the Barro and Lee (2010) dataset. In this case we estimated the indicator by combining educational attainment parameters from Nigeria, which were available in the Human Development Index database, and the progress made in this indicator by other African countries, particularly Ghana, South Africa, and Kenya, using Barro and Lee (2010). Thus, readers should be particularly cautious when interpreting the human capital trends for Nigeria.

Human capital per capita is further extended by considering the population of the country who achieve the average years of total education. Assuming that individuals engage in formal education at the age of five, then only the portion of the population of the age of 5 plus the average years of the educational attainment, P_{5+Edu}, or older are considered in the measurement of human capital. Therefore, the total amount of human capital in a country is:

EQUATION 2

$$H=h\,P_{5+Edu}$$

As the interest rate (ρ) is constant over time, changes in human capital are driven either by a change in the number of people educated, or by an increase or decrease in the average years of education.

The shadow price per unit of human capital, SP_{hc}, is obtained by computing the present value of the average labor compensation per unit of human capital, $\bar{r}$, received by workers over the expected life's working period, T, i.e.:

EQUATION 3

$$SP_{HC\,(t)} = \int_{0}^{T_{(t)}} \bar{r}\, e^{-\delta t}\, dt$$

The parameter T is obtained by using various demographic and socio-economic indicators, such as population, labor force, and mortality rates, which were all considered by age cohort and gender. In our case, these shadow prices were computed for each nation for every year within the time period of 1990 to 2010. Concerning the discount rate, ρ, it was fixed at

TABLE 1

Data sources used in the measurement of human capital

Variables	Data sources
Educational attainment	Barro and Lee (2010)
Population by age, gender, time	United Nations Population Division (2011)
Mortality rates by age, gender, time	World Health Organization (2012)
Labor force rates by age, gender, time	International Labour Organization (2013)
Market rate of interest	Klenow and Rodríguez-Clare (1997)
Discount rate	It is assumed a rate of 8.5 percent
Employment	International Labour Organization (2013) Conference Board (2013)
Compensation of Employees	United Nations Statistics Division (2012) OECD (2013) Feenstra et al. (2013) Lenzen et al. (2013) Conference Board (2013)

8.5 percent. Thus, the Human Capital Wealth (*HCW*) of a country is calculated as follows:

EQUATION 4

$$HCW_{(t)} = e^{(Edu_{(t)} \cdot \rho)} \cdot P_{5+Edu(t)} \cdot \int_0^{T_{(t)}} \bar{r} \cdot e^{-\delta \cdot t} . \mathrm{dt}$$

In order to obtain per capita estimates of human capital, we divided by the total population of the country, *P*, so as to be consistent with the other types of per capita wealth, namely, produced and natural capital. Therefore:

EQUATION 5

$$HCW per\ capita_{(t)} = \frac{HCW_{(t)}}{P_{(t)}} = \underbrace{e^{(Edu_{(t)} \cdot \rho)}}_{\text{Term I}} \cdot \underbrace{\frac{P_{5+Edu(t)}}{P_{(t)}}}_{\text{Term II}} \cdot \underbrace{\int_0^{T_{(t)}} \bar{r} \cdot e^{-\delta \cdot t} . \mathrm{dt}}_{\text{Term III}}$$

Under this income-based methodological framework, human capital is driven by the above three terms, where: changes in Term I depend on changes in the average educational attainment; in the case of Term II, movements are subject to the structure of the country population; and Term III evolves based on years remaining, *T*, for which the average person with human capital will receive monetary compensation, as earnings per unit of human capital, $\bar{r}$, are kept constant over time. We decided to capture those changes in the shadow price driven by the parameter *T*, since they relate to aspects of the population, such as mortality rates and participation in the labor market.

The data sources used to compute the calculations in this human capital framework are reported in Table 1.

2. Produced capital

With regard to produced capital, we followed the method developed originally by Harberger (1978) and applied, for example, in King and Levine (1994) as well as the recent work done in the Penn World Tables v.8 (FEENSTRA ET AL. 2013), who based their calculations on the perpetual inventory method (PIM) by setting an

TABLE 2
Key variables and data sources used in the measurement of produced capital

Variables	Data sources
Investment	United Nations Statistics Division (2013a)
Output	United Nations Statistics Division (2013a)
Depreciation rate	Feenstra et al. (2013)
Assets lifetime	It is assumed indefinite depreciation periods

initial capital estimate. Regarding the initial estimate, *Ko*, the economy is assumed to be in a steady state, implying that the capital-output ratio is constant in the long term, and can be derived as follows:

EQUATION 6

$$k = \frac{I/y}{(\delta + \gamma)}$$

where k is the capital-output ratio; I is investment; y is the output of the economy; γ is the steady-state growth rate of the economy, estimated as a weighted average growth rate of the economy under study and the global economy (see KING AND LEVINE 1994); δ is the depreciation rate of the capital, which is assumed to be 4 percent across countries and time[1].

This ratio is subsequently multiplied by the output of the economy under study in order to obtain a first estimate of the produced capital stock in the initial period, *Ko*. Our first empirical estimates were carried out for the year 1970 in order to minimize errors in the time period under study (1990 to 2010). As capital depreciates over time, the initial capital estimate retained in 1990 would be about 46 percent, and less than 20 percent in 2010. This way, potential errors in the departure point (year 1970) would be attenuated in the relevant period.

Subsequently, the PIM allows capturing the dynamics in the produced capital accumulation by looking at annual changes in investment. The corresponding formula of the PIM combined with the initial estimate is:

EQUATION 7

$$K_t = (1-\delta)^t K_0 + \sum_{j=1}^{t} I_j (1-\delta)^{t-j}$$

Finally, regarding the lifetimes of assets, we have assumed indefinite depreciation periods. For further details on this method see, for instance, King and Levine (1994).

3. Natural capital

3.1 Agricultural land

3.1.1 Cropland

The values for this natural capital asset were obtained by analyzing the physical amount of cropland area available every year, and corresponding shadow prices. We used cropland data from the Food and Agriculture Organization of the United Nations (FAO) for calculating the physical changes over the time span in study, 1990 to 2010. For valuing of this asset, we conceptually appealed to the net present value (NPV) of future rental flows. We applied this evaluation on an annual basis so as to obtain the average wealth value per hectare for the entire period of analysis. Once this wealth value per hectare was obtained, we multiplied by the total number of hectares available for cropland in the country. This method is also used in other studies, such as the World Bank (2011). In our method, however, we introduce minor

1 We arrive to this depreciation rate by taking the country average from Feenstra et al. (2013) for our reference period of 1990 to 2010.

TABLE 3

Key variables and data sources used in the measurement of agricultural land

Variables	Data sources
Quantity of crops produced	FAO (2013)
Price of crops produced	FAO (2013)
Rental Rate	Narayanan et. al. (2012)
Harvested area in crops	FAO (2013)
Discount rate	It is assumed a rate of 5 percent
Permanent crops land area	FAO (2013)
Permanent pasture land area	FAO (2013)

modifications by analyzing a vast number of crops (159) in order to arrive at a representative rental price per hectare for a specific year.

Concretely, we estimated the average rental price per hectare (RPA) for country *i* in year *j* as follows:

EQUATION 8

$$RPA_{ij} = \frac{1}{A}\sum_{k=1}^{159} R_{ik}P_{ijk}\,Q_{ijk}$$

where *Q*, *P*, and *R* are the quantity of production of crop *k*, (with *k=1,2,..,159*), the price per amount of crop *k* and the rental rate of crop *k*, respectively; *j* is the year of analysis, running from 1990 to 2010; and *A* is the total area harvested. To estimate the rental rate by crop group, we mapped FAO crop classification (HS) with those sectoral rental rates provided by Narayanan et al. (2012).

To calculate the value of total wealth per hectare (*Wha*) we estimated the present value of future rental flows as follows:

EQUATION 9

$$Wha_{ij} = \sum_{t=1}^{\infty} \frac{RPA_{ij}}{(1+r)^t}$$

where *r* is the discount rate, assumed to be equal to 5 percent, and *t* is the planning horizon, here assumed to reach infinity. Subsequently, we used the average wealth values per hectare ($\overline{Wha}_i$) over the study period as a proxy of the shadow price:

EQUATION 10

$$\overline{Wha}_i = \frac{1}{21}\sum_{j=1}^{21} Wha_{ij}$$

Finally, the total wealth in cropland (*WCL*) for country *i* in year *j* is derived as follows:

EQUATION 11

$$WCL_{ij} = \overline{Wha}_i . CLA_{ij}$$

where *CLA* is the physical amount of total cropland area of country *i* in year *j*, while *WCL* is the total wealth of cropland in the corresponding year and nation.

3.1.2 Pastureland

For pastureland, we applied a similar methodology as that used to compute cropland value, as we aimed at obtaining the total wealth per hectare of pastureland and the corresponding physical quantity available during the period of analysis. However, while it is possible to find data for production, prices, and rental rates of the products stemming from this kind of land, it is difficult to link such rents to a particular amount of land involved in the production process (unlike cropland). Given this limitation, we assumed rents per hectare in pastureland to be equal to those of cropland. This also implies that the total wealth per hectare in pastureland is identical to the estimates in the previous section for cropland. Therefore the total wealth in pastureland (*WPL*) was estimated as follows:

EQUATION 12

$$WPL_{ij} = \overline{Wha}_i \,.\, PLA_{ij}$$

where *PLA* is the physical amount of pastureland area available in the period *j* in country *i*.

3.2 Forest resources

In this version of the IWR accounts we excluded cultivated forest from the forest measures. The main reason for this is that the activity of cultivating a forest, where labor is required to carry out the process, is considered a production activity in the System of National Accounts (UNITED NATIONS 2009). This also implies that the corresponding changes in cultivated forest stock over time are part of gross fixed capital formation and inventories, which can both be treated as inputs in the produced capital model. Cultivated forest has therefore been accounted for under produced capital in the 2014 version of the IWR accounts, while our forest accounts reflect naturally regenerated forest and what is considered within the natural capital accounts.

3.2.1 Timber

As a starting point, we estimated the volume of timber commercially available. This is done by multiplying the total forest area (excluding cultivated forest) by timber density per area and percentage of total volume that is commercially available[2] – all these parameters are country-specific and were obtained from the Forest Resources Assessment (FAO 2010, FAO 2006, FAO 2001, AND FAO 1995). Unfortunately, parameters regarding volume, area, and density of forest are only available for the following years: 1990, 2000, 2005, and 2010. We therefore carried out linear interpolations to derive estimates for those years without data availability.

With regard to stumpage price, we followed the World Bank's (2006) method by adopting a weighted average price of two different commodities: industrial roundwood and fuelwood, which are also country-specific parameters. The weight attached to the different prices is based on the quantity of the commodity manufactured, while industrial roundwood and fuelwood prices are obtained from the value and quantity exported and produced, respectively. Three further steps were applied regarding the rental price estimates: (1) we converted the annual estimated values from current to constant prices by using each country-specific gross domestic product (GDP) deflator; (2) subsequently, we used information on the regional rental rates for timber estimated by Bolt et al. (2002). Such rates are assumed to be constant over time. (3) we then estimated the average price over the entire study period (1990 to 2010), thereby obtaining our proxy value for the shadow price of timber.

Concerning the estimates of total timber wealth, we multiplied the average rental price over time obtained in the last step by the total volume of timber commercially available every year:

EQUATION 13

$$Wealth\ of\ Timber_t = Stock\ commercially\ available_t \cdot \overline{Price} \cdot Rental\ Rate$$

3.2.2 Non-Timber Forest Benefits

One way to assess ecosystem services (ES) from an asset perspective is by valuing the expected flows of ecological services over time at their marginal contribution to economic welfare (UNITED NATIONS STATISTICS DIVISION 2013B). This can be represented by the following formulation:

EQUATION 14

$$ESW_t = \int_t^T P_t \,.\, (Q_t \,.\, r_t) \,.\, e^{-\delta \,.\, t} \,.\, \mathrm{dt}$$

2 This parameter is only available for the naturally generated forest and cultivated forest together. Therefore, we assumed that this coefficient also applies to only naturally regenerated forest.

TABLE 4

Average annual value per hectare in US$ of 2005 on the basis of 262 values.

	Select service	Temperate and boreal forests Unit = USD/yr/ha	Tropical forest Unit = USD/yr/ha
	Provisioning services		
1	food	23	107
2	water	146	137
3	genetic	2	451
4	medical		475
5	raw materials		
6	ornamental		
	Regulating services		
7	air quality	868	223
8	climate		
9	extreme events	0	33
10	water flows	2	14
11	waste	40	343
12	erosion	1	342
13	soil fertility	37	129
14	pollination	418	54
15	bio control	20	13
	Habitat services		
16	nursery		17
17	genepool	506	396
	Cultural services		
18	aesthetic		
19	recreation	27	257
20	inspiration	0	
21	spiritual		
22	cognitive	0	
	Total	**2,091**	**2,990**

Source: Van der Ploeg and de Groot (2010).

TABLE 5

Key variables and data sources used in the measurement of forest wealth

Variables	Data sources
Forest stocks	FAO (2010), FAO (2006), FAO (2001), FAO (1995)
Forest stock commercially available	FAO (2006)
Wood production	FAO (2013)
Value of wood production	FAO (2013)
Rental rate	Bolt et al. (2002)
Forest area	FAO (2013)
Value of non-timber forest benefits (NTFB)	Van der Ploeg and de Groot (2010)
Percentage of forest area used for the extraction of NTFB	World Bank (2006)
Discount rate	It is assumed a rate of 5 percent

where:
ESW: ecosystem service wealth
δ: discount rate, which is here assumed to be fixed at 5 percent.
T: planning horizon. We assume here infinite periods.
t: year under analysis. We carry out these estimates for the time period between 1990 and 2010.
P_t: marginal contribution of the ES flows to inter-temporal economic welfare. In empirical studies, the monetary value of a hectare per year (USD/ha/yr) is often used. For example, the World Bank (2011) and Arrow et al. (2012), based on the work of Lampietti and Dixon (1995), estimated this parameter at around 150 US$/ha/yr. In this version of the IWR accounts we updated this parameter using the Ecosystem Service Valuation Database, ESVD, (Van der Ploeg and de Groot, 2010). The average value per hectare varies considerably for temperate and boreal forest, and tropical forest as shown in Table 4. Since the ESVD presents information for these two types of forests, we weighted the corresponding values by the share of each forest type in the total forest of the country in order to arrive to the final value of the benefits per hectare and year.
Q_t: total forest area in the country under analysis excluding cultivated forest.
r_t: the fraction of the total forest area which is accessed by individuals to obtain benefits. Term $Q_t \cdot r_t$ reflects therefore the area of the forest in interaction with the population and contributing to economic welfare at time t. The ES literature has made emphasis on the idea of considering only the portion of the ecosystem services contributing to economic welfare, in contrast to taking into account the whole asset area (see, for example, Tallis et al. 2012). We here assume that this value is 10 percent as in the work of the World Bank (2006).

3.3 Fossil fuels

In our analysis, we followed the approach used by Arrow et al. (2012). The methodology of valuing the wealth of these stated components largely follows the same procedure.

We referred to BP Statistical Review of World Energy (BP 2013) for prices of coal, natural gas, and oil. For coal, we averaged prices from four sources: the United States, northwestern Europe, Japan coking, and Japan steam. For natural gas, we averaged prices from five sources: the European Union (EU), United Kingdom, the United States, Japan, and Canada. Lastly, we averaged the prices of four types of oil grades:

TABLE 6

Key variables and data sources used in the measurement of fossil fuels

Variables	Data sources
Reserves	U.S. Energy Information Administration (2013)
Production	U.S. Energy Information Administration (2013)
Prices	BP (2013)
Rental rate	Narayanan et al. (2012)

Dubai, Brent, Nigerian Forcados, and West Texas Intermediate. We adjusted for inflation before averaging over time using the U.S. GDP deflator. We obtained the rental prices by multiplying the above estimated prices and the corresponding sectoral rental rates from Narayanan et al. (2012).

We set the end of year reserves of natural gas and oil to 2010 and obtained this dataset from the U.S. Energy Information Administration (2013). In the case of coal, the reference year used was 2008; the data was also obtained from the U.S. Energy Information Administration.

The stocks of natural gas, oil, and coal for a year previous to 2010 were estimated as follows:

EQUATION 15

$$Stock_{t-1} = Stock_t + Production_t$$

where the corresponding stock under study in year *t-1* is derived from the production and the stock in year *t*. Finally, we computed the wealth of resource *i* (coal, natural gas, and oil) by multiplying the stocks and the unit rental price for each of our 140 countries for the period under study:

EQUATION 16

$$Wealth\ of\ Resource_t\ 'i' = Stock_{ti} \cdot \overline{Price_{ti}} \cdot Rental\ Rate_i$$

3.4 Metals and minerals

In order to value metals and minerals, we followed the method used by Arrow et al. (2012). We set the reserves base to 2010 and obtained reserves data from the U.S. Geological Survey published in their Mineral Commodity Summaries and/or Minerals Yearbooks (U.S. GEOLOGICAL SURVEY 2013A). We focused on ten mineral types: bauxite, copper, gold, iron, lead, nickel, phosphate, silver, tin, and zinc.

Production data are based on United States Geological Survey numbers, published in the Mineral Commodity Summaries and/or Minerals Yearbook (U.S. GEOLOGICAL SURVEY 2013A-B), and from the World Mineral Statistics Archive, contributed by permission of the British Geological Survey (BRITISH GEOLOGICAL SURVEY 2013). We filled in the missing years by extrapolating linearly.

Previous years' stocks were calculated by using the following equation:

EQUATION 17

$$Stock_{t-1} = Stock_t + Production_t$$

where the production and the stock in year *t* are used to compute the amount of the mineral available in year *t-1*.

For prices, we used world annual market prices for the ten mineral commodities from the World Bank (2013) and U.S. Geological Survey (2013A-B) for the period of 1990 to 2010. We converted to year 2005 constant prices and computed average prices for each mineral. As with fossil fuels, we retrieved sectoral rental rates of different mineral industries from Narayanan et al. (2013) and multiplied them by the corresponding prices.

TABLE 7

Key variables and data sources used in the measurement of minerals

Variables	Data sources
Reserves	U.S. Geological Survey (2013a)
Production	U.S. Geological Survey (2013a) and British Geological Survey (2013)
Prices	U.S. Geological Survey (2013-b) and World Bank (2013)
Rental rate	Narayanan et al. (2012)

We finally valued minerals by multiplying mineral stocks by rental prices to obtain the total mineral wealth for the period under study:

EQUATION 18

$$Wealth\ of\ Resource_t\ 'i' =$$

$$Stock_{ti} \cdot \overline{Price}_{ti} \cdot Rental\ Rate_i$$

4. Adjustments

4.1 Carbon damages

Carbon damage estimates are based on the method developed in Arrow et al. (2012). The key methodological steps can be described as follows: (1) obtain the total global carbon emissions for the period under analysis, 1990 to 2010; (2) derive the total global damages as a function of the emissions; and (3) allocate the global damages to the countries according to the potential effect of global warming in their economies.

Global carbon emissions: Two sources of carbon emissions were taken into account: (i) carbon emissions stemming from fuel consumption and cement, which were obtained from the Carbon Dioxide Information Analysis Center (BODEN ET AL. 2011); and (ii) emissions resulting from global deforestation. In this case, we used FAO (2013) data on the changes in annual global forest land. It is further estimated that the average carbon release per hectare is equal to 100 tonnes of carbon (LAMPIETTI AND DIXON 1995).

Global carbon damages: The damages per tonne of carbon released to the atmosphere are estimated at US$50 (see TOL 2009). By multiplying the total amount of global tons of carbon released to the atmosphere by the price per ton, we obtain the total global carbon damages. Note that this parameter is constant over time.

Assigning carbon damages to countries: To calculate the distribution of the damages that each region suffers, we referred to the study of Nordhaus and Boyer (2000). This study presents the distribution of damages which different regions and the global economy as a whole will suffer as a percentage of the corresponding regional and global GDP. By using country and global GDP information, we were able to re-estimate regional percentage damages in terms of the total global GDP – and not related to the country GDP – as initially presented in Nordhaus and Boyer (2000). Finally, we apportioned the global damages estimated in previous steps two according to this latter percentage.

TABLE 8

Key variables and data sources used in the measurement of carbon damages

Variables	Data sources
Carbon emission	Boden et al. (2011)
Forest area	FAO (2013)
Carbon release per hectare of forest	Lampietti and Dixon (1995)
Carbon cost	Tol (2009)
Climate change impacts	Nordhaus and Boyer (2000)
GDP	United Nations Statistics Division (2013a)

4.2 Oil capital gains

As noted in Chapter 1, gains in oil prices are separately accounted for in the wealth accounts. In order to include this adjustment, we assumed an annual increase of 5 percent in the rental price of oil, which corresponds to the annual average oil price increase during the years 1990 and 2010 (BP 2013). These increments in the rental price of oil are multiplied by the stock of oil available in each period. Data on oil stock rely on the method presented above in Section 3.3.

Conversely, countries that depend on oil imports may be negatively affected as their capacity to build other capital forms is impacted by higher prices. We therefore allocate those gains in oil prices to those nations that consume the commodity. To do so, we used data on oil consumption from our country sample as well as total world oil consumption. We were thus able to estimate the way in which the oil capital gains have to be distributed among the countries in this study. Finally, we subtracted the oil capital gains from the losses due to oil consumption, thereby obtaining the net oil capital gains/losses.

4.3 Total factor productivity measurement considering natural capital

We used a deterministic nonparametric analysis called Malmquist Productivity Index, based on the data envelopment analysis (see review for FÄRE ET AL. 1994, KERSTENS AND MANAGI 2012). The index based on distance function is suitable for assessing the relation between multivariate inputs and outputs. In addition, the measurement takes into account the efficiency of resource use and productivity changes. Using the distance function specification for the index, we can formulate our problem as follows:

EQUATION 19

$$T(t) \equiv \left\{ \left(x_t, y_t\right) : x_t \;\; \textit{can produce} \;\; y_t \right\}.$$

Let $x = (x^1, \ldots x^M) \in R_+^M$ and $y = (y^1, \ldots y^N) \in R_+^N$ be the input and output vectors, respectively. The technology set, defined by Equation (19), consists of all feasible input vectors, x_t, and output vectors, y_t, at time t, and satisfies certain axioms that are sufficient to define meaningful distance functions. Inputs used in this case are produced, human, and natural capital, and outputs are GDP. Compared to previous studies on inclusive wealth TFP computation, we explicitly added natural capital as an additional input, along with the two other conventional factors commonly taken into account, produced and human capital. The distance function is defined as

EQUATION 20

$$d(x_t, y_t) = \max\{\delta; (x_t, y_t / \delta) \in T(t)\}$$

where δ is the maximal proportional amount to which y_t can be expanded, given technology *T(t)*. In this analysis, we characterize production technology as having constant returns to scale. This formulation produces an output-oriented distance function. Equation (21) is a formulation of the Malmquist Productivity Index (*M* as *TFP* to inclusive investment), as follows:

EQUATION 21

$$M\left(GDP_{i,t}, H_{i,t}, P_{i,t}, N_{i,t}, GDP_{i,t+1}, H_{i,t+1}, P_{i,t+1}, N_{i,t+1}\right) = \left[\frac{d^t\left(GDP_{i,t+1}, H_{i,t+1}, P_{i,t+1}, N_{i,t+1}\right)}{d^t\left(GDP_{i,t}, H_{i,t}, P_{i,t}, N_{i,t}\right)} \times \frac{d^{t+1}\left(GDP_{i,t+1}, H_{i,t+1}, P_{i,t+1}, N_{i,t+1}\right)}{d^{t+1}\left(GDP_{i,t}, H_{i,t}, P_{i,t}, N_{i,t}\right)} \right]^{1/2}$$

where *d* is the geometric distance to the production frontier caused by production inefficiency, while the frontier denote the best available technology from the given inputs and outputs; *i* refers to the country under analysis, running *i* from 1 up to 140 nations in our sample; *GDP* is the corresponding value of gross domestic product; *H* stands for human capital; *P* represents produced capital; *N* represents natural capital. Thus we capture the productivity change from the variations in inefficiencies between two years. This methodology is widely used in the measurement of productivity (see, for example, TANAKA AND MANAGI 2013).

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ANNEX 3

Data

Wealth

Inclusive wealth
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	73,403	94,802	103,928	127,882	151,524
2	Albania	114,564	109,064	107,980	117,338	129,651
3	Algeria	1,167,108	1,221,564	1,267,935	1,319,205	1,409,174
4	Argentina	2,371,915	2,488,599	2,667,146	2,881,785	3,129,905
5	Armenia	68,530	64,309	63,353	66,322	73,326
6	Australia	8,264,944	8,722,411	9,290,457	10,174,447	11,484,564
7	Austria	2,720,433	3,048,956	3,215,545	3,508,807	3,729,039
8	Bahrain	59,209	72,000	83,824	99,768	178,028
9	Bangladesh	446,055	509,427	613,828	719,702	832,121
10	Barbados	55,845	57,386	59,594	64,533	66,562
11	Belgium	3,427,027	3,698,778	3,949,349	4,297,522	4,532,762
12	Belize	19,447	20,430	21,568	23,024	24,224
13	Benin	74,266	78,537	85,076	93,842	107,053
14	Bolivia (Plurinational State of)	1,014,643	1,007,867	1,007,083	1,005,307	999,736
15	Botswana	105,004	114,238	122,809	135,049	146,694
16	Brazil	12,345,895	13,480,646	14,609,964	15,579,794	16,439,769
17	Bulgaria	376,510	363,389	353,531	359,804	386,815
18	Burundi	21,567	23,423	23,845	27,366	31,548
19	Cambodia	122,363	123,940	126,859	131,797	139,011
20	Cameroon	380,359	386,601	399,149	410,420	430,305
21	Canada	13,181,342	13,630,760	14,449,766	16,006,849	17,109,382
22	Central African Republic	188,370	188,007	187,459	186,939	186,578
23	Chile	1,021,418	1,120,579	1,255,217	1,417,214	1,652,052
24	China	18,571,020	20,600,640	23,025,303	26,122,801	31,969,803
25	Colombia	2,423,524	2,638,037	2,848,572	3,022,557	3,315,723
26	Congo	269,412	270,155	266,719	263,506	267,092
27	Costa Rica	194,581	218,719	259,570	298,885	344,774
28	Côte d'Ivoire	222,704	252,194	274,679	297,501	315,782
29	Croatia*	632,797	655,601	656,831	690,218	729,929
30	Cuba	381,691	383,320	387,377	399,260	415,882
31	Cyprus	156,160	179,633	209,279	233,910	272,687
32	Czech Republic**	1,282,725	1,357,598	1,417,312	1,548,996	1,635,440
33	Democratic Republic of the Congo	1,119,619	1,133,175	1,140,858	1,159,528	1,184,607
34	Denmark	2,353,061	2,363,554	2,454,732	2,608,616	2,799,237
35	Dominican Republic	263,419	300,769	339,221	387,839	443,651
36	Ecuador	429,445	446,332	454,320	471,343	500,857
37	Egypt	727,607	794,660	896,349	1,004,425	1,178,805

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.

					Inclusive wealth per capita in millions of constant 2005 US$	Inclusive wealth change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
5,632	4,790	4,547	4,631	4,824	–15	–19	–18	–14
34,827	34,722	35,152	37,347	40,462	0	1	7	16
46,132	43,178	41,526	40,111	39,731	–6	–10	–13	–14
72,664	71,398	72,220	74,501	77,449	–2	–1	3	7
19,333	19,952	20,595	21,632	23,714	3	7	12	23
483,439	481,411	484,778	498,661	515,734	0	0	3	7
354,661	384,211	401,707	426,230	444,269	8	13	20	25
120,126	128,785	131,346	137,648	141,087	7	9	15	17
4,238	4,336	4,737	5,119	5,596	2	12	21	32
215,202	217,855	222,772	238,566	243,520	1	4	11	13
344,459	366,947	388,116	412,659	423,145	7	13	20	23
102,222	92,730	86,096	81,950	77,734	–9	–16	–20	–24
15,559	13,897	13,053	12,293	12,097	–11	–16	–21	–22
152,384	134,905	121,229	109,910	100,680	–11	–20	–28	–34
75,959	72,045	69,860	72,001	73,093	–5	–8	–5	–4
82,498	83,292	83,761	83,768	84,330	1	2	2	2
42,693	43,485	44,157	46,492	51,614	2	3	9	21
3,850	3,848	3,741	3,774	3,763	0	–3	–2	–2
12,837	11,097	10,192	9,867	9,832	–14	–21	–23	–23
31,226	27,733	25,459	23,381	21,956	–11	–18	–25	–30
475,846	465,180	471,177	495,823	502,972	–2	–1	4	6
64,185	56,497	50,643	46,527	42,394	–12	–21	–28	–34
77,452	77,767	81,403	86,936	96,534	0	5	12	25
16,216	16,969	18,143	19,978	23,834	5	12	23	47
72,990	72,367	71,637	70,226	71,622	–1	–2	–4	–2
112,776	98,860	85,057	74,580	66,064	–12	–25	–34	–41
63,377	63,051	66,231	69,356	74,003	–1	5	9	17
17,791	17,183	16,565	16,509	15,999	–3	–7	–7	–10
139,135	140,416	145,783	155,385	165,767	1	5	12	19
36,110	35,164	34,885	35,476	36,941	–3	–3	–2	2
203,688	209,993	221,860	226,533	247,078	3	9	11	21
124,371	131,559	138,370	151,556	155,861	6	11	22	25
30,753	25,715	22,989	20,194	17,958	–16	–25	–34	–42
457,702	451,632	459,731	481,344	504,354	–1	0	5	10
36,613	37,994	39,481	41,864	44,690	4	8	14	22
41,854	39,205	36,802	35,106	34,626	–6	–12	–16	–17
12,800	12,804	13,250	13,536	14,531	0	4	6	14

Wealth

Inclusive wealth
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
38	El Salvador	124,670	141,924	158,415	179,374	197,736
39	Estonia	155,224	151,263	158,574	171,436	187,151
40	Fiji	31,323	35,706	37,120	39,495	42,475
41	Finland	1,964,452	2,047,532	2,054,868	2,269,919	2,423,299
42	France	19,443,346	20,942,433	22,745,060	24,694,656	26,686,007
43	Gabon	237,028	242,441	249,860	258,767	273,794
44	Gambia	5,993	6,871	7,516	8,984	10,772
45	Germany	25,747,425	28,904,348	30,993,376	34,922,304	35,855,483
46	Ghana	160,056	171,435	183,337	199,512	227,090
47	Greece	1,809,046	1,938,570	2,054,842	2,207,873	2,455,237
48	Guatemala	277,525	311,995	355,921	402,973	471,936
49	Guyana	183,697	184,445	185,345	185,892	187,665
50	Haiti	33,386	38,513	44,518	49,811	56,231
51	Honduras	171,768	179,487	194,201	208,394	235,566
52	Hungary	1,146,512	1,232,464	1,292,072	1,389,011	1,425,079
53	Iceland	192,428	202,233	213,916	232,418	242,865
54	India	9,287,027	10,195,737	11,502,578	12,996,926	15,088,491
55	Indonesia	4,197,870	4,434,701	4,776,139	5,044,358	5,440,254
56	Iran (Islamic Republic of)	4,486,366	4,632,574	4,850,363	5,143,439	5,241,747
57	Iraq	1,183,949	1,191,866	1,189,261	1,189,287	1,198,590
58	Ireland	1,126,848	1,219,540	1,436,974	1,741,586	1,925,414
59	Israel	927,772	1,172,166	1,393,529	1,562,390	1,816,553
60	Italy	15,739,344	16,408,562	17,141,802	18,613,646	19,661,610
61	Jamaica	141,185	156,950	167,812	177,966	186,801
62	Japan	44,161,278	48,711,574	51,895,150	53,747,667	54,693,320
63	Jordan	102,394	141,480	158,391	177,113	212,282
64	Kazakhstan*	1,492,558	1,500,502	1,473,015	1,482,121	1,543,152
65	Kenya	215,582	255,182	285,111	331,645	387,396
66	Kuwait	1,433,968	1,399,021	1,390,094	1,394,859	1,422,032
67	Kyrgyzstan*	34,661	35,631	37,162	38,081	42,871
68	Lao People's Democratic Republic	135,058	134,923	136,633	139,337	147,464
69	Latvia	173,979	166,434	169,806	191,803	206,576
70	Lesotho	19,976	23,651	27,375	29,134	31,567
71	Liberia	37,984	36,642	36,694	36,147	37,005
72	Lithuania*	271,569	269,588	272,111	292,331	311,714
73	Luxembourg	178,050	197,065	227,539	263,673	318,999
74	Malawi	45,907	45,908	47,559	50,435	56,302

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.

Inclusive wealth per capita in millions of constant 2005 US$					Inclusive wealth change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
23,378	24,754	26,668	29,646	31,929	6	14	27	37
99,018	104,992	115,684	127,381	139,546	6	17	29	41
43,004	46,034	45,730	48,015	49,354	7	6	12	15
393,959	400,864	397,201	432,832	451,725	2	1	10	15
342,866	362,047	385,197	404,854	425,022	6	12	18	24
255,131	222,969	202,271	188,780	181,867	–13	–21	–26	–29
6,203	6,101	5,795	5,975	6,232	–2	–7	–4	0
325,513	352,796	376,366	423,092	435,655	8	16	30	34
10,819	10,086	9,566	9,220	9,310	–7	–12	–15	–14
178,047	181,653	187,027	197,429	216,142	2	5	11	21
31,102	31,151	31,674	31,687	32,799	0	2	2	5
253,400	253,365	252,823	249,106	248,731	0	0	–2	–2
4,686	4,889	5,149	5,329	5,627	4	10	14	20
35,131	32,194	31,231	30,293	30,993	–8	–11	–14	–12
110,493	119,293	126,543	137,704	142,741	8	15	25	29
755,232	756,075	760,700	783,229	758,631	0	1	4	0
10,628	10,571	10,914	11,400	12,321	–1	3	7	16
22,772	22,240	22,382	22,192	22,680	–2	–2	–3	0
81,763	77,523	74,230	73,760	70,860	–5	–9	–10	–13
68,146	58,747	49,849	43,469	37,844	–14	–27	–36	–44
319,110	337,733	377,775	418,848	430,751	6	18	31	35
206,174	219,833	231,677	236,562	244,871	7	12	15	19
276,943	288,031	300,806	317,254	324,712	4	9	15	17
59,700	63,761	65,002	66,364	68,149	7	9	11	14
361,234	391,299	412,783	425,243	432,236	8	14	18	20
29,979	32,287	32,813	33,155	34,310	8	9	11	14
90,384	94,218	98,485	97,689	96,288	4	9	8	7
9,194	9,304	9,122	9,312	9,562	1	–1	1	4
686,869	859,397	716,253	616,100	519,609	25	4	–10	–24
7,804	7,759	7,500	7,552	8,037	–1	–4	–3	3
32,215	28,138	25,697	24,218	23,781	–13	–20	–25	–26
65,310	66,785	71,199	83,192	91,727	2	9	27	40
12,187	13,179	13,939	14,104	14,538	8	14	16	19
17,857	17,493	12,888	11,358	9,265	–2	–28	–36	–48
73,435	74,285	77,745	85,583	93,788	1	6	17	28
467,048	483,569	522,489	576,715	628,634	4	12	23	35
4,894	4,645	4,235	3,933	3,778	–5	–13	–20	–23

Wealth

Inclusive wealth
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
75	Malaysia	1,287,401	1,542,098	1,776,498	1,954,619	2,185,440
76	Maldives	5,207	6,504	8,411	10,671	14,041
77	Mali	121,481	127,946	135,739	143,418	156,351
78	Malta	48,488	53,989	61,926	69,087	76,097
79	Mauritania	38,274	43,458	48,735	59,433	70,112
80	Mauritius	50,993	56,343	61,929	70,701	80,604
81	Mexico	5,659,273	6,337,459	7,064,330	8,067,346	9,107,473
82	Mongolia	232,447	226,291	233,566	221,330	229,253
83	Morocco	635,221	734,898	812,980	913,325	1,019,743
84	Mozambique	267,929	268,814	271,756	276,555	283,993
85	Myanmar	338,584	328,768	319,137	314,189	317,520
86	Namibia	148,256	159,015	169,200	184,862	204,607
87	Nepal	153,020	150,987	153,106	161,165	175,158
88	Netherlands	5,103,242	5,463,776	5,895,026	6,346,816	6,839,819
89	New Zealand	867,155	931,930	1,010,962	1,121,647	1,224,854
90	Nicaragua	81,535	84,403	91,494	96,521	101,188
91	Niger	52,084	56,293	62,432	70,249	83,881
92	Nigeria	1,604,302	1,623,550	1,644,292	1,711,318	1,814,508
93	Norway	2,602,873	2,666,385	2,770,344	2,950,411	3,178,995
94	Pakistan	1,051,539	1,224,868	1,408,752	1,630,292	1,853,840
95	Panama	132,533	151,945	168,641	189,994	217,620
96	Papua New Guinea	319,177	314,209	309,720	306,782	304,566
97	Paraguay	202,482	210,508	222,735	231,373	245,811
98	Peru	1,732,583	1,789,353	1,888,314	1,936,395	2,074,525
99	Philippines	796,723	904,962	1,047,595	1,165,500	1,330,369
100	Poland	3,301,177	3,479,992	3,715,899	3,841,872	4,145,075
101	Portugal	2,214,539	2,384,715	2,620,983	2,766,700	2,912,219
102	Qatar	436,878	440,189	453,075	514,920	763,008
103	Republic of Korea	5,268,564	6,413,398	7,439,254	8,444,159	9,397,391
104	Republic of Moldova	67,954	65,801	62,070	57,817	53,635
105	Romania	1,182,697	1,219,401	1,264,036	1,248,543	1,343,364
106	Russian Federation*	19,691,845	19,550,393	19,535,785	19,486,481	19,464,667
107	Rwanda	25,556	21,304	30,430	35,205	43,397
108	Saudi Arabia	5,758,030	6,229,676	6,368,480	6,823,590	7,469,646
109	Senegal	113,069	119,274	129,294	139,978	158,149
110	Serbia	478,857	527,318	532,370	539,616	570,721
111	Sierra Leone	35,269	34,227	34,945	40,278	43,677

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.

				Inclusive wealth per capita in millions of constant 2005 US$				Inclusive wealth change percentage change with respect to the base year, 1990
1990	1995	2000	2005	2010	1995	2000	2005	2010
70,703	74,423	75,870	74,889	76,949	5	7	6	9
23,724	26,152	30,783	36,144	44,451	10	30	52	87
14,007	13,023	12,017	10,884	10,173	–7	–14	–22	–27
131,930	139,659	155,821	168,794	182,700	6	18	28	38
19,180	18,960	18,441	19,504	20,265	–1	–4	2	6
48,128	49,550	51,779	56,258	62,042	3	8	17	29
67,127	68,682	70,672	75,761	80,296	2	5	13	20
106,017	98,126	96,860	86,887	83,183	–7	–9	–18	–22
25,633	27,291	28,235	30,051	31,915	6	10	17	25
19,778	16,871	14,931	13,315	12,141	–15	–25	–33	–39
8,622	7,803	7,099	6,783	6,620	–10	–18	–21	–23
104,787	96,294	89,248	88,878	89,611	–8	–15	–15	–14
8,019	6,992	6,275	5,907	5,847	–13	–22	–26	–27
342,690	354,281	371,625	389,245	411,715	3	8	14	20
255,197	253,582	262,041	271,315	280,407	–1	3	6	10
19,786	18,202	18,033	17,794	17,482	–8	–9	–10	–12
6,688	6,133	5,716	5,406	5,408	–8	–15	–19	–19
16,446	14,758	13,294	12,239	11,454	–10	–19	–26	–30
613,670	611,683	616,885	638,162	651,018	0	1	4	6
9,402	9,618	9,748	10,276	10,679	2	4	9	14
54,858	56,761	57,048	58,671	61,880	3	4	7	13
76,769	66,632	57,581	50,330	44,409	–13	–25	–34	–42
47,712	43,898	41,683	39,230	38,083	–8	–13	–18	–20
79,896	75,097	73,015	70,264	71,347	–6	–9	–12	–11
12,928	13,067	13,551	13,624	14,265	1	5	5	10
86,745	90,644	97,015	100,665	108,293	4	12	16	25
223,117	235,529	253,573	262,404	272,793	6	14	18	22
922,224	877,971	766,681	627,197	433,825	–5	–17	–32	–53
122,581	143,598	161,766	179,494	195,033	17	32	46	59
15,572	15,166	15,114	15,349	15,012	–3	–3	–1	–4
50,964	53,763	56,960	57,347	62,522	5	12	13	23
132,450	131,477	133,116	135,470	136,156	–1	1	2	3
3,595	3,825	3,758	3,826	4,085	6	5	6	14
356,776	336,888	317,705	283,830	272,137	–6	–11	–20	–24
15,614	14,252	13,601	12,875	12,719	–9	–13	–18	–19
50,044	51,678	52,535	54,749	57,905	3	5	9	16
8,858	8,780	8,434	7,816	7,444	–1	–5	–12	–16

Wealth

Inclusive wealth
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
112	Singapore	560,076	698,776	885,471	1,051,266	1,368,578
113	Slovakia**	528,665	546,157	578,849	623,258	666,294
114	Slovenia*	366,092	401,279	431,280	468,501	495,111
115	South Africa	2,616,273	3,013,284	3,127,813	3,433,802	3,628,541
116	Spain	9,309,175	10,741,110	12,256,939	14,018,657	16,074,035
117	Sri Lanka	291,846	322,911	369,254	394,298	442,899
118	Sudan (former)	520,644	521,368	534,550	571,482	624,194
119	Swaziland	41,244	48,706	54,142	57,458	60,387
120	Sweden	3,491,613	3,603,607	3,739,798	3,993,066	4,337,750
121	Switzerland	3,714,812	3,880,368	4,020,050	4,293,789	4,651,636
122	Syrian Arab Republic	296,073	334,935	373,837	411,842	460,871
123	Tajikistan*	30,644	30,782	30,419	30,837	31,826
124	Thailand	1,437,028	1,678,861	1,850,642	2,016,731	2,225,034
125	Togo	39,345	40,896	46,338	51,814	57,221
126	Trinidad and Tobago	174,561	175,416	182,804	191,142	184,628
127	Tunisia	292,994	332,547	373,827	411,675	467,016
128	Turkey	3,423,105	3,945,817	4,371,834	4,798,599	5,500,100
129	Uganda	65,758	71,707	81,331	93,607	116,156
130	Ukraine*	2,016,108	2,053,045	1,958,753	1,923,031	1,912,677
131	United Arab Emirates	1,758,990	1,967,716	2,238,375	2,677,592	4,004,059
132	United Kingdom	19,766,855	20,099,689	21,505,927	23,612,677	25,377,131
133	United Republic of Tanzania	231,635	234,884	234,544	240,914	256,542
134	United States of America	104,292,941	110,603,864	121,230,967	133,576,817	143,824,201
135	Uruguay	226,990	238,897	260,196	263,264	284,856
136	Venezuela (Bolivarian Republic of)	3,419,948	3,520,694	3,670,473	3,827,194	4,042,649
137	Vietnam	451,088	511,221	613,708	721,443	861,705
138	Yemen	201,889	236,196	280,911	325,030	375,183
139	Zambia	401,431	400,225	402,409	407,626	418,101
140	Zimbabwe	157,088	158,800	157,766	158,456	150,414

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Inclusive wealth per capita in millions of constant 2005 US$					Inclusive wealth change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
185,663	200,701	225,926	246,429	269,065	8	22	33	45
99,469	101,726	107,098	115,088	121,985	2	8	16	23
189,165	204,088	217,225	234,007	243,936	8	15	24	29
71,106	72,780	69,879	71,848	72,379	2	–2	1	2
239,377	272,431	304,230	323,044	348,852	14	27	35	46
16,834	17,714	19,699	19,871	21,232	5	17	18	26
19,651	17,298	15,636	14,878	14,332	–12	–20	–24	–27
47,794	50,547	50,893	52,003	50,914	6	6	9	7
407,954	408,251	422,092	442,232	462,462	0	3	8	13
556,631	552,861	560,840	579,067	606,921	–1	1	4	9
24,024	23,635	23,382	22,281	22,580	–2	–3	–7	–6
5,655	5,330	4,928	4,779	4,627	–6	–13	–16	–18
25,179	28,145	29,303	30,237	32,190	12	16	20	28
10,734	10,010	9,667	9,581	9,493	–7	–10	–11	–12
143,613	139,059	141,483	145,312	137,631	–3	–1	1	–4
35,665	37,216	39,533	41,532	44,559	4	11	16	25
63,238	67,032	68,709	70,419	75,600	6	9	11	20
3,715	3,442	3,359	3,292	3,475	–7	–10	–11	–6
39,022	40,160	40,063	40,982	42,085	3	3	5	8
972,547	837,847	737,888	657,990	533,044	–14	–24	–32	–45
345,487	346,563	365,287	392,219	409,074	0	6	14	18
9,091	7,844	6,891	6,204	5,721	–14	–24	–32	–37
411,673	415,299	429,142	450,026	463,375	1	4	9	13
73,008	74,113	78,394	79,236	84,557	2	7	9	16
173,732	159,778	150,749	143,533	139,499	–8	–13	–17	–20
6,722	6,908	7,792	8,675	9,809	3	16	29	46
16,897	15,592	15,850	15,741	15,599	–8	–6	–7	–8
51,072	44,871	39,446	35,562	31,944	–12	–23	–30	–37
15,005	13,590	12,612	12,605	11,965	–9	–16	–16	–20

Human capital

Human capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	39,480	61,321	71,117	92,528	111,250
2	Albania	42,720	41,466	41,309	45,641	48,460
3	Algeria	330,494	404,177	471,665	535,711	607,230
4	Argentina	1,209,100	1,305,938	1,442,112	1,640,718	1,754,180
5	Armenia	50,623	45,856	45,901	47,248	47,814
6	Australia	3,938,197	4,204,911	4,477,842	4,927,504	5,663,742
7	Austria	1,912,493	2,120,114	2,155,198	2,328,310	2,442,916
8	Bahrain	36,959	47,078	57,385	67,496	131,505
9	Bangladesh	351,223	404,298	484,267	552,709	609,936
10	Barbados	43,915	45,217	46,069	50,187	51,267
11	Belgium	2,605,881	2,763,022	2,884,003	3,096,223	3,173,437
12	Belize	4,292	5,062	6,084	7,382	8,417
13	Benin	31,003	36,814	44,364	52,716	64,989
14	Bolivia (Plurinational State of)	62,960	71,971	85,782	102,001	115,672
15	Botswana	27,720	35,083	40,050	47,166	52,377
16	Brazil	5,385,277	6,455,777	7,464,481	8,367,825	8,968,120
17	Bulgaria	210,179	202,913	199,625	196,728	198,201
18	Burundi	13,252	14,856	15,532	18,849	22,951
19	Cambodia	19,842	25,079	30,378	35,157	38,950
20	Cameroon	100,230	117,636	139,841	156,365	179,829
21	Canada	6,541,784	6,825,762	7,384,326	8,538,772	9,105,623
22	Central African Republic	4,280	4,988	5,639	6,322	6,888
23	Chile	661,306	730,906	816,619	920,373	1,068,195
24	China	9,210,965	10,464,623	11,597,065	12,427,482	13,446,810
25	Colombia	976,550	1,150,156	1,336,597	1,509,853	1,717,331
26	Congo	2,514	2,868	3,342	3,831	4,511
27	Costa Rica	134,876	156,077	191,409	221,220	251,580
28	Côte d'Ivoire	120,374	150,227	171,259	192,434	210,304
29	Croatia*	517,580	540,959	528,355	537,436	542,251
30	Cuba	244,605	249,111	256,195	269,802	278,918
31	Cyprus	125,474	143,466	168,537	186,875	216,058
32	Czech Republic**	861,255	917,084	929,790	1,006,725	1,016,335
33	Democratic Republic of the Congo	109,259	134,420	154,080	182,079	213,679
34	Denmark	1,830,664	1,790,251	1,788,566	1,845,875	1,934,085
35	Dominican Republic	200,150	230,567	253,255	287,492	321,863
36	Ecuador	121,991	142,567	159,212	179,493	203,225
37	Egypt	502,731	564,326	647,236	731,445	849,042

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Human capital per capita in millions of constant 2005 US$					Human capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
3,029	3,099	3,111	3,351	3,542	2	3	11	17
12,987	13,201	13,447	14,527	15,124	2	4	12	16
13,063	14,286	15,447	16,289	17,120	9	18	25	31
37,041	37,468	39,049	42,416	43,407	1	5	15	17
14,281	14,227	14,922	15,410	15,463	0	4	8	8
230,356	232,079	233,655	241,503	254,340	1	1	5	10
249,331	267,164	269,241	282,830	291,044	7	8	13	17
74,984	84,208	89,918	93,123	104,218	12	20	24	39
3,337	3,441	3,737	3,931	4,102	3	12	18	23
169,228	171,656	172,215	185,531	187,564	1	2	10	11
261,923	274,113	283,421	297,308	296,249	5	8	14	13
22,563	22,975	24,285	26,276	27,009	2	8	16	20
6,495	6,514	6,807	6,906	7,343	0	5	6	13
9,456	9,633	10,326	11,152	11,649	2	9	18	23
20,052	22,125	22,783	25,146	26,098	10	14	25	30
35,986	39,888	42,795	44,991	46,003	11	19	25	28
23,833	24,282	24,934	25,420	26,447	2	5	7	11
2,366	2,441	2,437	2,599	2,738	3	3	10	16
2,082	2,245	2,441	2,632	2,755	8	17	26	32
8,228	8,439	8,919	8,908	9,175	3	8	8	12
236,158	232,945	240,788	264,494	267,682	–1	2	12	13
1,458	1,499	1,524	1,573	1,565	3	4	8	7
50,145	50,724	52,959	56,459	62,418	1	6	13	24
8,043	8,620	9,138	9,504	10,025	7	14	18	25
29,411	31,551	33,613	35,080	37,096	7	14	19	26
1,052	1,049	1,066	1,084	1,116	0	1	3	6
43,930	44,993	48,839	51,334	54,000	2	11	17	23
9,616	10,235	10,328	10,678	10,655	6	7	11	11
113,802	115,862	117,268	120,990	123,146	2	3	6	8
23,141	22,853	23,072	23,973	24,775	–1	0	4	7
163,663	167,714	178,668	180,982	195,767	2	9	11	20
83,506	88,870	90,774	98,499	96,859	6	9	18	16
3,001	3,050	3,105	3,171	3,239	2	3	6	8
356,089	342,084	334,969	340,602	348,475	–4	–6	–4	–2
27,819	29,126	29,476	31,032	32,422	5	6	12	17
11,889	12,523	12,897	13,369	14,050	5	8	12	18
8,844	9,093	9,568	9,857	10,466	3	8	11	18

Human capital

Human capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
38	El Salvador	92,966	106,169	117,112	132,107	145,210
39	Estonia	107,181	102,068	105,380	108,193	111,841
40	Fiji	20,815	24,607	25,521	27,041	29,286
41	Finland	1,304,527	1,367,531	1,321,571	1,475,176	1,555,587
42	France	14,563,212	15,530,642	16,745,322	17,938,170	19,118,064
43	Gabon	47,646	58,089	69,020	80,896	97,620
44	Gambia	3,308	4,106	4,661	5,658	6,589
45	Germany	17,572,938	19,835,706	21,046,418	24,337,379	24,576,140
46	Ghana	62,036	73,103	84,082	97,187	113,336
47	Greece	1,055,664	1,161,390	1,231,362	1,342,330	1,413,804
48	Guatemala	199,192	230,123	265,597	303,490	362,912
49	Guyana	8,593	8,668	8,856	8,983	9,944
50	Haiti	26,449	31,563	36,863	41,020	46,341
51	Honduras	69,581	80,868	99,708	113,657	138,451
52	Hungary	804,809	880,945	918,322	971,444	968,933
53	Iceland	87,149	94,952	101,448	112,108	125,767
54	India	5,954,841	6,636,022	7,579,171	8,479,881	9,354,665
55	Indonesia	1,779,692	1,987,999	2,260,719	2,452,002	2,703,511
56	Iran (Islamic Republic of)	817,985	1,013,433	1,277,430	1,576,454	1,633,140
57	Iraq	99,340	117,674	143,166	165,540	190,166
58	Ireland	807,136	875,099	998,721	1,171,091	1,242,911
59	Israel	735,676	923,177	1,076,119	1,200,168	1,385,779
60	Italy	11,029,940	11,201,349	11,370,113	12,167,855	12,674,011
61	Jamaica	80,436	89,090	96,549	101,750	108,062
62	Japan	30,190,110	32,024,691	33,097,452	33,566,644	33,644,994
63	Jordan	67,127	100,266	112,892	126,396	152,675
64	Kazakhstan*	332,612	341,786	352,790	379,926	410,350
65	Kenya	143,493	180,514	206,607	247,204	288,468
66	Kuwait	110,822	95,524	115,047	138,186	164,920
67	Kyrgyzstan*	11,869	12,693	14,243	14,875	16,173
68	Lao People's Democratic Republic	9,928	11,795	13,925	15,668	18,185
69	Latvia	122,740	115,832	115,443	126,415	125,943
70	Lesotho	16,213	18,137	20,347	21,632	23,289
71	Liberia	2,749	2,884	4,242	4,864	6,461
72	Lithuania*	188,663	187,406	186,943	197,469	200,365
73	Luxembourg	130,302	139,026	154,553	170,127	202,291
74	Malawi	14,116	14,702	16,885	20,150	23,486

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Human capital per capita in millions of constant 2005 US$					Human capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
17,433	18,518	19,715	21,834	23,447	6	13	25	35
68,371	70,846	76,877	80,390	83,393	4	12	18	22
28,577	31,724	31,441	32,875	34,029	11	10	15	19
261,615	267,734	255,457	281,289	289,975	2	–2	8	11
256,809	268,490	283,589	294,085	304,489	5	10	15	19
51,284	53,424	55,874	59,016	64,844	4	9	15	26
3,424	3,646	3,594	3,763	3,812	6	5	10	11
222,166	242,107	255,576	294,853	298,608	9	15	33	34
4,194	4,301	4,387	4,491	4,646	3	5	7	11
103,899	108,828	112,076	120,032	124,462	5	8	16	20
22,323	22,976	23,636	23,865	25,222	3	6	7	13
11,854	11,908	12,080	12,038	13,180	0	2	2	11
3,712	4,007	4,264	4,388	4,637	8	15	18	25
14,231	14,505	16,035	16,522	18,216	2	13	16	28
77,562	85,269	89,939	96,307	97,052	10	16	24	25
342,040	354,992	360,754	377,793	392,854	4	5	10	15
6,815	6,880	7,192	7,438	7,639	1	6	9	12
9,654	9,970	10,594	10,787	11,271	3	10	12	17
14,908	16,959	19,550	22,607	22,077	14	31	52	48
5,718	5,800	6,001	6,051	6,004	1	5	6	5
228,571	242,345	262,560	281,645	278,062	6	15	23	22
163,485	173,136	178,907	181,718	186,803	6	9	11	14
194,079	196,625	199,524	207,391	209,312	1	3	7	8
34,012	36,193	37,398	37,943	39,424	6	10	12	16
246,951	257,254	263,263	265,574	265,893	4	7	8	8
19,653	22,881	23,387	23,661	24,676	16	19	20	26
20,142	21,461	23,587	25,042	25,605	7	17	24	27
6,120	6,582	6,611	6,941	7,120	8	8	13	16
53,083	58,679	59,278	61,036	60,262	11	12	15	14
2,672	2,764	2,875	2,950	3,032	3	8	10	13
2,368	2,460	2,619	2,723	2,933	4	11	15	24
46,075	46,480	48,404	54,831	55,923	1	5	19	21
9,891	10,107	10,360	10,472	10,726	2	5	6	8
1,292	1,377	1,490	1,528	1,618	7	15	18	25
51,016	51,640	53,412	57,811	60,285	1	5	13	18
341,799	341,150	354,895	372,110	398,644	0	4	9	17
1,505	1,488	1,504	1,571	1,576	–1	0	4	5

Human capital

Human capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
75	Malaysia	722,253	908,587	1,078,764	1,223,142	1,403,269
76	Maldives	4,430	5,323	6,610	7,837	9,499
77	Mali	36,437	41,792	48,511	56,049	69,024
78	Malta	41,628	44,604	49,155	53,543	58,450
79	Mauritania	27,487	32,992	38,658	47,698	55,448
80	Mauritius	42,119	44,710	46,981	52,099	57,015
81	Mexico	3,303,020	3,771,351	4,239,892	4,933,308	5,525,249
82	Mongolia	12,800	13,977	15,548	17,591	19,563
83	Morocco	467,171	549,131	602,563	666,207	706,976
84	Mozambique	27,655	32,156	37,213	42,850	48,938
85	Myanmar	47,259	53,335	58,554	63,957	68,550
86	Namibia	69,509	80,338	90,451	105,109	120,738
87	Nepal	37,056	41,214	48,612	57,640	66,392
88	Netherlands	3,711,231	3,921,464	4,100,906	4,325,578	4,581,766
89	New Zealand	484,972	539,080	579,080	658,248	705,712
90	Nicaragua	26,559	30,692	36,869	41,713	46,591
91	Niger	28,153	34,456	42,392	49,739	61,341
92	Nigeria	558,170	632,976	715,751	827,020	963,107
93	Norway	1,538,519	1,613,671	1,693,401	1,852,887	1,982,162
94	Pakistan	683,751	820,901	974,190	1,169,587	1,346,483
95	Panama	74,718	91,658	102,642	119,752	132,099
96	Papua New Guinea	13,522	15,732	18,117	20,706	23,973
97	Paraguay	50,657	59,572	67,422	80,063	94,100
98	Peru	386,127	446,428	530,178	570,603	654,704
99	Philippines	509,938	585,668	682,538	756,472	863,279
100	Poland	2,661,481	2,814,946	2,920,790	2,942,842	3,044,674
101	Portugal	1,791,067	1,888,218	2,010,059	2,051,338	2,130,564
102	Qatar	60,764	68,418	82,281	126,648	302,140
103	Republic of Korea	4,093,798	4,591,453	4,938,518	5,245,909	5,499,675
104	Republic of Moldova	28,414	29,005	28,869	26,960	22,969
105	Romania	723,290	767,448	804,769	763,252	767,888
106	Russian Federation*	5,669,166	5,691,289	6,177,924	6,458,518	6,390,872
107	Rwanda	20,108	16,094	24,782	28,561	34,148
108	Saudi Arabia	1,433,460	1,763,841	2,005,961	2,536,731	3,118,153
109	Senegal	37,707	43,714	51,898	59,645	71,729
110	Serbia	395,030	443,777	449,425	448,405	458,295
111	Sierra Leone	17,618	17,207	18,674	24,455	28,128

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Human capital per capita in millions of constant 2005 US$					Human capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
39,666	43,849	46,072	46,863	49,409	11	16	18	25
20,187	21,403	24,193	26,544	30,071	6	20	31	49
4,201	4,254	4,295	4,254	4,491	1	2	1	7
113,266	115,382	123,685	130,818	140,331	2	9	15	24
13,774	14,394	14,628	15,653	16,027	5	6	14	16
39,752	39,319	39,281	41,456	43,886	–1	–1	4	10
39,179	40,872	42,416	46,329	48,714	4	8	18	24
5,838	6,061	6,448	6,906	7,098	4	10	18	22
18,852	20,392	20,927	21,920	22,127	8	11	16	17
2,041	2,018	2,045	2,063	2,092	–1	0	1	2
1,203	1,266	1,302	1,381	1,429	5	8	15	19
49,129	48,650	47,710	50,534	52,879	–1	–3	3	8
1,942	1,908	1,992	2,113	2,216	–2	3	9	14
249,214	254,275	258,523	265,284	275,794	2	4	6	11
142,723	146,686	150,097	159,223	161,559	3	5	12	13
6,445	6,619	7,267	7,690	8,049	3	13	19	25
3,615	3,754	3,881	3,828	3,954	4	7	6	9
5,722	5,754	5,787	5,915	6,079	1	1	3	6
362,731	370,185	377,077	400,772	405,922	2	4	10	12
6,113	6,446	6,741	7,372	7,757	5	10	21	27
30,927	34,240	34,722	36,980	37,562	11	12	20	21
3,252	3,336	3,368	3,397	3,496	3	4	4	7
11,936	12,423	12,618	13,575	14,579	4	6	14	22
17,806	18,736	20,500	20,705	22,517	5	15	16	26
8,274	8,457	8,829	8,843	9,257	2	7	7	12
69,936	73,322	76,256	77,108	79,544	5	9	10	14
180,451	186,492	194,468	194,556	199,574	3	8	8	11
128,269	136,462	139,233	154,264	171,788	6	9	20	34
95,248	102,804	107,388	111,510	114,140	8	13	17	20
6,511	6,685	7,030	7,157	6,429	3	8	10	–1
31,167	33,837	36,264	35,057	35,738	9	16	12	15
38,132	38,274	42,096	44,900	44,704	0	10	18	17
2,828	2,889	3,060	3,104	3,214	2	8	10	14
88,819	95,385	100,072	105,516	113,602	7	13	19	28
5,207	5,223	5,460	5,486	5,769	0	5	5	11
41,283	43,491	44,350	45,495	46,498	5	7	10	13
4,425	4,414	4,507	4,745	4,794	0	2	7	8

Human capital

Human capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
112	Singapore	429,721	510,905	604,867	701,993	907,291
113	Slovakia**	360,909	373,975	386,533	412,498	426,543
114	Slovenia*	269,040	300,332	314,073	329,523	329,473
115	South Africa	1,470,352	1,868,184	1,962,459	2,227,970	2,297,274
116	Spain	6,745,216	7,787,640	8,778,299	9,765,963	11,050,147
117	Sri Lanka	235,388	260,333	297,495	310,668	336,914
118	Sudan (former)	111,466	125,975	148,000	171,486	201,691
119	Swaziland	28,930	33,551	37,660	41,849	45,462
120	Sweden	2,522,960	2,581,896	2,634,171	2,766,056	2,953,824
121	Switzerland	2,711,651	2,788,798	2,817,812	2,970,641	3,181,542
122	Syrian Arab Republic	188,240	227,706	267,644	300,041	337,908
123	Tajikistan*	11,166	11,669	12,745	14,310	15,756
124	Thailand	847,717	886,318	959,879	1,063,295	1,170,214
125	Togo	23,258	26,356	32,837	39,350	44,899
126	Trinidad and Tobago	70,034	77,649	88,812	98,724	100,828
127	Tunisia	204,989	236,098	267,044	291,620	328,994
128	Turkey	2,585,417	2,950,242	3,173,236	3,423,735	3,835,905
129	Uganda	36,804	42,756	50,754	59,884	74,525
130	Ukraine*	745,666	782,291	757,268	756,514	749,004
131	United Arab Emirates	422,414	634,804	901,039	1,319,613	2,541,624
132	United Kingdom	15,996,765	15,957,772	16,768,300	18,116,941	19,079,056
133	United Republic of Tanzania	29,379	35,446	39,754	46,840	53,811
134	United States of America	77,709,588	81,467,032	87,203,943	93,882,940	99,641,223
135	Uruguay	156,431	163,165	176,921	177,808	190,024
136	Venezuela (Bolivarian Republic of)	947,252	1,089,164	1,298,414	1,516,600	1,696,277
137	Vietnam	308,545	349,104	410,208	462,888	517,070
138	Yemen	114,725	148,476	189,488	229,656	276,793
139	Zambia	27,859	32,989	37,446	43,326	50,141
140	Zimbabwe	52,511	60,821	66,540	73,792	73,197

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Human capital per capita in millions of constant 2005 US$					Human capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
142,451	146,741	154,330	164,555	178,375	3	8	16	25
67,906	69,656	71,516	76,170	78,091	3	5	12	15
139,017	152,747	158,191	164,590	162,328	10	14	18	17
39,962	45,123	43,844	46,617	45,824	13	10	17	15
173,447	197,521	217,886	225,046	239,819	14	26	30	38
13,577	14,281	15,871	15,657	16,151	5	17	15	19
4,207	4,180	4,329	4,465	4,631	–1	3	6	10
33,525	34,819	35,401	37,876	38,331	4	6	13	14
294,779	292,501	297,305	306,341	314,917	–1	1	4	7
406,317	397,338	393,115	400,625	415,111	–2	–3	–1	2
15,274	16,068	16,740	16,232	16,556	5	10	6	8
2,061	2,020	2,065	2,218	2,291	–2	0	8	11
14,853	14,859	15,199	15,942	16,930	0	2	7	14
6,345	6,451	6,850	7,276	7,449	2	8	15	17
57,618	61,556	68,737	75,053	75,163	7	19	30	30
24,953	26,422	28,240	29,421	31,390	6	13	18	26
47,763	50,119	49,872	50,243	52,726	5	4	5	10
2,079	2,053	2,096	2,106	2,230	–1	1	1	7
14,432	15,303	15,489	16,122	16,480	6	7	12	14
233,553	270,297	297,031	324,281	338,356	16	27	39	45
279,593	275,147	284,816	300,932	307,550	–2	2	8	10
1,153	1,184	1,168	1,206	1,200	3	1	5	4
306,741	305,895	308,691	316,296	321,026	0	1	3	5
50,314	50,619	53,304	53,516	56,407	1	6	6	12
48,120	49,429	53,327	56,878	58,533	3	11	18	22
4,598	4,717	5,208	5,566	5,886	3	13	21	28
9,602	9,802	10,692	11,122	11,508	2	11	16	20
3,544	3,699	3,671	3,780	3,831	4	4	7	8
5,016	5,205	5,319	5,870	5,822	4	6	17	16

Produced capital

Produced capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	25,451	25,065	24,444	26,994	31,927
2	Albania	41,198	37,168	36,242	41,945	50,506
3	Algeria	295,715	309,446	327,508	360,431	430,264
4	Argentina	466,667	506,843	574,605	598,862	739,816
5	Armenia	15,116	15,826	14,991	16,780	23,485
6	Australia	1,320,821	1,543,146	1,885,364	2,386,429	3,103,463
7	Austria	747,277	867,386	997,936	1,117,769	1,225,301
8	Bahrain	17,401	20,991	23,414	30,132	45,240
9	Bangladesh	53,417	66,472	91,401	129,805	185,330
10	Barbados	11,464	11,729	13,130	14,007	15,010
11	Belgium	817,777	931,848	1,060,901	1,196,425	1,354,303
12	Belize	1,350	1,887	2,394	2,946	3,499
13	Benin	6,537	7,244	8,481	10,500	13,066
14	Bolivia (Plurinational State of)	12,743	14,657	18,763	20,852	24,969
15	Botswana	9,332	13,887	20,166	28,013	37,144
16	Brazil	1,899,175	2,067,899	2,316,349	2,506,169	2,903,836
17	Bulgaria	95,413	90,613	85,813	94,908	120,397
18	Burundi	2,756	3,455	3,453	3,681	3,885
19	Cambodia	4,025	4,514	5,963	9,126	15,498
20	Cameroon	32,426	33,765	36,238	42,452	49,927
21	Canada	1,889,256	2,143,343	2,505,853	3,017,978	3,658,851
22	Central African Republic	3,002	3,105	3,080	3,044	3,290
23	Chile	88,636	124,775	179,493	237,604	333,443
24	China	1,567,556	2,421,380	3,963,916	6,596,072	11,734,004
25	Colombia	276,942	338,743	382,932	420,501	531,831
26	Congo	15,538	19,636	20,857	22,106	29,980
27	Costa Rica	22,709	28,592	36,548	45,967	60,066
28	Côte d'Ivoire	30,072	29,124	30,961	32,483	33,540
29	Croatia*	94,315	93,542	107,005	130,837	165,199
30	Cuba	110,893	105,653	100,707	97,455	105,523
31	Cyprus	29,362	34,854	39,409	45,633	55,325
32	Czech Republic**	389,981	412,377	464,267	523,615	604,732
33	Democratic Republic of the Congo	21,160	19,591	17,641	18,259	21,675
34	Denmark	478,058	532,838	631,858	736,144	845,459
35	Dominican Republic	32,871	39,692	56,115	70,911	92,528
36	Ecuador	83,572	93,913	100,664	115,064	138,340
37	Egypt	79,630	101,449	138,013	177,679	252,061

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Produced capital per capita in millions of constant 2005 US$					Produced capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
1,953	1,267	1,069	978	1,016	−35	−45	−50	−48
12,524	11,833	11,798	13,351	15,762	−6	−6	7	26
11,689	10,938	10,726	10,959	12,131	−6	−8	−6	4
14,296	14,541	15,559	15,482	18,307	2	9	8	28
4,264	4,910	4,873	5,473	7,595	15	14	28	78
77,258	85,170	98,379	116,962	139,366	10	27	51	80
97,422	109,303	124,669	135,780	145,980	12	28	39	50
35,305	37,546	36,689	41,572	35,852	6	4	18	2
507	566	705	923	1,246	11	39	82	146
44,175	44,526	49,080	51,783	54,916	1	11	17	24
82,197	92,446	104,258	114,884	126,428	12	27	40	54
7,094	8,564	9,556	10,485	11,230	21	35	48	58
1,370	1,282	1,301	1,375	1,476	−6	−5	0	8
1,914	1,962	2,259	2,280	2,515	3	18	19	31
6,751	8,758	11,472	14,935	18,507	30	70	121	174
12,691	12,777	13,280	13,475	14,896	1	5	6	17
10,819	10,843	10,718	12,263	16,065	0	−1	13	48
492	568	542	508	463	15	10	3	−6
422	404	479	683	1,096	−4	13	62	160
2,662	2,422	2,311	2,418	2,547	−9	−13	−9	−4
68,202	73,146	81,711	93,484	107,561	7	20	37	58
1,023	933	832	758	748	−9	−19	−26	−27
6,721	8,659	11,640	14,575	19,484	29	73	117	190
1,369	1,995	3,123	5,044	8,748	46	128	269	539
8,341	9,293	9,630	9,770	11,488	11	15	17	38
6,504	7,185	6,651	6,257	7,416	10	2	−4	14
7,396	8,242	9,325	10,667	12,893	11	26	44	74
2,402	1,984	1,867	1,803	1,699	−17	−22	−25	−29
20,737	20,035	23,750	29,455	37,517	−3	15	42	81
10,491	9,692	9,069	8,659	9,373	−8	−14	−17	−11
38,299	40,745	41,779	44,194	50,129	6	9	15	31
37,812	39,962	45,326	51,231	57,632	6	20	35	52
581	445	355	318	329	−24	−39	−45	−43
92,989	101,816	118,336	135,834	152,331	9	27	46	64
4,569	5,014	6,531	7,654	9,321	10	43	68	104
8,145	8,249	8,154	8,570	9,564	1	0	5	17
1,401	1,635	2,040	2,394	3,107	17	46	71	122

Produced capital

Produced capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
38	El Salvador	23,942	27,968	33,493	39,359	44,902
39	Estonia	30,788	31,246	34,552	44,631	56,961
40	Fiji	4,753	5,208	5,793	6,674	7,437
41	Finland	496,242	514,190	564,731	631,803	704,663
42	France	4,611,452	5,142,790	5,729,333	6,479,550	7,290,809
43	Gabon	32,901	33,220	35,523	36,801	39,183
44	Gambia	356	396	439	867	1,660
45	Germany	6,580,914	7,527,739	8,446,071	9,124,010	9,856,172
46	Ghana	34,449	37,893	40,787	46,875	61,339
47	Greece	523,442	551,922	611,918	727,129	844,548
48	Guatemala	42,021	47,813	58,703	70,172	82,604
49	Guyana	3,418	4,111	4,848	5,285	6,113
50	Haiti	6,283	6,344	7,096	8,281	9,431
51	Honduras	15,581	19,808	25,500	30,823	38,695
52	Hungary	291,623	304,260	329,291	374,393	415,982
53	Iceland	28,655	30,739	36,330	44,454	52,969
54	India	848,080	1,114,016	1,515,896	2,171,823	3,456,372
55	Indonesia	301,769	471,588	640,925	787,249	1,025,167
56	Iran (Islamic Republic of)	466,200	488,275	526,761	635,378	782,036
57	Iraq	32,169	28,621	25,157	28,929	44,031
58	Ireland	279,911	313,381	407,400	540,659	651,173
59	Israel	185,414	242,412	310,956	356,248	425,063
60	Italy	4,384,260	4,888,355	5,439,510	6,112,982	6,648,672
61	Jamaica	30,668	36,868	41,299	46,988	50,565
62	Japan	13,570,113	16,288,603	18,399,084	19,795,727	20,668,040
63	Jordan	27,492	33,401	37,917	43,404	52,451
64	Kazakhstan*	273,576	284,303	260,495	265,334	326,750
65	Kenya	30,411	33,326	38,261	44,654	59,364
66	Kuwait	49,530	58,821	71,836	98,390	149,139
67	Kyrgyzstan*	9,062	9,070	8,831	8,903	10,551
68	Lao People's Democratic Republic	1,249	1,765	3,140	6,106	11,588
69	Latvia	33,141	31,445	34,147	44,339	57,622
70	Lesotho	3,613	5,364	6,880	7,354	8,130
71	Liberia	3,409	2,901	2,566	2,367	2,598
72	Lithuania*	68,473	67,526	70,265	79,512	96,027
73	Luxembourg	46,734	56,914	71,750	92,310	115,473
74	Malawi	8,344	8,605	8,412	8,610	11,751

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Produced capital per capita in millions of constant 2005 US$					Produced capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
4,490	4,878	5,638	6,505	7,250	9	26	45	61
19,640	21,688	25,206	33,162	42,472	10	28	69	116
6,525	6,714	7,137	8,114	8,641	3	9	24	32
99,518	100,668	109,161	120,473	131,356	1	10	21	32
81,319	88,907	97,029	106,228	116,119	9	19	31	43
35,413	30,552	28,757	26,848	26,027	–14	–19	–24	–27
369	352	339	577	960	–5	–8	56	160
83,199	91,881	102,564	110,539	119,755	10	23	33	44
2,329	2,229	2,128	2,166	2,515	–4	–9	–7	8
51,517	51,718	55,695	65,020	74,348	0	8	26	44
4,709	4,774	5,224	5,518	5,741	1	11	17	22
4,715	5,647	6,613	7,082	8,103	20	40	50	72
882	805	821	886	944	–9	–7	0	7
3,187	3,553	4,101	4,481	5,091	11	29	41	60
28,105	29,450	32,250	37,117	41,666	5	15	32	48
112,463	114,920	129,192	149,807	165,457	2	15	33	47
971	1,155	1,438	1,905	2,822	19	48	96	191
1,637	2,365	3,003	3,463	4,274	44	83	112	161
8,496	8,171	8,062	9,112	10,572	–4	–5	7	24
1,852	1,411	1,054	1,057	1,390	–24	–43	–43	–25
79,268	86,786	107,104	130,027	145,680	9	35	64	84
41,204	45,463	51,697	53,940	57,298	10	25	31	39
77,144	85,809	95,453	104,190	109,803	11	24	35	42
12,968	14,978	15,997	17,522	18,447	16	23	35	42
111,002	130,846	146,349	156,621	163,337	18	32	41	47
8,049	7,622	7,855	8,125	8,477	–5	–2	1	5
16,567	17,852	17,417	17,489	20,388	8	5	6	23
1,297	1,215	1,224	1,254	1,465	–6	–6	–3	13
23,725	36,133	37,014	43,458	54,495	52	56	83	130
2,040	1,975	1,782	1,766	1,978	–3	–13	–13	–3
298	368	591	1,061	1,869	24	98	256	527
12,441	12,618	14,318	19,232	25,586	1	15	55	106
2,204	2,989	3,503	3,560	3,744	36	59	61	70
1,602	1,385	901	744	650	–14	–44	–54	–59
18,516	18,607	20,075	23,278	28,892	0	8	26	56
122,588	139,659	164,757	201,903	227,556	14	34	65	86
889	871	749	671	789	–2	–16	–25	–11

Produced capital

Produced capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
75	Malaysia	119,981	208,507	299,254	365,961	450,159
76	Maldives	773	1,178	1,797	2,831	4,539
77	Mali	6,107	7,561	8,997	10,820	13,718
78	Malta	6,702	9,251	12,662	15,430	17,522
79	Mauritania	4,819	4,903	4,932	6,995	10,228
80	Mauritius	7,514	10,348	13,696	17,422	22,463
81	Mexico	1,359,588	1,592,960	1,899,978	2,265,913	2,757,829
82	Mongolia	10,681	11,578	12,553	13,190	23,047
83	Morocco	113,846	131,147	155,911	193,023	258,846
84	Mozambique	6,210	7,249	9,729	13,275	18,672
85	Myanmar	2,630	3,336	5,199	9,028	22,713
86	Namibia	15,408	16,788	18,418	21,003	26,709
87	Nepal	9,269	12,357	16,204	20,543	25,786
88	Netherlands	1,267,929	1,433,637	1,699,609	1,940,251	2,190,994
89	New Zealand	210,571	231,818	269,984	329,724	386,182
90	Nicaragua	18,472	18,372	20,428	22,444	24,796
91	Niger	11,618	10,990	10,776	11,442	13,975
92	Nigeria	220,009	206,845	195,235	189,725	209,513
93	Norway	627,418	661,494	751,299	838,474	993,996
94	Pakistan	165,804	208,457	246,979	282,919	343,841
95	Panama	18,003	22,280	29,409	34,220	50,042
96	Papua New Guinea	7,300	8,011	9,156	11,170	13,020
97	Paraguay	18,847	23,580	26,493	27,618	30,909
98	Peru	168,947	181,997	211,372	230,280	304,429
99	Philippines	180,541	212,159	255,815	297,862	352,574
100	Poland	428,126	471,573	618,486	742,648	960,224
101	Portugal	393,042	465,610	579,805	684,693	751,653
102	Qatar	25,373	28,560	39,192	72,109	164,883
103	Republic of Korea	841,614	1,475,163	2,133,910	2,808,704	3,494,869
104	Republic of Moldova	35,957	33,009	29,210	26,561	26,143
105	Romania	274,003	274,100	287,342	322,425	416,065
106	Russian Federation*	3,415,470	3,445,515	3,163,169	3,097,099	3,402,771
107	Rwanda	3,115	3,280	3,584	4,425	6,936
108	Saudi Arabia	365,249	426,815	494,168	601,057	858,912
109	Senegal	13,024	15,050	18,576	23,518	30,893
110	Serbia	62,521	61,545	60,258	66,004	81,970

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Produced capital per capita in millions of constant 2005 US$					Produced capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
6,589	10,063	12,780	14,021	15,850	53	94	113	141
3,522	4,735	6,578	9,588	14,370	34	87	172	308
704	770	797	821	893	9	13	17	27
18,234	23,931	31,861	37,700	42,068	31	75	107	131
2,415	2,139	1,866	2,296	2,956	–11	–23	–5	22
7,092	9,101	11,451	13,863	17,291	28	61	95	144
16,127	17,264	19,007	21,279	24,315	7	18	32	51
4,871	5,021	5,206	5,178	8,362	3	7	6	72
4,594	4,870	5,415	6,351	8,101	6	18	38	76
458	455	535	639	798	–1	17	39	74
67	79	116	195	474	18	73	191	607
10,890	10,166	9,715	10,098	11,697	–7	–11	–7	7
486	572	664	753	861	18	37	55	77
85,143	92,959	107,144	118,994	131,884	9	26	40	55
61,970	63,079	69,980	79,757	88,409	2	13	29	43
4,483	3,962	4,026	4,138	4,284	–12	–10	–8	–4
1,492	1,197	987	881	901	–20	–34	–41	–40
2,255	1,880	1,578	1,357	1,322	–17	–30	–40	–41
147,924	151,750	167,295	181,358	203,558	3	13	23	38
1,482	1,637	1,709	1,783	1,981	10	15	20	34
7,452	8,323	9,948	10,567	14,229	12	34	42	91
1,756	1,699	1,702	1,832	1,898	–3	–3	4	8
4,441	4,917	4,958	4,683	4,789	11	12	5	8
7,791	7,638	8,173	8,356	10,470	–2	5	7	34
2,929	3,063	3,309	3,482	3,781	5	13	19	29
11,250	12,283	16,147	19,459	25,086	9	44	73	123
39,599	45,986	56,095	64,939	70,409	16	42	64	78
53,560	56,963	66,320	87,832	93,748	6	24	64	75
19,581	33,029	46,402	59,704	72,532	69	137	205	270
8,240	7,608	7,113	7,051	7,317	–8	–14	–14	–11
11,807	12,085	12,948	14,809	19,364	2	10	25	64
22,973	23,171	21,554	21,531	23,803	1	–6	–6	4
438	589	443	481	653	34	1	10	49
22,631	23,081	24,653	25,001	31,292	2	9	10	38
1,798	1,798	1,954	2,163	2,485	0	9	20	38
6,534	6,031	5,946	6,697	8,317	–8	–9	2	27

Produced capital

Produced capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
111	Sierra Leone	1,138	1,157	1,060	1,239	1,565
112	Singapore	130,321	187,836	280,570	349,238	461,252
113	Slovakia**	152,085	156,514	176,657	195,095	224,086
114	Slovenia*	77,935	81,396	97,081	117,971	143,632
115	South Africa	453,800	470,590	512,459	576,926	726,246
116	Spain	2,344,858	2,732,645	3,251,642	4,029,463	4,804,877
117	Sri Lanka	35,309	42,106	51,793	63,524	85,686
118	Sudan (former)	8,234	9,541	16,528	36,239	67,470
119	Swaziland	9,927	12,659	13,881	12,910	12,133
120	Sweden	760,258	814,967	900,452	1,012,899	1,166,991
121	Switzerland	920,651	1,008,601	1,120,851	1,241,788	1,388,524
122	Syrian Arab Republic	42,567	49,821	57,484	71,061	89,093
123	Tajikistan*	13,367	13,024	11,605	10,475	10,032
124	Thailand	308,166	519,936	634,845	711,558	824,125
125	Togo	7,544	6,996	6,831	7,032	7,654
126	Trinidad and Tobago	49,845	46,840	47,590	53,317	55,227
127	Tunisia	66,189	76,267	88,500	103,585	123,402
128	Turkey	499,362	664,497	870,502	1,052,519	1,367,017
129	Uganda	9,133	10,973	14,442	19,428	29,208
130	Ukraine*	584,144	592,168	529,811	503,488	509,202
131	United Arab Emirates	281,987	317,808	362,856	426,769	579,019
132	United Kingdom	3,502,941	3,929,715	4,591,999	5,406,740	6,247,208
133	United Republic of Tanzania	11,822	18,330	23,007	31,649	49,562
134	United States of America	17,158,834	19,966,588	25,108,673	30,919,448	35,543,091
135	Uruguay	33,979	39,033	46,291	48,909	59,070
136	Venezuela (Bolivarian Republic of)	495,509	519,957	538,862	546,101	644,299
137	Vietnam	22,952	39,526	73,387	126,666	218,664
138	Yemen	16,334	20,165	29,106	38,859	45,956
139	Zambia	14,278	13,021	15,342	20,083	28,694
140	Zimbabwe	3,409	4,030	4,430	4,980	4,598

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Produced capital per capita in millions of constant 2005 US$					Produced capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
286	297	256	240	267	4	−10	−16	−7
43,201	53,950	71,587	81,865	90,683	25	66	89	110
28,615	29,152	32,685	36,025	41,025	2	14	26	43
40,270	41,397	48,898	58,924	70,766	3	21	46	76
12,334	11,366	11,449	12,071	14,486	−8	−7	−2	17
60,296	69,309	80,709	92,855	104,279	15	34	54	73
2,037	2,310	2,763	3,201	4,108	13	36	57	102
311	317	483	943	1,549	2	56	204	398
11,504	13,137	13,048	11,684	10,230	14	13	2	−11
88,827	92,327	101,629	112,179	124,417	4	14	26	40
137,951	143,702	156,371	167,470	181,167	4	13	21	31
3,454	3,516	3,595	3,844	4,365	2	4	11	26
2,467	2,255	1,880	1,623	1,458	−9	−24	−34	−41
5,400	8,716	10,052	10,668	11,923	61	86	98	121
2,058	1,712	1,425	1,300	1,270	−17	−31	−37	−38
41,008	37,132	36,833	40,533	41,169	−9	−10	−1	0
8,057	8,535	9,359	10,450	11,774	6	16	30	46
9,225	11,289	13,681	15,446	18,790	22	48	67	104
516	527	596	683	874	2	16	32	69
11,306	11,583	10,836	10,730	11,204	2	−4	−5	−1
155,911	135,322	119,617	104,874	77,082	−13	−23	−33	−51
61,225	67,757	77,997	89,809	100,704	11	27	47	64
464	612	676	815	1,105	32	46	76	138
67,731	74,971	88,881	104,169	114,513	11	31	54	69
10,929	12,109	13,947	14,720	17,535	11	28	35	60
25,172	23,597	22,131	20,481	22,233	−6	−12	−19	−12
342	534	932	1,523	2,489	56	172	345	628
1,367	1,331	1,642	1,882	1,911	−3	20	38	40
1,817	1,460	1,504	1,752	2,192	−20	−17	−4	21
326	345	354	396	366	6	9	22	12

Natural capital

Natural capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	8,472	8,416	8,368	8,360	8,347
2	Albania	30,646	30,430	30,429	29,752	30,685
3	Algeria	540,899	507,941	468,762	423,063	371,680
4	Argentina	696,148	675,818	650,429	642,205	635,909
5	Armenia	2,791	2,626	2,461	2,294	2,026
6	Australia	3,005,926	2,974,354	2,927,251	2,860,514	2,717,359
7	Austria	60,663	61,456	62,411	62,729	60,822
8	Bahrain	4,849	3,931	3,025	2,140	1,283
9	Bangladesh	41,415	38,657	38,160	37,188	36,855
10	Barbados	467	441	395	339	284
11	Belgium	3,369	3,907	4,445	4,874	5,021
12	Belize	13,805	13,481	13,091	12,696	12,308
13	Benin	36,726	34,478	32,231	30,626	28,999
14	Bolivia (Plurinational State of)	938,941	921,240	902,539	882,454	859,094
15	Botswana	67,952	65,268	62,593	59,870	57,173
16	Brazil	5,061,443	4,956,971	4,829,135	4,705,799	4,567,813
17	Bulgaria	70,918	69,862	68,093	68,169	68,216
18	Burundi	5,559	5,112	4,860	4,836	4,711
19	Cambodia	98,497	94,347	90,519	87,515	84,563
20	Cameroon	247,702	235,200	223,070	211,603	200,549
21	Canada	4,750,302	4,661,655	4,559,587	4,450,099	4,344,908
22	Central African Republic	181,088	179,914	178,739	177,574	176,399
23	Chile	271,477	264,898	259,105	259,238	250,413
24	China	7,792,499	7,714,637	7,464,322	7,099,247	6,788,988
25	Colombia	1,170,032	1,149,137	1,129,043	1,092,203	1,066,561
26	Congo	251,360	247,651	242,520	237,569	232,601
27	Costa Rica	36,996	34,050	31,613	31,697	33,128
28	Côte d'Ivoire	72,258	72,842	72,459	72,584	71,938
29	Croatia*	20,902	21,099	21,472	21,944	22,478
30	Cuba	26,193	28,556	30,475	32,002	31,441
31	Cyprus	1,324	1,313	1,333	1,402	1,304
32	Czech Republic**	31,489	28,138	23,255	18,656	14,373
33	Democratic Republic of the Congo	989,199	979,165	969,137	959,191	949,252
34	Denmark	44,339	40,465	34,308	26,598	19,693
35	Dominican Republic	30,398	30,509	29,851	29,437	29,260
36	Ecuador	223,882	209,852	194,445	176,787	159,292
37	Egypt	145,246	128,885	111,100	95,301	77,702

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Natural capital per capita in millions of constant 2005 US$					Natural capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
650	425	366	303	266	–35	–44	–53	–59
9,316	9,688	9,906	9,470	9,576	4	6	2	3
21,380	17,954	15,352	12,864	10,479	–16	–28	–40	–51
21,326	19,389	17,612	16,603	15,736	–9	–17	–22	–26
787	815	800	748	655	3	2	–5	–17
175,825	164,162	152,745	140,197	122,028	–7	–13	–20	–31
7,909	7,744	7,797	7,620	7,246	–2	–1	–4	–8
9,837	7,031	4,739	2,953	1,017	–29	–52	–70	–90
393	329	294	265	248	–16	–25	–33	–37
1,799	1,673	1,477	1,253	1,039	–7	–18	–30	–42
339	388	437	468	469	14	29	38	38
72,565	61,192	52,255	45,189	39,496	–16	–28	–38	–46
7,694	6,101	4,945	4,012	3,277	–21	–36	–48	–57
141,015	123,310	108,645	96,478	86,516	–13	–23	–32	–39
49,156	41,162	35,606	31,919	28,488	–16	–28	–35	–42
33,822	30,627	27,686	25,302	23,431	–9	–18	–25	–31
8,042	8,360	8,505	8,808	9,102	4	6	10	13
992	840	762	667	562	–15	–23	–33	–43
10,333	8,447	7,272	6,552	5,981	–18	–30	–37	–42
20,335	16,872	14,228	12,055	10,233	–17	–30	–41	–50
171,486	159,089	148,679	137,845	127,729	–7	–13	–20	–26
61,704	54,065	48,287	44,196	40,081	–12	–22	–28	–35
20,585	18,384	16,803	15,902	14,632	–11	–18	–23	–29
6,805	6,355	5,882	5,429	5,061	–7	–14	–20	–26
35,238	31,524	28,393	25,376	23,038	–11	–19	–28	–35
105,220	90,625	77,340	67,240	57,533	–14	–26	–36	–45
12,050	9,816	8,066	7,355	7,111	–19	–33	–39	–41
5,772	4,963	4,370	4,028	3,645	–14	–24	–30	–37
4,596	4,519	4,766	4,940	5,105	–2	4	7	11
2,478	2,620	2,744	2,844	2,793	6	11	15	13
1,726	1,534	1,413	1,358	1,182	–11	–18	–21	–32
3,053	2,727	2,270	1,825	1,370	–11	–26	–40	–55
27,171	22,220	19,529	16,705	14,390	–18	–28	–39	–47
8,624	7,732	6,425	4,908	3,548	–10	–25	–43	–59
4,225	3,854	3,474	3,177	2,947	–9	–18	–25	–30
21,820	18,433	15,751	13,167	11,012	–16	–28	–40	–50
2,555	2,077	1,642	1,284	958	–19	–36	–50	–63

Natural capital

Natural capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
38	El Salvador	7,762	7,786	7,810	7,908	7,624
39	Estonia	17,255	17,949	18,643	18,612	18,349
40	Fiji	5,756	5,891	5,806	5,780	5,751
41	Finland	163,683	165,811	168,566	162,940	163,050
42	France	268,682	269,002	270,405	276,935	277,134
43	Gabon	156,482	151,131	145,317	141,070	136,992
44	Gambia	2,328	2,369	2,416	2,459	2,523
45	Germany	1,593,574	1,540,903	1,500,887	1,460,914	1,423,171
46	Ghana	63,571	60,439	58,468	55,450	52,414
47	Greece	229,940	225,258	211,562	138,414	196,886
48	Guatemala	36,312	34,058	31,621	29,312	26,419
49	Guyana	171,686	171,665	171,641	171,624	171,608
50	Haiti	653	606	559	510	459
51	Honduras	86,606	78,811	68,993	63,915	58,420
52	Hungary	50,079	47,258	44,459	43,175	40,164
53	Iceland	76,624	76,542	76,139	75,856	64,129
54	India	2,484,106	2,445,698	2,407,511	2,345,221	2,277,454
55	Indonesia	2,116,409	1,975,114	1,874,495	1,805,107	1,711,576
56	Iran (Islamic Republic of)	3,202,181	3,130,867	3,046,171	2,931,607	2,826,571
57	Iraq	1,052,440	1,045,572	1,020,938	994,817	964,393
58	Ireland	39,801	31,059	30,854	29,836	31,330
59	Israel	6,682	6,578	6,453	5,974	5,711
60	Italy	325,144	318,858	332,179	332,809	338,927
61	Jamaica	30,081	30,992	29,964	29,229	28,174
62	Japan	401,054	398,280	398,614	385,297	380,285
63	Jordan	7,775	7,813	7,581	7,313	7,155
64	Kazakhstan*	886,369	874,413	859,730	836,861	806,053
65	Kenya	41,677	41,343	40,243	39,787	39,565
66	Kuwait	1,273,616	1,244,676	1,203,211	1,158,284	1,107,973
67	Kyrgyzstan*	13,730	13,868	14,088	14,303	16,147
68	Lao People's Democratic Republic	123,881	121,363	119,569	117,563	117,691
69	Latvia	18,098	19,157	20,216	21,049	23,011
70	Lesotho	150	149	149	149	148
71	Liberia	31,827	30,856	29,886	28,916	27,946
72	Lithuania*	14,433	14,656	14,903	15,350	15,322
73	Luxembourg	1,015	1,125	1,235	1,235	1,235
74	Malawi	23,447	22,600	22,263	21,675	21,066

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Natural capital per capita in millions of constant 2005 US$					Natural capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
1,456	1,358	1,315	1,307	1,231	–7	–10	–10	–15
11,007	12,458	13,600	13,829	13,681	13	24	26	24
7,902	7,595	7,153	7,027	6,683	–4	–9	–11	–15
32,826	32,462	32,583	31,070	30,394	–1	–1	–5	–7
4,738	4,650	4,579	4,540	4,414	–2	–3	–4	–7
168,433	138,994	117,640	102,916	90,996	–17	–30	–39	–46
2,410	2,104	1,862	1,635	1,460	–13	–23	–32	–39
20,147	18,808	18,226	17,699	17,292	–7	–10	–12	–14
4,297	3,556	3,051	2,562	2,149	–17	–29	–40	–50
22,631	21,108	19,256	12,377	17,332	–7	–15	–45	–23
4,069	3,401	2,814	2,305	1,836	–16	–31	–43	–55
236,831	235,810	234,130	229,987	227,448	0	–1	–3	–4
92	77	65	55	46	–16	–29	–41	–50
17,713	14,136	11,095	9,291	7,686	–20	–37	–48	–57
4,826	4,574	4,354	4,280	4,023	–5	–10	–11	–17
300,729	286,163	270,754	255,629	200,320	–5	–10	–15	–33
2,843	2,536	2,284	2,057	1,860	–11	–20	–28	–35
11,481	9,905	8,784	7,941	7,135	–14	–23	–31	–38
58,359	52,393	46,619	42,041	38,211	–10	–20	–28	–35
60,576	51,536	42,793	36,361	30,450	–15	–29	–40	–50
11,271	8,601	8,111	7,175	7,009	–24	–28	–36	–38
1,485	1,234	1,073	905	770	–17	–28	–39	–48
5,721	5,597	5,829	5,672	5,597	–2	2	–1	–2
12,720	12,591	11,606	10,900	10,279	–1	–9	–14	–19
3,281	3,199	3,171	3,048	3,005	–2	–3	–7	–8
2,276	1,783	1,571	1,369	1,156	–22	–31	–40	–49
53,675	54,905	57,481	55,159	50,295	2	7	3	–6
1,778	1,507	1,288	1,117	977	–15	–28	–37	–45
610,061	764,585	619,961	511,606	404,853	25	2	–16	–34
3,091	3,020	2,843	2,837	3,027	–2	–8	–8	–2
29,549	25,310	22,488	20,434	18,980	–14	–24	–31	–36
6,794	7,687	8,476	9,130	10,218	13	25	34	50
91	83	76	72	68	–9	–17	–21	–25
14,962	14,731	10,496	9,086	6,997	–2	–30	–39	–53
3,903	4,038	4,258	4,494	4,610	3	9	15	18
2,661	2,761	2,837	2,702	2,435	4	7	2	–9
2,499	2,287	1,983	1,690	1,414	–9	–21	–32	–43

Natural capital

Natural capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
75	Malaysia	445,167	425,004	398,481	365,515	332,012
76	Maldives	3	3	3	3	3
77	Mali	78,936	78,594	78,231	76,549	73,609
78	Malta	158	134	109	113	125
79	Mauritania	5,968	5,563	5,146	4,740	4,436
80	Mauritius	1,360	1,285	1,253	1,180	1,125
81	Mexico	996,664	973,148	924,459	868,124	824,395
82	Mongolia	208,966	200,736	205,465	190,548	186,644
83	Morocco	54,203	54,621	54,506	54,096	53,922
84	Mozambique	234,064	229,408	224,813	220,430	216,384
85	Myanmar	288,694	272,096	255,384	241,204	226,257
86	Namibia	63,339	61,889	60,332	58,750	57,160
87	Nepal	106,695	97,416	88,290	82,982	82,981
88	Netherlands	124,082	108,675	94,511	80,987	67,059
89	New Zealand	171,612	161,032	161,897	133,675	132,960
90	Nicaragua	36,505	35,339	34,198	32,364	29,802
91	Niger	12,313	10,846	9,263	9,068	8,565
92	Nigeria	826,123	783,729	733,306	694,573	641,889
93	Norway	436,937	391,220	325,644	259,050	202,837
94	Pakistan	201,983	195,509	187,584	177,785	163,516
95	Panama	39,813	38,007	36,590	36,023	35,479
96	Papua New Guinea	298,355	290,466	282,447	274,907	267,573
97	Paraguay	132,978	127,356	128,820	123,693	120,802
98	Peru	1,177,508	1,160,928	1,146,764	1,135,512	1,115,393
99	Philippines	106,244	107,136	109,241	111,167	114,515
100	Poland	211,569	193,474	176,624	156,382	140,177
101	Portugal	30,430	30,887	31,120	30,669	30,002
102	Qatar	350,742	343,211	331,602	316,163	295,984
103	Republic of Korea	333,151	346,782	366,825	389,546	402,847
104	Republic of Moldova	3,583	3,787	3,991	4,296	4,522
105	Romania	185,404	177,854	171,925	162,866	159,411
106	Russian Federation*	10,607,209	10,413,589	10,194,693	9,930,864	9,671,023
107	Rwanda	2,333	1,929	2,063	2,220	2,314
108	Saudi Arabia	3,959,322	4,039,020	3,868,351	3,685,802	3,492,581
109	Senegal	62,338	60,509	58,820	56,816	55,527
110	Serbia	21,306	21,996	22,687	25,208	30,456
111	Sierra Leone	16,514	15,862	15,211	14,584	13,984

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Natural capital per capita in millions of constant 2005 US$					Natural capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
24,448	20,511	17,018	14,004	11,690	−16	−30	−43	−52
15	13	12	11	11	−12	−20	−26	−31
9,102	8,000	6,926	5,809	4,789	−12	−24	−36	−47
430	346	275	276	301	−20	−36	−36	−30
2,991	2,427	1,947	1,556	1,282	−19	−35	−48	−57
1,284	1,130	1,047	939	866	−12	−18	−27	−33
11,822	10,546	9,248	8,153	7,268	−11	−22	−31	−39
95,307	87,044	85,207	74,803	67,723	−9	−11	−22	−29
2,187	2,028	1,893	1,780	1,688	−7	−13	−19	−23
17,278	14,398	12,352	10,613	9,251	−17	−29	−39	−46
7,352	6,458	5,681	5,207	4,717	−12	−23	−29	−36
44,768	37,478	31,823	28,246	25,034	−16	−29	−37	−44
5,592	4,511	3,618	3,042	2,770	−19	−35	−46	−50
8,332	7,047	5,958	4,967	4,037	−15	−28	−40	−52
50,504	43,818	41,964	32,335	30,439	−13	−17	−36	−40
8,859	7,621	6,740	5,966	5,149	−14	−24	−33	−42
1,581	1,182	848	698	552	−25	−46	−56	−65
8,469	7,124	5,929	4,968	4,052	−16	−30	−41	−52
103,015	89,748	72,513	56,032	41,538	−13	−30	−46	−60
1,806	1,535	1,298	1,121	942	−15	−28	−38	−48
16,479	14,198	12,378	11,124	10,088	−14	−25	−32	−39
71,760	61,597	52,511	45,100	39,015	−14	−27	−37	−46
31,334	26,558	24,108	20,973	18,716	−15	−23	−33	−40
54,299	48,723	44,342	41,203	38,361	−10	−18	−24	−29
1,724	1,547	1,413	1,299	1,228	−10	−18	−25	−29
5,559	5,039	4,611	4,098	3,662	−9	−17	−26	−34
3,066	3,051	3,011	2,909	2,810	0	−2	−5	−8
740,395	684,545	561,128	385,101	168,288	−8	−24	−48	−77
7,751	7,765	7,977	8,280	8,361	0	3	7	8
821	873	972	1,140	1,266	6	18	39	54
7,989	7,842	7,747	7,481	7,419	−2	−3	−6	−7
71,346	70,032	69,466	69,040	67,649	−2	−3	−3	−5
328	346	255	241	218	6	−22	−26	−34
245,326	218,422	192,981	153,312	127,243	−11	−21	−38	−48
8,608	7,230	6,188	5,226	4,466	−16	−28	−39	−48
2,227	2,156	2,239	2,558	3,090	−3	1	15	39
4,148	4,069	3,671	2,830	2,383	−2	−11	−32	−43

Natural capital

Natural capital level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
112	Singapore	34	34	34	34	34
113	Slovakia**	15,671	15,668	15,659	15,665	15,665
114	Slovenia*	19,117	19,551	20,126	21,008	22,006
115	South Africa	692,121	674,510	652,895	628,906	605,021
116	Spain	219,100	220,826	226,998	223,231	219,010
117	Sri Lanka	21,149	20,471	19,967	20,105	20,299
118	Sudan (former)	400,945	385,852	370,022	363,757	355,033
119	Swaziland	2,387	2,497	2,601	2,699	2,791
120	Sweden	208,395	206,744	205,174	214,112	216,935
121	Switzerland	82,510	82,969	81,387	81,360	81,570
122	Syrian Arab Republic	65,267	57,408	48,709	40,740	33,870
123	Tajikistan*	6,111	6,088	6,069	6,052	6,038
124	Thailand	281,145	272,607	255,917	241,878	230,696
125	Togo	8,543	7,544	6,671	5,432	4,669
126	Trinidad and Tobago	54,682	50,927	46,402	39,101	28,572
127	Tunisia	21,816	20,182	18,283	16,470	14,619
128	Turkey	338,325	331,078	328,096	322,346	297,177
129	Uganda	19,822	17,978	16,135	14,296	12,423
130	Ukraine*	686,298	678,586	671,674	663,029	654,471
131	United Arab Emirates	1,054,588	1,015,103	974,480	931,210	883,415
132	United Kingdom	267,148	212,203	145,628	88,995	50,867
133	United Republic of Tanzania	190,434	181,108	171,782	162,425	153,169
134	United States of America	9,424,518	9,170,245	8,918,350	8,774,429	8,639,887
135	Uruguay	36,580	36,700	36,984	36,547	35,762
136	Venezuela (Bolivarian Republic of)	1,977,186	1,911,574	1,833,197	1,764,493	1,702,074
137	Vietnam	119,591	122,592	130,113	131,889	125,972
138	Yemen	70,830	67,555	62,317	56,515	52,434
139	Zambia	359,294	354,215	349,621	344,216	339,266
140	Zimbabwe	101,168	93,949	86,796	79,684	72,619

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Natural capital per capita in millions of constant 2005 US$					Natural capital change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
11	10	9	8	7	−13	−23	−29	−41
2,949	2,918	2,897	2,893	2,868	−1	−2	−2	−3
9,878	9,944	10,137	10,493	10,842	1	3	6	10
18,811	16,292	14,586	13,159	12,068	−13	−22	−30	−36
5,634	5,601	5,634	5,144	4,753	−1	0	−9	−16
1,220	1,123	1,065	1,013	973	−8	−13	−17	−20
15,133	12,802	10,823	9,470	8,152	−15	−28	−37	−46
2,766	2,591	2,445	2,443	2,353	−6	−12	−12	−15
24,349	23,422	23,157	23,713	23,128	−4	−5	−3	−5
12,363	11,821	11,354	10,972	10,643	−4	−8	−11	−14
5,296	4,051	3,046	2,204	1,659	−24	−42	−58	−69
1,128	1,054	983	938	878	−7	−13	−17	−22
4,926	4,570	4,052	3,626	3,338	−7	−18	−26	−32
2,331	1,847	1,392	1,004	775	−21	−40	−57	−67
44,987	40,372	35,913	29,726	21,299	−10	−20	−34	−53
2,656	2,259	1,934	1,662	1,395	−15	−27	−37	−47
6,250	5,624	5,156	4,730	4,085	−10	−17	−24	−35
1,120	863	666	503	372	−23	−40	−55	−67
13,283	13,274	13,738	14,130	14,400	0	3	6	8
583,083	432,228	321,240	228,835	117,605	−26	−45	−61	−80
4,669	3,659	2,474	1,478	820	−22	−47	−68	−82
7,474	6,048	5,047	4,183	3,416	−19	−32	−44	−54
37,201	34,433	31,570	29,561	27,836	−7	−15	−21	−25
11,765	11,385	11,143	11,000	10,616	−3	−5	−7	−10
100,440	86,752	75,291	66,175	58,733	−14	−25	−34	−42
1,782	1,656	1,652	1,586	1,434	−7	−7	−11	−20
5,928	4,460	3,516	2,737	2,180	−25	−41	−54	−63
45,711	39,713	34,271	30,030	25,921	−13	−25	−34	−43
9,663	8,040	6,938	6,339	5,776	−17	−28	−34	−40

Renewable resources

Renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	5,482	5,482	5,482	5,482	5,482
2	Albania	14,477	14,516	14,647	14,091	15,154
3	Algeria	67,763	68,913	69,150	70,481	70,210
4	Argentina	578,665	572,279	565,862	577,985	591,816
5	Armenia	2,791	2,626	2,461	2,294	2,026
6	Australia	1,626,609	1,625,957	1,616,272	1,592,871	1,498,281
7	Austria	56,846	58,270	59,865	60,895	59,703
8	Bahrain					
9	Bangladesh	38,625	36,067	35,843	35,286	35,542
10	Barbados	345	345	329	296	263
11	Belgium	3,369	3,907	4,445	4,874	5,021
12	Belize	13,805	13,481	13,091	12,696	12,308
13	Benin	36,726	34,478	32,231	30,626	28,999
14	Bolivia (Plurinational State of)	916,165	899,264	881,500	862,932	841,746
15	Botswana	66,153	63,629	61,123	58,587	56,081
16	Brazil	4,662,966	4,575,207	4,470,724	4,379,204	4,284,272
17	Bulgaria	20,804	22,065	22,756	25,140	27,652
18	Burundi	5,559	5,112	4,860	4,836	4,711
19	Cambodia	98,497	94,347	90,519	87,515	84,563
20	Cameroon	238,983	228,730	218,490	208,296	198,622
21	Canada	2,634,350	2,615,960	2,597,020	2,578,415	2,566,897
22	Central African Republic	181,088	179,914	178,739	177,574	176,399
23	Chile	207,026	203,539	202,738	209,006	206,852
24	China	4,929,045	4,994,483	4,911,710	4,754,842	4,751,033
25	Colombia	976,405	966,507	962,638	941,167	934,492
26	Congo	220,844	220,073	219,345	218,612	217,952
27	Costa Rica	36,996	34,050	31,613	31,697	33,128
28	Côte d'Ivoire	69,992	70,633	70,492	70,938	71,117
29	Croatia*	17,727	18,491	19,446	20,405	21,376
30	Cuba	13,863	16,732	19,601	22,393	23,144
31	Cyprus	1,324	1,313	1,333	1,402	1,304
32	Czech Republic**	215	226	245	252	272
33	Democratic Republic of the Congo	985,906	976,326	966,747	957,169	947,585
34	Denmark	6,995	6,935	6,838	7,326	7,156
35	Dominican Republic	29,086	29,373	28,885	28,609	28,494
36	Ecuador	124,550	117,063	108,989	99,962	92,041

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Empty cells represent either missing data or unavailability of the resource in the related countries.

Renewable resources per capita in millions of constant 2005 US$					Renewable resources change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
421	277	240	199	175	–34	–43	–53	–59
4,401	4,621	4,768	4,485	4,729	5	8	2	7
2,678	2,436	2,265	2,143	1,980	–9	–15	–20	–26
17,727	16,419	15,322	14,942	14,644	–7	–14	–16	–17
787	815	800	748	655	3	2	–5	–17
95,145	89,741	84,337	78,068	67,283	–6	–11	–18	–29
7,411	7,343	7,479	7,397	7,113	–1	1	0	–4
367	307	277	251	239	–16	–25	–32	–35
1,329	1,309	1,228	1,094	963	–1	–8	–18	–28
339	388	437	468	469	14	29	38	38
72,565	61,192	52,255	45,189	39,496	–16	–28	–38	–46
7,694	6,101	4,945	4,012	3,277	–21	–36	–48	–57
137,594	120,368	106,112	94,344	84,769	–13	–23	–31	–38
47,855	40,128	34,770	31,235	27,944	–16	–27	–35	–42
31,159	28,269	25,631	23,546	21,977	–9	–18	–24	–29
2,359	2,640	2,842	3,248	3,690	12	20	38	56
992	840	762	667	562	–15	–23	–33	–43
10,333	8,447	7,272	6,552	5,981	–18	–30	–37	–42
19,620	16,408	13,936	11,866	10,134	–16	–29	–40	–48
95,100	89,276	84,684	79,868	75,460	–6	–11	–16	–21
61,704	54,065	48,287	44,196	40,081	–12	–22	–28	–35
15,698	14,125	13,148	12,821	12,087	–10	–16	–18	–23
4,304	4,114	3,870	3,636	3,542	–4	–10	–16	–18
29,407	26,514	24,209	21,867	20,186	–10	–18	–26	–31
92,446	80,533	69,949	61,874	53,910	–13	–24	–33	–42
12,050	9,816	8,066	7,355	7,111	–19	–33	–39	–41
5,591	4,812	4,251	3,936	3,603	–14	–24	–30	–36
3,898	3,960	4,316	4,594	4,854	2	11	18	25
1,312	1,535	1,765	1,990	2,056	17	35	52	57
1,726	1,534	1,413	1,358	1,182	–11	–18	–21	–32
21	22	24	25	26	5	15	19	25
27,081	22,155	19,481	16,669	14,365	–18	–28	–38	–47
1,361	1,325	1,281	1,352	1,289	–3	–6	–1	–5
4,043	3,711	3,362	3,088	2,870	–8	–17	–24	–29
12,139	10,283	8,829	7,445	6,363	–15	–27	–39	–48

Renewable resources

Renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	7,978	9,891	9,915	10,614	11,060
38	El Salvador	7,762	7,786	7,810	7,908	7,624
39	Estonia	17,255	17,949	18,643	18,612	18,349
40	Fiji	5,756	5,891	5,806	5,780	5,751
41	Finland	163,683	165,811	168,566	162,940	163,050
42	France	266,093	267,182	269,106	276,059	276,568
43	Gabon	118,073	118,073	118,073	118,073	118,073
44	Gambia	2,328	2,369	2,416	2,459	2,523
45	Germany	150,677	151,532	154,266	155,259	154,286
46	Ghana	60,756	57,824	56,201	53,540	50,945
47	Greece	159,978	160,089	151,545	84,152	147,907
48	Guatemala	34,702	32,549	30,395	28,375	25,748
49	Guyana	169,938	169,938	169,938	169,938	169,938
50	Haiti	653	606	559	510	459
51	Honduras	86,606	78,811	68,993	63,915	58,420
52	Hungary	25,782	24,945	24,001	24,192	22,372
53	Iceland	76,624	76,542	76,139	75,856	64,129
54	India	1,006,461	1,006,703	1,014,782	1,007,976	1,011,246
55	Indonesia	1,622,714	1,528,164	1,480,161	1,461,770	1,431,679
56	Iran (Islamic Republic of)	140,919	144,815	142,924	121,221	122,979
57	Iraq	5,375	5,423	5,470	5,518	5,518
58	Ireland	37,957	29,618	29,738	28,998	30,741
59	Israel	4,334	4,289	4,238	3,886	3,902
60	Italy	307,596	304,528	321,218	324,797	333,699
61	Jamaica	25,651	26,674	25,763	25,159	24,224
62	Japan	386,489	385,980	388,184	376,360	372,748
63	Jordan	2,459	2,609	2,518	2,404	2,382
64	Kazakhstan*	12,041	11,890	11,701	12,325	12,242
65	Kenya	41,677	41,343	40,243	39,787	39,565
66	Kuwait					
67	Kyrgyzstan*	5,506	5,713	5,973	6,227	8,107
68	Lao People's Democratic Republic	123,881	121,363	119,569	117,563	117,691
69	Latvia	18,098	19,157	20,216	21,049	23,011
70	Lesotho	150	149	149	149	148
71	Liberia	31,827	30,856	29,886	28,916	27,946
72	Lithuania*	14,141	14,382	14,684	15,219	15,243

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Renewable resources per capita in millions of constant 2005 US$					Renewable resources change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
140	159	147	143	136	14	4	2	–3
1,456	1,358	1,315	1,307	1,231	–7	–10	–10	–15
11,007	12,458	13,600	13,829	13,681	13	24	26	24
7,902	7,595	7,153	7,027	6,683	–4	–9	–11	–15
32,826	32,462	32,583	31,070	30,394	–1	–1	–5	–7
4,692	4,619	4,557	4,526	4,405	–2	–3	–4	–6
127,091	108,590	95,584	86,139	78,430	–15	–25	–32	–38
2,410	2,104	1,862	1,635	1,460	–13	–23	–32	–39
1,905	1,850	1,873	1,881	1,875	–3	–2	–1	–2
4,107	3,402	2,932	2,474	2,089	–17	–29	–40	–49
15,745	15,001	13,793	7,525	13,021	–5	–12	–52	–17
3,889	3,250	2,705	2,231	1,789	–16	–30	–43	–54
234,419	233,438	231,807	227,727	225,235	0	–1	–3	–4
92	77	65	55	46	–16	–29	–41	–50
17,713	14,136	11,095	9,291	7,686	–20	–37	–48	–57
2,485	2,415	2,351	2,398	2,241	–3	–5	–3	–10
300,729	286,163	270,754	255,629	200,320	–5	–10	–15	–33
1,152	1,044	963	884	826	–9	–16	–23	–28
8,803	7,664	6,936	6,431	5,969	–13	–21	–27	–32
2,568	2,423	2,187	1,738	1,662	–6	–15	–32	–35
309	267	229	202	174	–14	–26	–35	–44
10,749	8,202	7,818	6,974	6,877	–24	–27	–35	–36
963	804	704	588	526	–16	–27	–39	–45
5,412	5,346	5,637	5,536	5,511	–1	4	2	2
10,847	10,836	9,979	9,382	8,838	0	–8	–14	–19
3,161	3,101	3,088	2,978	2,946	–2	–2	–6	–7
720	595	522	450	385	–17	–28	–38	–47
729	747	782	812	764	2	7	11	5
1,778	1,507	1,288	1,117	977	–15	–28	–37	–45
1,240	1,244	1,205	1,235	1,520	0	–3	0	23
29,549	25,310	22,488	20,434	18,980	–14	–24	–31	–36
6,794	7,687	8,476	9,130	10,218	13	25	34	50
91	83	76	72	68	–9	–17	–21	–25
14,962	14,731	10,496	9,086	6,997	–2	–30	–39	–53
3,824	3,963	4,195	4,456	4,586	4	10	17	20

Renewable resources

Renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg	1,015	1,125	1,235	1,235	1,235
74	Malawi	23,447	22,600	22,263	21,675	21,066
75	Malaysia	210,322	207,661	203,659	196,207	188,417
76	Maldives	3	3	3	3	3
77	Mali	78,936	78,594	78,231	76,549	73,609
78	Malta	158	134	109	113	125
79	Mauritania	1,860	1,619	1,379	1,134	1,002
80	Mauritius	1,360	1,285	1,253	1,180	1,125
81	Mexico	779,881	784,405	767,731	746,122	736,605
82	Mongolia	169,414	161,621	166,730	152,248	149,355
83	Morocco	54,116	54,539	54,432	54,031	53,868
84	Mozambique	230,835	226,182	221,588	217,208	213,164
85	Myanmar	268,976	252,897	236,818	225,097	213,313
86	Namibia	63,339	61,889	60,332	58,750	57,160
87	Nepal	106,680	97,401	88,276	82,968	82,968
88	Netherlands	22,601	22,127	22,037	21,831	21,504
89	New Zealand	152,703	144,238	147,304	120,947	122,310
90	Nicaragua	36,505	35,339	34,198	32,364	29,802
91	Niger	11,717	10,257	8,681	8,494	7,998
92	Nigeria	276,360	269,814	258,447	262,684	253,157
93	Norway	59,888	62,408	62,241	65,283	68,046
94	Pakistan	104,911	103,100	100,693	97,491	92,205
95	Panama	39,813	38,007	36,590	36,023	35,479
96	Papua New Guinea	284,410	277,987	271,564	265,133	258,681
97	Paraguay	132,978	127,356	128,820	123,693	120,802
98	Peru	1,113,028	1,099,987	1,089,735	1,083,220	1,069,643
99	Philippines	99,638	100,688	102,945	105,108	109,216
100	Poland	43,553	43,608	43,582	38,754	36,379
101	Portugal	30,372	30,840	31,081	30,631	29,965
102	Qatar	487	519	527	508	527
103	Republic of Korea	327,088	342,069	362,716	385,885	399,542
104	Republic of Moldova	3,583	3,787	3,991	4,296	4,522
105	Romania	151,079	151,201	151,495	148,126	150,034
106	Russian Federation*	5,349,101	5,344,681	5,339,156	5,331,594	5,358,877
107	Rwanda	2,333	1,929	2,063	2,220	2,314
108	Saudi Arabia	608,139	853,368	853,368	853,036	851,271

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Empty cells represent either missing data or unavailability of the resource in the related countries.

				Renewable resources per capita in millions of constant 2005 US$				Renewable resources change percentage change with respect to the base year, 1990
1990	1995	2000	2005	2010	1995	2000	2005	2010
2,661	2,761	2,837	2,702	2,435	4	7	2	–9
2,499	2,287	1,983	1,690	1,414	–9	–21	–32	–43
11,551	10,022	8,698	7,517	6,634	–13	–25	–35	–43
15	13	12	11	11	–12	–20	–26	–31
9,102	8,000	6,926	5,809	4,789	–12	–24	–36	–47
430	346	275	276	301	–20	–36	–36	–30
932	706	522	372	290	–24	–44	–60	–69
1,284	1,130	1,047	939	866	–12	–18	–27	–33
9,251	8,501	7,680	7,007	6,494	–8	–17	–24	–30
77,268	70,083	69,143	59,767	54,193	–9	–11	–23	–30
2,184	2,025	1,890	1,778	1,686	–7	–13	–19	–23
17,039	14,195	12,175	10,458	9,113	–17	–29	–39	–47
6,850	6,002	5,268	4,859	4,447	–12	–23	–29	–35
44,768	37,478	31,823	28,246	25,034	–16	–29	–37	–44
5,591	4,510	3,618	3,041	2,769	–19	–35	–46	–50
1,518	1,435	1,389	1,339	1,294	–5	–8	–12	–15
44,939	39,248	38,181	29,256	28,000	–13	–15	–35	–38
8,859	7,621	6,740	5,966	5,149	–14	–24	–33	–42
1,505	1,118	795	654	516	–26	–47	–57	–66
2,833	2,453	2,089	1,879	1,598	–13	–26	–34	–44
14,120	14,317	13,860	14,120	13,935	1	–2	0	–1
938	810	697	615	531	–14	–26	–34	–43
16,479	14,198	12,378	11,124	10,088	–14	–25	–32	–39
68,406	58,950	50,488	43,497	37,718	–14	–26	–36	–45
31,334	26,558	24,108	20,973	18,716	–15	–23	–33	–40
51,326	46,165	42,137	39,306	36,787	–10	–18	–23	–28
1,617	1,454	1,332	1,229	1,171	–10	–18	–24	–28
1,144	1,136	1,138	1,015	950	–1	–1	–11	–17
3,060	3,046	3,007	2,905	2,807	0	–2	–5	–8
1,029	1,036	893	619	300	1	–13	–40	–71
7,610	7,659	7,887	8,203	8,292	1	4	8	9
821	873	972	1,140	1,266	6	18	39	54
6,510	6,666	6,827	6,804	6,983	2	5	5	7
35,979	35,943	36,381	37,065	37,486	0	1	3	4
328	346	255	241	218	6	–22	–26	–34
37,681	46,148	42,572	35,482	31,014	22	13	–6	–18

Renewable resources

Renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	61,427	59,637	57,984	56,014	54,742
110	Serbia	21,306	21,996	22,687	25,208	30,456
111	Sierra Leone	16,514	15,862	15,211	14,584	13,984
112	Singapore	34	34	34	34	34
113	Slovakia**	9,202	9,437	9,829	10,229	10,545
114	Slovenia*	13,512	14,323	15,337	16,644	18,056
115	South Africa	157,076	159,270	159,801	158,866	158,056
116	Spain	197,370	202,767	211,693	210,291	207,440
117	Sri Lanka	21,149	20,471	19,967	20,105	20,299
118	Sudan (former)	350,775	335,682	320,590	318,175	315,766
119	Swaziland	1,496	1,609	1,723	1,834	1,941
120	Sweden	197,792	196,433	195,169	204,407	207,554
121	Switzerland	82,510	82,969	81,387	81,360	81,570
122	Syrian Arab Republic	1,084	1,085	1,087	1,083	1,084
123	Tajikistan*	1,471	1,465	1,458	1,452	1,455
124	Thailand	204,895	200,838	191,602	187,719	190,830
125	Togo	8,129	7,182	6,357	5,145	4,400
126	Trinidad and Tobago	5,444	5,352	5,190	4,979	4,834
127	Tunisia	6,843	7,213	7,272	7,442	7,567
128	Turkey	275,350	273,730	277,104	276,687	258,570
129	Uganda	19,822	17,978	16,135	14,296	12,423
130	Ukraine*	34,794	36,967	39,683	41,085	42,618
131	United Arab Emirates					
132	United Kingdom	7,804	7,879	7,953	8,477	9,138
133	United Republic of Tanzania	188,852	179,528	170,204	160,850	151,597
134	United States of America	4,591,232	4,629,866	4,671,883	4,811,674	4,967,448
135	Uruguay	36,580	36,700	36,984	36,547	35,762
136	Venezuela (Bolivarian Republic of)	531,200	520,136	509,220	500,088	490,410
137	Vietnam	83,561	88,854	100,837	109,979	113,357
138	Yemen	30,602	30,732	30,653	30,480	30,546
139	Zambia	353,043	348,416	344,170	339,172	334,847
140	Zimbabwe	92,697	85,859	79,021	72,182	65,345

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Empty cells represent either missing data or unavailability of the resource in the related countries.

Renewable resources per capita in millions of constant 2005 US$					Renewable resources change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
8,483	7,126	6,100	5,152	4,403	–16	–28	–39	–48
2,227	2,156	2,239	2,558	3,090	–3	1	15	39
4,148	4,069	3,671	2,830	2,383	–2	–11	–32	–43
11	10	9	8	7	–13	–23	–29	–41
1,731	1,758	1,819	1,889	1,931	2	5	9	12
6,982	7,285	7,725	8,313	8,896	4	11	19	27
4,269	3,847	3,570	3,324	3,153	–10	–16	–22	–26
5,075	5,143	5,254	4,846	4,502	1	4	–5	–11
1,220	1,123	1,065	1,013	973	–8	–13	–17	–20
13,240	11,137	9,377	8,284	7,250	–16	–29	–37	–45
1,733	1,670	1,619	1,660	1,636	–4	–7	–4	–6
23,110	22,254	22,028	22,638	22,128	–4	–5	–2	–4
12,363	11,821	11,354	10,972	10,643	–4	–8	–11	–14
88	77	68	59	53	–13	–23	–33	–40
271	254	236	225	212	–7	–13	–17	–22
3,590	3,367	3,034	2,814	2,761	–6	–15	–22	–23
2,218	1,758	1,326	951	730	–21	–40	–57	–67
4,479	4,243	4,017	3,785	3,604	–5	–10	–15	–20
833	807	769	751	722	–3	–8	–10	–13
5,087	4,650	4,355	4,060	3,554	–9	–14	–20	–30
1,120	863	666	503	372	–23	–40	–55	–67
673	723	812	876	938	7	21	30	39
136	136	135	141	147	0	–1	3	8
7,412	5,996	5,000	4,142	3,381	–19	–33	–44	–54
18,123	17,384	16,538	16,211	16,004	–4	–9	–11	–12
11,765	11,385	11,143	11,000	10,616	–3	–5	–7	–10
26,985	23,605	20,914	18,755	16,922	–13	–22	–30	–37
1,245	1,201	1,280	1,322	1,290	–4	3	6	4
2,561	2,029	1,730	1,476	1,270	–21	–32	–42	–50
44,916	39,062	33,737	29,590	25,583	–13	–25	–34	–43
8,854	7,348	6,317	5,742	5,198	–17	–29	–35	–41

Non-renewable resources

Non-renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	2,990	2,934	2,886	2,877	2,864
2	Albania	16,169	15,914	15,782	15,661	15,531
3	Algeria	473,137	439,028	399,611	352,582	301,470
4	Argentina	117,483	103,540	84,567	64,220	44,094
5	Armenia					
6	Australia	1,379,316	1,348,397	1,310,979	1,267,643	1,219,079
7	Austria	3,816	3,186	2,546	1,834	1,120
8	Bahrain	4,849	3,931	3,025	2,140	1,283
9	Bangladesh	2,790	2,590	2,317	1,903	1,313
10	Barbados	122	96	66	43	21
11	Belgium					
12	Belize					
13	Benin					
14	Bolivia (Plurinational State of)	22,776	21,976	21,039	19,522	17,348
15	Botswana	1,799	1,640	1,470	1,283	1,092
16	Brazil	398,477	381,764	358,411	326,595	283,542
17	Bulgaria	50,114	47,798	45,338	43,028	40,564
18	Burundi					
19	Cambodia					
20	Cameroon	8,719	6,470	4,580	3,308	1,927
21	Canada	2,115,952	2,045,695	1,962,567	1,871,684	1,778,012
22	Central African Republic					
23	Chile	64,451	61,358	56,366	50,231	43,562
24	China	2,863,453	2,720,154	2,552,612	2,344,406	2,037,955
25	Colombia	193,628	182,630	166,404	151,036	132,069
26	Congo	30,516	27,578	23,175	18,957	14,649
27	Costa Rica					
28	Côte d'Ivoire	2,266	2,210	1,966	1,645	821
29	Croatia*	NaN	2,608	2,026	1,539	1,103
30	Cuba	12,330	11,824	10,873	9,610	8,297
31	Cyprus					
32	Czech Republic**	31,274	27,912	23,010	18,403	14,102
33	Democratic Republic of the Congo	3,294	2,839	2,390	2,021	1,667
34	Denmark	37,343	33,530	27,470	19,272	12,537
35	Dominican Republic	1,312	1,136	967	828	766
36	Ecuador	99,332	92,789	85,456	76,825	67,252

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Non-renewable resources per capita in millions of constant 2005 US$					Non-renewable resources change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
229	148	126	104	91	–35	–45	–55	–60
4,915	5,066	5,138	4,985	4,847	3	5	1	–1
18,702	15,518	13,087	10,721	8,500	–17	–30	–43	–55
3,599	2,971	2,290	1,660	1,091	–17	–36	–54	–70
80,680	74,421	68,407	62,129	54,745	–8	–15	–23	–32
498	401	318	223	133	–19	–36	–55	–73
9,837	7,031	4,739	2,953	1,017	–29	–52	–70	–90
27	22	18	14	9	–17	–33	–49	–67
470	363	248	159	77	–23	–47	–66	–84
3,421	2,942	2,533	2,134	1,747	–14	–26	–38	–49
1,302	1,034	836	684	544	–21	–36	–47	–58
2,663	2,359	2,055	1,756	1,454	–11	–23	–34	–45
5,683	5,720	5,663	5,560	5,413	1	0	–2	–5
716	464	292	188	98	–35	–59	–74	–86
76,386	69,814	63,995	57,977	52,269	–9	–16	–24	–32
4,887	4,258	3,655	3,081	2,545	–13	–25	–37	–48
2,500	2,241	2,011	1,793	1,519	–10	–20	–28	–39
5,832	5,010	4,185	3,509	2,853	–14	–28	–40	–51
12,774	10,092	7,391	5,365	3,623	–21	–42	–58	–72
181	151	119	91	42	–17	–35	–50	–77
698	559	450	346	250	–20	–36	–50	–64
1,166	1,085	979	854	737	–7	–16	–27	–37
3,032	2,705	2,246	1,801	1,344	–11	–26	–41	–56
90	64	48	35	25	–29	–47	–61	–72
7,264	6,407	5,145	3,556	2,259	–12	–29	–51	–69
182	143	113	89	77	–21	–38	–51	–58
9,681	8,150	6,922	5,722	4,649	–16	–28	–41	–52

Non-renewable resources

Non-renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	137,268	118,994	101,185	84,687	66,641
38	El Salvador					
39	Estonia					
40	Fiji					
41	Finland					
42	France	2,589	1,820	1,300	876	566
43	Gabon	38,409	33,059	27,244	22,997	18,919
44	Gambia					
45	Germany	1,442,897	1,389,371	1,346,621	1,305,655	1,268,885
46	Ghana	2,816	2,616	2,267	1,910	1,469
47	Greece	69,962	65,168	60,016	54,262	48,979
48	Guatemala	1,610	1,510	1,226	937	671
49	Guyana	1,748	1,727	1,703	1,686	1,670
50	Haiti					
51	Honduras					
52	Hungary	24,297	22,313	20,458	18,982	17,792
53	Iceland					
54	India	1,477,645	1,438,996	1,392,729	1,337,246	1,266,207
55	Indonesia	493,695	446,950	394,334	343,337	279,897
56	Iran (Islamic Republic of)	3,061,262	2,986,051	2,903,247	2,810,386	2,703,592
57	Iraq	1,047,065	1,040,149	1,015,468	989,299	958,875
58	Ireland	1,844	1,441	1,116	838	589
59	Israel	2,348	2,288	2,216	2,088	1,809
60	Italy	17,548	14,330	10,960	8,012	5,227
61	Jamaica	4,430	4,318	4,201	4,070	3,950
62	Japan	14,566	12,300	10,430	8,937	7,538
63	Jordan	5,315	5,204	5,064	4,909	4,774
64	Kazakhstan*	874,329	862,523	848,029	824,536	793,811
65	Kenya					
66	Kuwait	1,273,616	1,244,676	1,203,211	1,158,284	1,107,973
67	Kyrgyzstan*	8,224	8,155	8,115	8,076	8,040
68	Lao People's Democratic Republic					
69	Latvia					
70	Lesotho					
71	Liberia					
72	Lithuania*	292	274	219	130	79

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Empty cells represent either missing data or unavailability of the resource in the related countries.

Non-renewable resources per capita in millions of constant 2005 US$					Non-renewable resources change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
2,415	1,917	1,496	1,141	822	–21	–38	–53	–66
46	31	22	14	9	–31	–52	–69	–80
41,342	30,404	22,055	16,777	12,567	–26	–47	–59	–70
18,242	16,958	16,353	15,818	15,417	–7	–10	–13	–15
190	154	118	88	60	–19	–38	–54	–68
6,886	6,107	5,463	4,852	4,312	–11	–21	–30	–37
180	151	109	74	47	–16	–40	–59	–74
2,411	2,373	2,323	2,260	2,213	–2	–4	–6	–8
2,342	2,160	2,004	1,882	1,782	–8	–14	–20	–24
1,691	1,492	1,322	1,173	1,034	–12	–22	–31	–39
2,678	2,241	1,848	1,510	1,167	–16	–31	–44	–56
55,791	49,970	44,431	40,303	36,548	–10	–20	–28	–34
60,267	51,269	42,564	36,159	30,276	–15	–29	–40	–50
522	399	293	201	132	–24	–44	–61	–75
522	429	368	316	244	–18	–29	–39	–53
309	252	192	137	86	–19	–38	–56	–72
1,873	1,754	1,627	1,518	1,441	–6	–13	–19	–23
119	99	83	71	60	–17	–30	–41	–50
1,556	1,188	1,049	919	772	–24	–33	–41	–50
52,946	54,159	56,699	54,347	49,532	2	7	3	–6
610,061	764,585	619,961	511,606	404,853	25	2	–16	–34
1,852	1,776	1,638	1,602	1,507	–4	–12	–13	–19
79	75	63	38	24	–4	–21	–52	–70

Non-renewable resources

Non-renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg					
74	Malawi					
75	Malaysia	234,845	217,342	194,822	169,308	143,595
76	Maldives					
77	Mali					
78	Malta					
79	Mauritania	4,109	3,943	3,767	3,606	3,433
80	Mauritius					
81	Mexico	216,784	188,743	156,728	122,002	87,789
82	Mongolia	39,552	39,115	38,735	38,300	37,289
83	Morocco	87	82	74	65	55
84	Mozambique	3,229	3,226	3,225	3,223	3,220
85	Myanmar	19,718	19,199	18,566	16,107	12,944
86	Namibia					
87	Nepal	15	15	14	13	12
88	Netherlands	101,482	86,547	72,474	59,156	45,555
89	New Zealand	18,909	16,794	14,593	12,728	10,650
90	Nicaragua					
91	Niger	596	589	582	574	566
92	Nigeria	549,763	513,915	474,860	431,889	388,732
93	Norway	377,049	328,812	263,403	193,767	134,791
94	Pakistan	97,073	92,410	86,890	80,294	71,312
95	Panama					
96	Papua New Guinea	13,944	12,479	10,883	9,774	8,893
97	Paraguay					
98	Peru	64,481	60,941	57,029	52,292	45,750
99	Philippines	6,606	6,448	6,297	6,060	5,299
100	Poland	168,016	149,866	133,042	117,628	103,798
101	Portugal	58	47	39	38	38
102	Qatar	350,254	342,692	331,075	315,654	295,457
103	Republic of Korea	6,064	4,713	4,109	3,661	3,305
104	Republic of Moldova					
105	Romania	34,325	26,653	20,430	14,740	9,377
106	Russian Federation*	5,258,107	5,068,908	4,855,536	4,599,270	4,312,146
107	Rwanda					
108	Saudi Arabia	3,351,183	3,185,652	3,014,983	2,832,766	2,641,310

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Non-renewable resources per capita in millions of constant 2005 US$					Non-renewable resources change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
12,897	10,489	8,320	6,487	5,056	–19	–35	–50	–61
2,059	1,720	1,425	1,183	992	–16	–31	–43	–52
2,571	2,045	1,568	1,146	774	–20	–39	–55	–70
18,039	16,961	16,064	15,035	13,530	–6	–11	–17	–25
4	3	3	2	2	–13	–27	–39	–51
238	202	177	155	138	–15	–26	–35	–42
502	456	413	348	270	–9	–18	–31	–46
1	1	1			–13	–28	–38	–48
6,815	5,612	4,569	3,628	2,742	–18	–33	–47	–60
5,565	4,570	3,782	3,079	2,438	–18	–32	–45	–56
77	64	53	44	37	–16	–30	–42	–52
5,636	4,671	3,839	3,089	2,454	–17	–32	–45	–56
88,895	75,431	58,653	41,911	27,603	–15	–34	–53	–69
868	726	601	506	411	–16	–31	–42	–53
3,354	2,646	2,023	1,603	1,297	–21	–40	–52	–61
2,973	2,558	2,205	1,897	1,573	–14	–26	–36	–47
107	93	81	71	57	–13	–24	–34	–47
4,415	3,904	3,473	3,082	2,712	–12	–21	–30	–39
6	5	4	4	4	–21	–35	–38	–39
739,366	683,509	560,235	384,482	167,988	–8	–24	–48	–77
141	106	89	78	69	–25	–37	–45	–51
1,479	1,175	921	677	436	–21	–38	–54	–70
35,367	34,088	33,085	31,974	30,164	–4	–6	–10	–15
207,644	172,273	150,409	117,830	96,229	–17	–28	–43	–54

Non-renewable resources

Non-renewable resources level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	911	873	837	802	785
110	Serbia					
111	Sierra Leone					
112	Singapore					
113	Slovakia**	6,469	6,231	5,830	5,436	5,120
114	Slovenia*	5,604	5,228	4,788	4,364	3,950
115	South Africa	535,045	515,241	493,094	470,040	446,965
116	Spain	21,730	18,058	15,305	12,940	11,570
117	Sri Lanka					
118	Sudan (former)	50,170	50,170	49,432	45,582	39,266
119	Swaziland	891	887	878	864	850
120	Sweden	10,603	10,311	10,005	9,704	9,380
121	Switzerland					
122	Syrian Arab Republic	64,182	56,323	47,622	39,657	32,786
123	Tajikistan*	4,640	4,623	4,611	4,599	4,582
124	Thailand	76,250	71,769	64,316	54,159	39,866
125	Togo	414	362	314	287	268
126	Trinidad and Tobago	49,238	45,575	41,212	34,122	23,738
127	Tunisia	14,973	12,969	11,011	9,027	7,052
128	Turkey	62,975	57,348	50,992	45,659	38,607
129	Uganda					
130	Ukraine*	651,504	641,619	631,991	621,944	611,853
131	United Arab Emirates	1,054,588	1,015,103	974,480	931,210	883,415
132	United Kingdom	259,344	204,324	137,674	80,518	41,729
133	United Republic of Tanzania	1,582	1,581	1,578	1,576	1,572
134	United States of America	4,833,286	4,540,380	4,246,468	3,962,755	3,672,439
135	Uruguay					
136	Venezuela (Bolivarian Republic of)	1,445,986	1,391,438	1,323,977	1,264,405	1,211,664
137	Vietnam	36,030	33,738	29,275	21,910	12,615
138	Yemen	40,228	36,823	31,664	26,034	21,888
139	Zambia	6,250	5,800	5,451	5,045	4,419
140	Zimbabwe	8,471	8,090	7,776	7,501	7,274

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Non-renewable resources per capita in millions of constant 2005 US$					Non-renewable resources change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
126	104	88	74	63	–17	–30	–41	–50
1,217	1,161	1,079	1,004	937	–5	–11	–18	–23
2,896	2,659	2,412	2,180	1,946	–8	–17	–25	–33
14,542	12,445	11,016	9,835	8,916	–14	–24	–32	–39
559	458	380	298	251	–18	–32	–47	–55
1,894	1,664	1,446	1,187	902	–12	–24	–37	–52
1,033	921	825	782	717	–11	–20	–24	–31
1,239	1,168	1,129	1,075	1,000	–6	–9	–13	–19
5,208	3,974	2,979	2,145	1,606	–24	–43	–59	–69
856	800	747	713	666	–7	–13	–17	–22
1,336	1,203	1,018	812	577	–10	–24	–39	–57
113	89	65	53	45	–22	–42	–53	–61
40,508	36,129	31,896	25,941	17,696	–11	–21	–36	–56
1,823	1,451	1,164	911	673	–20	–36	–50	–63
1,163	974	801	670	531	–16	–31	–42	–54
12,610	12,551	12,926	13,254	13,463	0	3	5	7
583,083	432,228	321,240	228,835	117,605	–26	–45	–61	–80
4,533	3,523	2,338	1,337	673	–22	–48	–70	–85
62	53	46	41	35	–15	–25	–35	–44
19,078	17,048	15,032	13,351	11,832	–11	–21	–30	–38
73,456	63,147	54,377	47,420	41,811	–14	–26	–35	–43
537	456	372	263	144	–15	–31	–51	–73
3,367	2,431	1,787	1,261	910	–28	–47	–63	–73
795	650	534	440	338	–18	–33	–45	–58
809	692	622	597	579	–14	–23	–26	–28

Agricultural land

Agricultural land level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan					
2	Albania	9,380	9,430	9,573	9,012	10,052
3	Algeria	58,766	60,244	60,810	62,618	62,864
4	Argentina	257,809	258,779	259,719	278,489	296,515
5	Armenia					
6	Australia	624,747	623,224	612,668	598,745	536,108
7	Austria	23,066	22,618	22,341	21,504	20,859
8	Bahrain					
9	Bangladesh	23,358	21,082	21,141	20,941	20,783
10	Barbados	310	310	294	261	229
11	Belgium					
12	Belize	497	576	588	600	619
13	Benin					
14	Bolivia (Plurinational State of)	56,024	57,675	58,463	58,405	58,410
15	Botswana	5,989	5,972	5,973	5,948	5,953
16	Brazil	290,077	310,324	313,847	325,724	328,272
17	Bulgaria	5,973	5,978	5,414	5,106	4,900
18	Burundi	3,928	3,965	4,196	4,225	4,103
19	Cambodia	16,900	17,336	18,094	20,317	21,452
20	Cameroon	12,735	12,721	12,721	12,725	13,332
21	Canada	61,354	61,559	61,214	61,174	57,280
22	Central African Republic					
23	Chile	122,348	117,969	116,276	122,240	121,147
24	China	3,698,250	3,842,709	3,838,959	3,829,279	3,793,372
25	Colombia	296,717	292,966	295,243	280,092	279,737
26	Congo	21,459	21,457	21,498	21,502	21,539
27	Costa Rica	23,973	21,300	19,137	18,669	19,553
28	Côte d'Ivoire	13,811	14,446	14,300	14,738	14,957
29	Croatia*					
30	Cuba					
31	Cyprus	360	322	316	371	253
32	Czech Republic**					
33	Democratic Republic of the Congo					
34	Denmark	5,885	5,754	5,587	5,714	5,543
35	Dominican Republic	14,665	14,952	14,463	14,187	14,072
36	Ecuador	15,154	15,660	15,579	14,486	14,482

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Agricultural land per capita in millions of constant 2005 US$					Agricultural land change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
2,852	3,002	3,116	2,868	3,137	5	9	1	10
2,323	2,129	1,992	1,904	1,772	–8	–14	–18	–24
7,898	7,424	7,033	7,200	7,337	–6	–11	–9	–7
36,543	34,397	31,969	29,345	24,075	–6	–13	–20	–34
3,007	2,850	2,791	2,612	2,485	–5	–7	–13	–17
222	179	163	149	140	–19	–26	–33	–37
1,195	1,177	1,098	965	836	–1	–8	–19	–30
2,613	2,615	2,347	2,135	1,988	0	–10	–18	–24
8,414	7,720	7,038	6,385	5,882	–8	–16	–24	–30
4,333	3,766	3,398	3,171	2,966	–13	–22	–27	–32
1,938	1,917	1,799	1,751	1,684	–1	–7	–10	–13
677	715	676	660	654	6	0	–3	–3
701	651	658	583	489	–7	–6	–17	–30
1,773	1,552	1,454	1,521	1,517	–12	–18	–14	–14
1,045	913	811	725	680	–13	–22	–31	–35
2,215	2,101	1,996	1,895	1,684	–5	–10	–14	–24
9,277	8,187	7,541	7,499	7,079	–12	–19	–19	–24
3,229	3,165	3,025	2,928	2,828	–2	–6	–9	–12
8,936	8,037	7,425	6,508	6,042	–10	–17	–27	–32
8,983	7,852	6,856	6,086	5,328	–13	–24	–32	–41
7,808	6,140	4,883	4,332	4,197	–21	–37	–45	–46
1,103	984	862	818	758	–11	–22	–26	–31
470	377	335	359	230	–20	–29	–23	–51
1,145	1,100	1,046	1,054	999	–4	–9	–8	–13
2,038	1,889	1,683	1,531	1,418	–7	–17	–25	–30
1,477	1,376	1,262	1,079	1,001	–7	–15	–27	–32

Agricultural land

Agricultural land level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	7,978	9,891	9,915	10,614	11,060
38	El Salvador	5,448	5,622	5,795	6,046	5,909
39	Estonia					
40	Fiji	2,156	2,314	2,251	2,251	2,249
41	Finland	15,496	14,604	14,339	14,701	14,811
42	France	161,666	158,963	157,097	156,272	154,140
43	Gabon					
44	Gambia	144	137	136	131	152
45	Germany	81,803	78,677	77,430	77,262	75,760
46	Ghana	19,770	20,546	22,632	23,683	24,781
47	Greece	138,347	137,477	127,950	59,572	122,295
48	Guatemala					
49	Guyana					
50	Haiti					
51	Honduras	9,530	9,989	8,425	9,042	9,243
52	Hungary	23,184	22,128	20,964	20,996	19,134
53	Iceland	76,607	76,527	76,124	75,842	64,115
54	India	691,106	690,114	696,958	686,594	686,216
55	Indonesia	328,610	307,501	332,940	358,954	397,980
56	Iran (Islamic Republic of)	88,278	92,165	90,264	68,370	69,956
57	Iraq					
58	Ireland	37,242	28,935	29,087	28,362	30,115
59	Israel	4,049	4,007	3,958	3,598	3,618
60	Italy	183,719	167,278	170,595	160,765	156,257
61	Jamaica	23,602	24,643	23,751	23,156	22,263
62	Japan	237,571	227,138	219,418	195,799	191,667
63	Jordan	2,108	2,257	2,166	2,053	2,031
64	Kazakhstan*					
65	Kenya	20,599	20,943	20,522	20,777	21,122
66	Kuwait					
67	Kyrgyzstan*					
68	Lao People's Democratic Republic	12,513	12,815	13,840	15,144	17,926
69	Latvia					
70	Lesotho					
71	Liberia					
72	Lithuania*					

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Agricultural land per capita in millions of constant 2005 US$					Agricultural land change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
140	159	147	143	136	14	4	2	–3
1,022	980	976	999	954	–4	–4	–2	–7
2,961	2,984	2,773	2,737	2,613	1	–6	–8	–12
3,108	2,859	2,772	2,803	2,761	–8	–11	–10	–11
2,851	2,748	2,660	2,562	2,455	–4	–7	–10	–14
150	122	105	87	88	–18	–30	–42	–41
1,034	960	940	936	921	–7	–9	–9	–11
1,336	1,209	1,181	1,094	1,016	–10	–12	–18	–24
13,616	12,882	11,646	5,327	10,766	–5	–14	–61	–21
1,949	1,792	1,355	1,314	1,216	–8	–30	–33	–38
2,234	2,142	2,053	2,082	1,917	–4	–8	–7	–14
300,665	286,104	270,700	255,580	200,273	–5	–10	–15	–33
791	716	661	602	560	–10	–16	–24	–29
1,783	1,542	1,560	1,579	1,659	–13	–12	–11	–7
1,609	1,542	1,381	980	946	–4	–14	–39	–41
10,547	8,013	7,647	6,821	6,737	–24	–27	–35	–36
900	751	658	545	488	–16	–27	–39	–46
3,233	2,936	2,994	2,740	2,581	–9	–7	–15	–20
9,980	10,012	9,200	8,635	8,122	0	–8	–13	–19
1,943	1,825	1,745	1,549	1,515	–6	–10	–20	–22
617	515	449	384	328	–17	–27	–38	–47
879	764	657	583	521	–13	–25	–34	–41
2,985	2,672	2,603	2,632	2,891	–10	–13	–12	–3

Agricultural land

Agricultural land level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg					
74	Malawi	5,678	5,761	6,354	6,960	7,511
75	Malaysia	14,775	16,127	16,138	16,097	16,097
76	Maldives					
77	Mali	15,221	16,783	18,325	19,115	19,437
78	Malta	158	134	109	113	125
79	Mauritania					
80	Mauritius	1,196	1,120	1,088	1,034	980
81	Mexico	458,401	473,416	467,234	457,076	454,789
82	Mongolia	84,489	79,657	87,726	76,282	76,375
83	Morocco	31,943	32,370	32,268	31,570	31,570
84	Mozambique	39,884	40,051	40,277	40,779	41,323
85	Myanmar					
86	Namibia	25,986	26,092	26,092	26,092	26,085
87	Nepal	9,702	9,709	9,871	9,950	9,950
88	Netherlands	22,601	22,127	22,037	21,831	21,504
89	New Zealand	113,443	104,981	108,052	82,106	79,975
90	Nicaragua	7,975	9,021	10,093	10,501	10,196
91	Niger	1,962	2,137	2,196	2,550	2,599
92	Nigeria	200,126	202,226	199,504	212,416	211,583
93	Norway	11,111	12,830	11,863	11,794	11,453
94	Pakistan	73,494	75,222	76,356	76,667	74,797
95	Panama	9,150	9,184	9,606	9,662	9,736
96	Papua New Guinea					
97	Paraguay	26,616	25,528	31,527	30,929	32,558
98	Peru	110,552	107,509	107,256	108,091	108,699
99	Philippines	45,756	45,243	45,937	46,619	49,288
100	Poland	39,712	39,350	38,909	33,611	30,860
101	Portugal	16,345	16,184	15,797	15,759	15,166
102	Qatar	487	519	527	508	527
103	Republic of Korea	220,431	207,179	199,592	190,285	179,359
104	Republic of Moldova					
105	Romania	79,778	79,930	80,254	76,597	76,467
106	Russian Federation*					
107	Rwanda	1,744	1,378	1,550	1,690	1,782
108	Saudi Arabia	601,962	847,191	847,191	846,859	845,095

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Agricultural land per capita in millions of constant 2005 US$					Agricultural land change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
605	583	566	543	504	–4	–7	–10	–17
811	778	689	617	567	–4	–15	–24	–30
1,755	1,708	1,622	1,451	1,265	–3	–8	–17	–28
430	346	275	276	301	–20	–36	–36	–30
1,129	985	910	823	755	–13	–19	–27	–33
5,437	5,131	4,674	4,292	4,010	–6	–14	–21	–26
38,535	34,541	36,380	29,946	27,712	–10	–6	–22	–28
1,289	1,202	1,121	1,039	988	–7	–13	–19	–23
2,944	2,514	2,213	1,963	1,767	–15	–25	–33	–40
18,367	15,800	13,763	12,545	11,424	–14	–25	–32	–38
508	450	405	365	332	–12	–20	–28	–35
1,518	1,435	1,389	1,339	1,294	–5	–8	–12	–15
33,385	28,566	28,007	19,861	18,309	–14	–16	–41	–45
1,935	1,945	1,989	1,936	1,761	1	3	0	–9
252	233	201	196	168	–8	–20	–22	–33
2,051	1,838	1,613	1,519	1,336	–10	–21	–26	–35
2,620	2,943	2,642	2,551	2,345	12	1	–3	–10
657	591	528	483	431	–10	–20	–26	–34
3,787	3,431	3,250	2,984	2,768	–9	–14	–21	–27
6,272	5,324	5,900	5,244	5,044	–15	–6	–16	–20
5,098	4,512	4,147	3,922	3,738	–11	–19	–23	–27
742	653	594	545	529	–12	–20	–27	–29
1,044	1,025	1,016	881	806	–2	–3	–16	–23
1,647	1,598	1,528	1,495	1,421	–3	–7	–9	–14
1,029	1,036	893	619	300	1	–13	–40	–71
5,129	4,639	4,340	4,045	3,722	–10	–15	–21	–27
3,438	3,524	3,616	3,518	3,559	3	5	2	4
245	247	191	184	168	1	–22	–25	–32
37,298	45,814	42,264	35,225	30,789	23	13	–6	–17

Agricultural land

Agricultural land level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	4,617	4,518	4,557	4,594	4,948
110	Serbia					
111	Sierra Leone					
112	Singapore					
113	Slovakia**					
114	Slovenia*					
115	South Africa	120,819	123,245	124,010	123,198	122,450
116	Spain	134,420	131,099	131,306	128,650	121,509
117	Sri Lanka	11,010	10,948	11,061	11,815	12,332
118	Sudan (former)					
119	Swaziland					
120	Sweden	10,037	9,607	9,272	9,457	9,072
121	Switzerland	65,870	65,870	63,828	63,524	63,474
122	Syrian Arab Republic					
123	Tajikistan*					
124	Thailand	92,046	91,301	85,378	84,413	90,655
125	Togo	1,758	1,818	2,000	1,791	2,039
126	Trinidad and Tobago	684	675	595	480	480
127	Tunisia	5,374	5,812	5,938	6,108	6,241
128	Turkey	169,393	168,608	172,817	175,994	166,554
129	Uganda					
130	Ukraine*					
131	United Arab Emirates					
132	United Kingdom					
133	United Republic of Tanzania					
134	United States of America	1,351,532	1,329,978	1,311,807	1,303,529	1,300,835
135	Uruguay	33,453	33,521	33,754	33,262	32,409
136	Venezuela (Bolivarian Republic of)	216,967	214,585	212,352	211,905	210,913
137	Vietnam	33,382	35,134	43,576	49,899	53,443
138	Yemen	27,845	27,974	27,895	27,723	27,789
139	Zambia	20,233	20,862	21,873	22,129	23,075
140	Zimbabwe					

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Agricultural land per capita in millions of constant 2005 US$					Agricultural land change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
638	540	479	423	398	–15	–25	–34	–38
3,284	2,977	2,771	2,578	2,443	–9	–16	–21	–26
3,457	3,325	3,259	2,965	2,637	–4	–6	–14	–24
635	601	590	595	591	–5	–7	–6	–7
1,173	1,088	1,046	1,047	967	–7	–11	–11	–18
9,870	9,385	8,905	8,567	8,282	–5	–10	–13	–16
1,613	1,531	1,352	1,266	1,312	–5	–16	–22	–19
479	445	417	331	338	–7	–13	–31	–29
563	535	460	365	357	–5	–18	–35	–36
654	650	628	616	595	–1	–4	–6	–9
3,129	2,864	2,716	2,583	2,289	–8	–13	–17	–27
5,335	4,994	4,644	4,392	4,191	–6	–13	–18	–21
10,760	10,399	10,170	10,011	9,620	–3	–5	–7	–11
11,022	9,738	8,721	7,947	7,278	–12	–21	–28	–34
497	475	553	600	608	–5	11	21	22
2,330	1,847	1,574	1,343	1,155	–21	–32	–42	–50
2,574	2,339	2,144	1,931	1,763	–9	–17	–25	–32

Forest resources

Total forest level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	5,482	5,482	5,482	5,482	5,482
2	Albania	5,097	5,086	5,075	5,079	5,102
3	Algeria	8,997	8,669	8,341	7,863	7,346
4	Argentina	320,856	313,500	306,143	299,496	295,301
5	Armenia	2,791	2,626	2,461	2,294	2,026
6	Australia	1,001,862	1,002,733	1,003,605	994,126	962,173
7	Austria	33,780	35,652	37,524	39,390	38,844
8	Bahrain					
9	Bangladesh	15,267	14,984	14,702	14,345	14,759
10	Barbados	35	35	35	35	35
11	Belgium	3,369	3,907	4,445	4,874	5,021
12	Belize	13,308	12,905	12,503	12,096	11,688
13	Benin	36,726	34,478	32,231	30,626	28,999
14	Bolivia (Plurinational State of)	860,141	841,589	823,037	804,528	783,337
15	Botswana	60,163	57,657	55,150	52,639	50,129
16	Brazil	4,372,889	4,264,883	4,156,877	4,053,480	3,956,000
17	Bulgaria	14,831	16,086	17,342	20,034	22,752
18	Burundi	1,631	1,148	664	611	608
19	Cambodia	81,597	77,011	72,424	67,197	63,112
20	Cameroon	226,248	216,009	205,769	195,570	185,290
21	Canada	2,572,996	2,554,401	2,535,806	2,517,241	2,509,616
22	Central African Republic	181,088	179,914	178,739	177,574	176,399
23	Chile	84,679	85,570	86,462	86,766	85,704
24	China	1,230,795	1,151,773	1,072,752	925,563	957,661
25	Colombia	679,688	673,542	667,396	661,075	654,755
26	Congo	199,385	198,616	197,847	197,110	196,413
27	Costa Rica	13,023	12,749	12,476	13,028	13,574
28	Côte d'Ivoire	56,181	56,187	56,193	56,201	56,160
29	Croatia*	17,727	18,491	19,446	20,405	21,376
30	Cuba	13,863	16,732	19,601	22,393	23,144
31	Cyprus	964	990	1,017	1,031	1,051
32	Czech Republic**	215	226	245	252	272
33	Democratic Republic of the Congo	985,906	976,326	966,747	957,169	947,585
34	Denmark	1,110	1,181	1,251	1,612	1,613
35	Dominican Republic	14,421	14,421	14,421	14,421	14,421
36	Ecuador	109,395	101,402	93,410	85,476	77,559

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				Total forest per capita in millions of constant 2005 US$				Total forest change percentage change with respect to the base year, 1990
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
421	277	240	199	175	−34	−43	−53	−59
1,550	1,619	1,652	1,617	1,592	4	7	4	3
356	306	273	239	207	−14	−23	−33	−42
9,829	8,994	8,290	7,743	7,307	−8	−16	−21	−26
787	815	800	748	655	3	2	−5	−17
58,602	55,343	52,368	48,723	43,208	−6	−11	−17	−26
4,404	4,493	4,688	4,785	4,628	2	6	9	5
145	128	113	102	99	−12	−22	−30	−32
134	132	130	128	127	−1	−3	−4	−6
339	388	437	468	469	14	29	38	38
69,951	58,577	49,908	43,054	37,508	−16	−29	−38	−46
7,694	6,101	4,945	4,012	3,277	−21	−36	−48	−57
129,180	112,649	99,075	87,959	78,887	−13	−23	−32	−39
43,522	36,362	31,372	28,064	24,978	−16	−28	−36	−43
29,221	26,351	23,832	21,794	20,293	−10	−18	−25	−31
1,682	1,925	2,166	2,589	3,036	14	29	54	81
291	189	104	84	73	−35	−64	−71	−75
8,560	6,895	5,819	5,031	4,464	−19	−32	−41	−48
18,574	15,495	13,124	11,141	9,454	−17	−29	−40	−49
92,885	87,175	82,687	77,973	73,776	−6	−11	−16	−21
61,704	54,065	48,287	44,196	40,081	−12	−22	−28	−35
6,421	5,938	5,607	5,323	5,008	−8	−13	−17	−22
1,075	949	845	708	714	−12	−21	−34	−34
20,470	18,477	16,784	15,359	14,143	−10	−18	−25	−31
83,463	72,681	63,093	55,788	48,582	−13	−24	−33	−42
4,242	3,675	3,183	3,023	2,914	−13	−25	−29	−31
4,488	3,828	3,389	3,119	2,845	−15	−24	−31	−37
3,898	3,960	4,316	4,594	4,854	2	11	18	25
1,312	1,535	1,765	1,990	2,056	17	35	52	57
1,257	1,158	1,078	998	952	−8	−14	−21	−24
21	22	24	25	26	5	15	19	25
27,081	22,155	19,481	16,669	14,365	−18	−28	−38	−47
216	226	234	297	291	4	8	38	35
2,004	1,822	1,678	1,557	1,453	−9	−16	−22	−28
10,662	8,907	7,567	6,366	5,362	−16	−29	−40	−50

Forest resources

Total forest level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt					
38	El Salvador	2,315	2,165	2,014	1,861	1,715
39	Estonia	17,255	17,949	18,643	18,612	18,349
40	Fiji	3,599	3,577	3,555	3,529	3,502
41	Finland	148,187	151,207	154,227	148,239	148,239
42	France	104,427	108,218	112,009	119,788	122,428
43	Gabon	118,073	118,073	118,073	118,073	118,073
44	Gambia	2,184	2,232	2,279	2,328	2,371
45	Germany	68,874	72,855	76,836	77,997	78,526
46	Ghana	40,986	37,277	33,569	29,857	26,164
47	Greece	21,631	22,613	23,595	24,580	25,612
48	Guatemala	34,702	32,549	30,395	28,375	25,748
49	Guyana	169,938	169,938	169,938	169,938	169,938
50	Haiti	653	606	559	510	459
51	Honduras	77,076	68,822	60,568	54,873	49,178
52	Hungary	2,597	2,817	3,037	3,196	3,238
53	Iceland	16	16	15	15	15
54	India	315,355	316,589	317,823	321,382	325,030
55	Indonesia	1,294,103	1,220,662	1,147,221	1,102,816	1,033,699
56	Iran (Islamic Republic of)	52,641	52,651	52,660	52,851	53,023
57	Iraq	5,375	5,423	5,470	5,518	5,518
58	Ireland	715	683	651	636	626
59	Israel	285	282	279	288	284
60	Italy	123,877	137,250	150,624	164,032	177,442
61	Jamaica	2,049	2,030	2,012	2,003	1,961
62	Japan	148,918	158,842	168,765	180,561	181,080
63	Jordan	352	352	352	351	351
64	Kazakhstan*	12,041	11,890	11,701	12,325	12,242
65	Kenya	21,079	20,400	19,720	19,010	18,443
66	Kuwait					
67	Kyrgyzstan*	5,506	5,713	5,973	6,227	8,107
68	Lao People's Democratic Republic	111,367	108,548	105,729	102,419	99,766
69	Latvia	18,098	19,157	20,216	21,049	23,011
70	Lesotho	150	149	149	149	148
71	Liberia	31,827	30,856	29,886	28,916	27,946
72	Lithuania*	14,141	14,382	14,684	15,219	15,243

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Total forest per capita in millions of constant 2005 US$					Total forest change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
434	378	339	308	277	–13	–22	–29	–36
11,007	12,458	13,600	13,829	13,681	13	24	26	24
4,941	4,612	4,379	4,290	4,070	–7	–11	–13	–18
29,718	29,603	29,812	28,266	27,633	0	0	–5	–7
1,841	1,871	1,897	1,964	1,950	2	3	7	6
127,091	108,590	95,584	86,139	78,430	–15	–25	–32	–38
2,260	1,982	1,757	1,548	1,372	–12	–22	–32	–39
871	889	933	945	954	2	7	9	10
2,771	2,193	1,752	1,380	1,073	–21	–37	–50	–61
2,129	2,119	2,148	2,198	2,255	0	1	3	6
3,889	3,250	2,705	2,231	1,789	–16	–30	–43	–54
234,419	233,438	231,807	227,727	225,235	0	–1	–3	–4
92	77	65	55	46	–16	–29	–41	–50
15,764	12,345	9,741	7,977	6,470	–22	–38	–49	–59
250	273	297	317	324	9	19	27	30
64	59	53	49	46	–9	–17	–23	–28
361	328	302	282	265	–9	–16	–22	–26
7,020	6,122	5,376	4,852	4,309	–13	–23	–31	–39
959	881	806	758	717	–8	–16	–21	–25
309	267	229	202	174	–14	–26	–35	–44
202	189	171	153	140	–7	–16	–24	–31
63	53	46	44	38	–16	–27	–31	–40
2,180	2,409	2,643	2,796	2,930	11	21	28	34
866	825	779	747	715	–5	–10	–14	–17
1,218	1,276	1,342	1,429	1,431	5	10	17	17
103	80	73	66	57	–22	–29	–36	–45
729	747	782	812	764	2	7	11	5
899	744	631	534	455	–17	–30	–41	–49
1,240	1,244	1,205	1,235	1,520	0	–3	0	23
26,564	22,637	19,885	17,802	16,089	–15	–25	–33	–39
6,794	7,687	8,476	9,130	10,218	13	25	34	50
91	83	76	72	68	–9	–17	–21	–25
14,962	14,731	10,496	9,086	6,997	–2	–30	–39	–53
3,824	3,963	4,195	4,456	4,586	4	10	17	20

Forest resources

Total forest level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg	1,015	1,125	1,235	1,235	1,235
74	Malawi	17,769	16,839	15,909	14,715	13,555
75	Malaysia	195,547	191,534	187,522	180,111	172,320
76	Maldives	3	3	3	3	3
77	Mali	63,715	61,811	59,906	57,434	54,172
78	Malta					
79	Mauritania	1,860	1,619	1,379	1,134	1,002
80	Mauritius	164	164	165	146	145
81	Mexico	321,479	310,988	300,498	289,046	281,817
82	Mongolia	84,924	81,964	79,003	75,966	72,980
83	Morocco	22,173	22,169	22,164	22,461	22,298
84	Mozambique	190,951	186,131	181,311	176,429	171,841
85	Myanmar	268,976	252,897	236,818	225,097	213,313
86	Namibia	37,353	35,797	34,240	32,658	31,075
87	Nepal	96,978	87,692	78,406	73,018	73,018
88	Netherlands					
89	New Zealand	39,260	39,257	39,253	38,841	42,335
90	Nicaragua	28,530	26,318	24,105	21,863	19,606
91	Niger	9,756	8,120	6,485	5,943	5,400
92	Nigeria	76,234	67,588	58,942	50,268	41,574
93	Norway	48,776	49,578	50,379	53,489	56,593
94	Pakistan	31,417	27,877	24,338	20,824	17,407
95	Panama	30,663	28,823	26,984	26,360	25,743
96	Papua New Guinea	284,410	277,987	271,564	265,133	258,681
97	Paraguay	106,362	101,827	97,293	92,763	88,244
98	Peru	1,002,476	992,478	982,480	975,129	960,944
99	Philippines	53,882	55,445	57,008	58,489	59,928
100	Poland	3,841	4,257	4,673	5,142	5,519
101	Portugal	14,027	14,656	15,284	14,872	14,799
102	Qatar					
103	Republic of Korea	106,657	134,891	163,125	195,600	220,182
104	Republic of Moldova	3,583	3,787	3,991	4,296	4,522
105	Romania	71,301	71,271	71,242	71,529	73,567
106	Russian Federation*	5,349,101	5,344,681	5,339,156	5,331,594	5,358,877
107	Rwanda	589	551	513	530	532
108	Saudi Arabia	6,177	6,177	6,177	6,177	6,177

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Total forest per capita in millions of constant 2005 US$					Total forest change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
2,661	2,761	2,837	2,702	2,435	4	7	2	–9
1,894	1,704	1,417	1,148	910	–10	–25	–39	–52
10,739	9,244	8,009	6,901	6,067	–14	–25	–36	–44
15	13	12	11	11	–12	–20	–26	–31
7,347	6,292	5,304	4,359	3,525	–14	–28	–41	–52
932	706	522	372	290	–24	–44	–60	–69
155	145	138	116	112	–7	–11	–25	–28
3,813	3,370	3,006	2,714	2,485	–12	–21	–29	–35
38,733	35,542	32,763	29,822	26,480	–8	–15	–23	–32
895	823	770	739	698	–8	–14	–17	–22
14,095	11,682	9,962	8,494	7,347	–17	–29	–40	–48
6,850	6,002	5,268	4,859	4,447	–12	–23	–29	–35
26,401	21,677	18,061	15,701	13,610	–18	–32	–41	–48
5,082	4,061	3,213	2,676	2,437	–20	–37	–47	–52
11,554	10,682	10,174	9,395	9,692	–8	–12	–19	–16
6,923	5,676	4,751	4,031	3,387	–18	–31	–42	–51
1,253	885	594	457	348	–29	–53	–63	–72
781	614	477	360	262	–21	–39	–54	–66
11,500	11,373	11,218	11,569	11,590	–1	–2	1	1
281	219	168	131	100	–22	–40	–53	–64
12,692	10,767	9,128	8,140	7,320	–15	–28	–36	–42
68,406	58,950	50,488	43,497	37,718	–14	–26	–36	–45
25,063	21,235	18,208	15,728	13,672	–15	–27	–37	–45
46,228	41,653	37,989	35,384	33,049	–10	–18	–23	–29
874	801	737	684	643	–8	–16	–22	–27
101	111	122	135	144	10	21	33	43
1,413	1,447	1,479	1,410	1,386	2	5	0	–2
2,482	3,020	3,547	4,158	4,570	22	43	68	84
821	873	972	1,140	1,266	6	18	39	54
3,072	3,142	3,210	3,285	3,424	2	4	7	11
35,979	35,943	36,381	37,065	37,486	0	1	3	4
83	99	63	58	50	19	–23	–31	–40
383	334	308	257	225	–13	–19	–33	–41

Forest resources

Total forest level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	56,810	55,118	53,426	51,420	49,794
110	Serbia	21,306	21,996	22,687	25,208	30,456
111	Sierra Leone	16,514	15,862	15,211	14,584	13,984
112	Singapore	34	34	34	34	34
113	Slovakia**	9,202	9,437	9,829	10,229	10,545
114	Slovenia*	13,512	14,323	15,337	16,644	18,056
115	South Africa	36,258	36,024	35,791	35,667	35,605
116	Spain	62,950	71,669	80,387	81,641	85,932
117	Sri Lanka	10,140	9,522	8,905	8,291	7,967
118	Sudan (former)	350,775	335,682	320,590	318,175	315,766
119	Swaziland	1,496	1,609	1,723	1,834	1,941
120	Sweden	187,755	186,826	185,897	194,950	198,482
121	Switzerland	16,640	17,099	17,559	17,836	18,096
122	Syrian Arab Republic	1,084	1,085	1,087	1,083	1,084
123	Tajikistan*	1,471	1,465	1,458	1,452	1,455
124	Thailand	112,850	109,537	106,224	103,305	100,174
125	Togo	6,371	5,364	4,357	3,354	2,362
126	Trinidad and Tobago	4,760	4,677	4,595	4,500	4,355
127	Tunisia	1,469	1,402	1,334	1,335	1,326
128	Turkey	105,957	105,122	104,287	100,693	92,016
129	Uganda	19,822	17,978	16,135	14,296	12,423
130	Ukraine*	34,794	36,967	39,683	41,085	42,618
131	United Arab Emirates					
132	United Kingdom	7,804	7,879	7,953	8,477	9,138
133	United Republic of Tanzania	188,852	179,528	170,204	160,850	151,597
134	United States of America	3,239,701	3,299,888	3,360,075	3,508,145	3,666,612
135	Uruguay	3,126	3,178	3,231	3,285	3,353
136	Venezuela (Bolivarian Republic of)	314,233	305,551	296,868	288,183	279,497
137	Vietnam	50,180	53,720	57,261	60,079	59,914
138	Yemen	2,757	2,757	2,757	2,757	2,757
139	Zambia	332,811	327,554	322,297	317,042	311,771
140	Zimbabwe	92,697	85,859	79,021	72,182	65,345

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Empty cells represent either missing data or unavailability of the resource in the related countries.

				Total forest per capita in millions of constant 2005 US$				Total forest change percentage change with respect to the base year, 1990
1990	1995	2000	2005	2010	1995	2000	2005	2010
7,845	6,586	5,620	4,730	4,005	–16	–28	–40	–49
2,227	2,156	2,239	2,558	3,090	–3	1	15	39
4,148	4,069	3,671	2,830	2,383	–2	–11	–32	–43
11	10	9	8	7	–13	–23	–29	–41
1,731	1,758	1,819	1,889	1,931	2	5	9	12
6,982	7,285	7,725	8,313	8,896	4	11	19	27
985	870	800	746	710	–12	–19	–24	–28
1,619	1,818	1,995	1,881	1,865	12	23	16	15
585	522	475	418	382	–11	–19	–29	–35
13,240	11,137	9,377	8,284	7,250	–16	–29	–37	–45
1,733	1,670	1,619	1,660	1,636	–4	–7	–4	–6
21,937	21,165	20,981	21,591	21,161	–4	–4	–2	–4
2,493	2,436	2,450	2,405	2,361	–2	–2	–4	–5
88	77	68	59	53	–13	–23	–33	–40
271	254	236	225	212	–7	–13	–17	–22
1,977	1,836	1,682	1,549	1,449	–7	–15	–22	–27
1,738	1,313	909	620	392	–24	–48	–64	–77
3,916	3,708	3,556	3,421	3,246	–5	–9	–13	–17
179	157	141	135	127	–12	–21	–25	–29
1,957	1,786	1,639	1,478	1,265	–9	–16	–25	–35
1,120	863	666	503	372	–23	–40	–55	–67
673	723	812	876	938	7	21	30	39
136	136	135	141	147	0	–1	3	8
7,412	5,996	5,000	4,142	3,381	–19	–33	–44	–54
12,788	12,391	11,894	11,819	11,813	–3	–7	–8	–8
1,006	986	973	989	995	–2	–3	–2	–1
15,963	13,867	12,193	10,808	9,645	–13	–24	–32	–40
748	726	727	722	682	–3	–3	–3	–9
231	182	156	134	115	–21	–33	–42	–50
42,342	36,724	31,593	27,659	23,820	–13	–25	–35	–44
8,854	7,348	6,317	5,742	5,198	–17	–29	–35	–41

Fossil fuels

Fossil fuels level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	2,990	2,934	2,886	2,877	2,864
2	Albania	16,169	15,914	15,782	15,661	15,531
3	Algeria	464,491	430,399	391,003	343,990	292,908
4	Argentina	117,483	103,540	84,567	64,220	44,094
5	Armenia					
6	Australia	1,244,704	1,217,886	1,185,823	1,149,089	1,108,598
7	Austria	3,816	3,186	2,546	1,834	1,120
8	Bahrain	4,849	3,931	3,025	2,140	1,283
9	Bangladesh	2,790	2,590	2,317	1,903	1,313
10	Barbados	122	96	66	43	21
11	Belgium					
12	Belize					
13	Benin					
14	Bolivia (Plurinational State of)	20,802	20,143	19,349	17,982	16,104
15	Botswana	989	912	835	754	676
16	Brazil	278,607	265,103	245,249	217,711	180,818
17	Bulgaria	50,114	47,798	45,338	43,028	40,564
18	Burundi					
19	Cambodia					
20	Cameroon	8,719	6,470	4,580	3,308	1,927
21	Canada	2,080,365	2,013,411	1,933,582	1,845,581	1,754,582
22	Central African Republic					
23	Chile	6,103	5,675	5,346	5,075	4,757
24	China	2,723,608	2,586,137	2,425,505	2,225,843	1,937,952
25	Colombia	191,437	180,549	164,483	149,413	130,693
26	Congo	30,516	27,578	23,175	18,957	14,649
27	Costa Rica					
28	Côte d'Ivoire	2,266	2,210	1,966	1,645	821
29	Croatia*	3,175	2,608	2,026	1,539	1,103
30	Cuba	7,006	6,627	5,922	4,948	3,907
31	Cyprus					
32	Czech Republic**	31,274	27,912	23,010	18,403	14,102
33	Democratic Republic of the Congo	3,294	2,839	2,390	2,021	1,667
34	Denmark	37,343	33,530	27,470	19,272	12,537
35	Dominican Republic					
36	Ecuador	99,332	92,789	85,456	76,825	67,252

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Fossil fuels per capita in millions of constant 2005 US$					Fossil fuels change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
229	148	126	104	91	−35	−45	−55	−60
4,915	5,066	5,138	4,985	4,847	3	5	1	−1
18,360	15,213	12,806	10,459	8,258	−17	−30	−43	−55
3,599	2,971	2,290	1,660	1,091	−17	−36	−54	−70
72,806	67,218	61,876	56,318	49,784	−8	−15	−23	−32
498	401	318	223	133	−19	−36	−55	−73
9,837	7,031	4,739	2,953	1,017	−29	−52	−70	−90
27	22	18	14	9	−17	−33	−49	−67
470	363	248	159	77	−23	−47	−66	−84
3,124	2,696	2,329	1,966	1,622	−14	−25	−37	−48
716	575	475	402	337	−20	−34	−44	−53
1,862	1,638	1,406	1,171	928	−12	−24	−37	−50
5,683	5,720	5,663	5,560	5,413	1	0	−2	−5
716	464	292	188	98	−35	−59	−74	−86
75,101	68,712	63,050	57,168	51,580	−9	−16	−24	−31
463	394	347	311	278	−15	−25	−33	−40
2,378	2,130	1,911	1,702	1,445	−10	−20	−28	−39
5,766	4,953	4,136	3,471	2,823	−14	−28	−40	−51
12,774	10,092	7,391	5,365	3,623	−21	−42	−58	−72
181	151	119	91	42	−17	−35	−50	−77
698	559	450	346	250	−20	−36	−50	−64
663	608	533	440	347	−8	−20	−34	−48
3,032	2,705	2,246	1,801	1,344	−11	−26	−41	−56
90	64	48	35	25	−29	−47	−61	−72
7,264	6,407	5,145	3,556	2,259	−12	−29	−51	−69
9,681	8,150	6,922	5,722	4,649	−16	−28	−41	−52

Fossil fuels

Fossil fuels level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	136,744	118,476	100,687	84,225	66,244
38	El Salvador					
39	Estonia					
40	Fiji					
41	Finland					
42	France	2,589	1,820	1,300	876	566
43	Gabon	38,409	33,059	27,244	22,997	18,919
44	Gambia					
45	Germany	1,442,897	1,389,371	1,346,621	1,305,655	1,268,885
46	Ghana	1	1	1	1	
47	Greece	68,678	63,906	58,773	53,042	47,780
48	Guatemala	1,610	1,510	1,226	937	671
49	Guyana					
50	Haiti					
51	Honduras					
52	Hungary	24,297	22,313	20,458	18,982	17,792
53	Iceland					
54	India	1,354,496	1,316,992	1,272,097	1,218,856	1,151,561
55	Indonesia	471,571	425,922	375,237	326,894	266,096
56	Iran (Islamic Republic of)	3,052,570	2,977,450	2,894,785	2,802,213	2,695,922
57	Iraq	1,047,065	1,040,149	1,015,468	989,299	958,875
58	Ireland	1,037	735	515	425	370
59	Israel	1,353	1,347	1,341	1,286	1,067
60	Italy	17,548	14,330	10,960	8,012	5,227
61	Jamaica					
62	Japan	14,258	12,035	10,206	8,751	7,389
63	Jordan	433	393	339	282	235
64	Kazakhstan*	843,641	832,261	818,386	795,775	766,123
65	Kenya					
66	Kuwait	1,273,616	1,244,676	1,203,211	1,158,284	1,107,973
67	Kyrgyzstan*	8,224	8,155	8,115	8,076	8,040
68	Lao People's Democratic Republic					
69	Latvia					
70	Lesotho					
71	Liberia					
72	Lithuania*	292	274	219	130	79

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Fossil fuels per capita in millions of constant 2005 US$					Fossil fuels change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
2,406	1,909	1,488	1,135	817	–21	–38	–53	–66
46	31	22	14	9	–31	–52	–69	–80
41,342	30,404	22,055	16,777	12,567	–26	–47	–59	–70
18,242	16,958	16,353	15,818	15,417	–7	–10	–13	–15
					–18	–43	–66	–83
6,759	5,988	5,349	4,743	4,206	–11	–21	–30	–38
180	151	109	74	47	–16	–40	–59	–74
2,342	2,160	2,004	1,882	1,782	–8	–14	–20	–24
1,550	1,365	1,207	1,069	940	–12	–22	–31	–39
2,558	2,136	1,758	1,438	1,109	–16	–31	–44	–57
55,632	49,826	44,302	40,185	36,444	–10	–20	–28	–34
60,267	51,269	42,564	36,159	30,276	–15	–29	–40	–50
294	204	135	102	83	–31	–54	–65	–72
301	253	223	195	144	–16	–26	–35	–52
309	252	192	137	86	–19	–38	–56	–72
117	97	81	69	58	–17	–30	–41	–50
127	90	70	53	38	–29	–45	–58	–70
51,088	52,259	54,717	52,451	47,804	2	7	3	–6
610,061	764,585	619,961	511,606	404,853	25	2	–16	–34
1,852	1,776	1,638	1,602	1,507	–4	–12	–13	–19
79	75	63	38	24	–4	–21	–52	–70

Fossil fuels

Fossil fuels level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg					
74	Malawi					
75	Malaysia	234,671	217,196	194,689	169,184	143,478
76	Maldives					
77	Mali					
78	Malta					
79	Mauritania					
80	Mauritius					
81	Mexico	198,001	170,880	140,005	106,447	73,634
82	Mongolia	39,552	39,115	38,735	38,300	37,289
83	Morocco	87	82	74	65	55
84	Mozambique	3,229	3,226	3,225	3,223	3,220
85	Myanmar	19,718	19,199	18,566	16,107	12,944
86	Namibia					
87	Nepal	15	15	14	13	12
88	Netherlands	101,482	86,547	72,474	59,156	45,555
89	New Zealand	18,909	16,794	14,593	12,728	10,650
90	Nicaragua					
91	Niger	596	589	582	574	566
92	Nigeria	549,763	513,915	474,860	431,889	388,732
93	Norway	377,049	328,812	263,403	193,767	134,791
94	Pakistan	97,073	92,410	86,890	80,294	71,312
95	Panama					
96	Papua New Guinea	11,759	10,562	9,235	8,425	7,827
97	Paraguay					
98	Peru	29,477	27,061	24,922	22,976	19,773
99	Philippines	5,018	4,912	4,832	4,686	4,388
100	Poland	159,577	141,879	125,590	110,796	97,519
101	Portugal					
102	Qatar	350,254	342,692	331,075	315,654	295,457
103	Republic of Korea	6,064	4,713	4,109	3,661	3,305
104	Republic of Moldova					
105	Romania	34,325	26,653	20,430	14,740	9,377
106	Russian Federation*	5,150,441	4,964,039	4,754,122	4,501,983	4,219,197
107	Rwanda					
108	Saudi Arabia	3,351,183	3,185,652	3,014,983	2,832,766	2,641,310

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Fossil fuels per capita in millions of constant 2005 US$					Fossil fuels change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
12,888	10,482	8,315	6,482	5,052	–19	–35	–50	–61
2,349	1,852	1,401	1,000	649	–21	–40	–57	–72
18,039	16,961	16,064	15,035	13,530	–6	–11	–17	–25
4	3	3	2	2	–13	–27	–39	–51
238	202	177	155	138	–15	–26	–35	–42
502	456	413	348	270	–9	–18	–31	–46
0,79	0,69	0,57	0,49	0,41	–13	–28	–38	–48
6,815	5,612	4,569	3,628	2,742	–18	–33	–47	–60
5,565	4,570	3,782	3,079	2,438	–18	–32	–45	–56
77	64	53	44	37	–16	–30	–42	–52
5,636	4,671	3,839	3,089	2,454	–17	–32	–45	–56
88,895	75,431	58,653	41,911	27,603	–15	–34	–53	–69
868	726	601	506	411	–16	–31	–42	–53
2,828	2,240	1,717	1,382	1,141	–21	–39	–51	–60
1,359	1,136	964	834	680	–16	–29	–39	–50
81	71	63	55	47	–13	–23	–33	–42
4,193	3,696	3,279	2,903	2,548	–12	–22	–31	–39
739,366	683,509	560,235	384,482	167,988	–8	–24	–48	–77
141	106	89	78	69	–25	–37	–45	–51
1,479	1,175	921	677	436	–21	–38	–54	–70
34,643	33,383	32,394	31,298	29,514	–4	–6	–10	–15
207,644	172,273	150,409	117,830	96,229	–17	–28	–43	–54

Fossil fuels

Fossil fuels level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal					
110	Serbia					
111	Sierra Leone					
112	Singapore					
113	Slovakia**	6,469	6,231	5,830	5,436	5,120
114	Slovenia*	5,604	5,228	4,788	4,364	3,950
115	South Africa	504,431	488,230	469,134	448,662	427,642
116	Spain	21,730	18,058	15,305	12,940	11,570
117	Sri Lanka					
118	Sudan (former)	50,170	50,170	49,432	45,582	39,266
119	Swaziland	891	887	878	864	850
120	Sweden					
121	Switzerland					
122	Syrian Arab Republic	58,592	50,752	42,085	34,160	27,340
123	Tajikistan*	4,640	4,623	4,611	4,599	4,582
124	Thailand	76,131	71,666	64,217	54,064	39,771
125	Togo					
126	Trinidad and Tobago	49,238	45,575	41,212	34,122	23,738
127	Tunisia	14,030	12,140	10,330	8,497	6,671
128	Turkey	62,975	57,348	50,992	45,659	38,607
129	Uganda					
130	Ukraine*	579,631	570,306	561,267	551,939	542,700
131	United Arab Emirates	1,054,588	1,015,103	974,480	931,210	883,415
132	United Kingdom	259,344	204,324	137,674	80,518	41,729
133	United Republic of Tanzania	1,582	1,581	1,578	1,576	1,572
134	United States of America	4,776,408	4,489,046	4,200,976	3,921,848	3,635,680
135	Uruguay					
136	Venezuela (Bolivarian Republic of)	1,431,829	1,377,597	1,310,444	1,251,207	1,198,785
137	Vietnam	36,030	33,738	29,275	21,910	12,615
138	Yemen	40,228	36,823	31,664	26,034	21,888
139	Zambia	191	170	157	144	143
140	Zimbabwe	8,471	8,090	7,776	7,501	7,274

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Fossil fuels per capita in millions of constant 2005 US$					Fossil fuels change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
1,217	1,161	1,079	1,004	937	–5	–11	–18	–23
2,896	2,659	2,412	2,180	1,946	–8	–17	–25	–33
13,710	11,792	10,481	9,388	8,530	–14	–24	–32	–38
559	458	380	298	251	–18	–32	–47	–55
1,894	1,664	1,446	1,187	902	–12	–24	–37	–52
1,033	921	825	782	717	–11	–20	–24	–31
4,754	3,581	2,632	1,848	1,340	–25	–45	–61	–72
856	800	747	713	666	–7	–13	–17	–22
1,334	1,201	1,017	811	575	–10	–24	–39	–57
40,508	36,129	31,896	25,941	17,696	–11	–21	–36	–56
1,708	1,359	1,092	857	636	–20	–36	–50	–63
1,163	974	801	670	531	–16	–31	–42	–54
11,219	11,156	11,480	11,762	11,941	–1	2	5	6
583,083	432,228	321,240	228,835	117,605	–26	–45	–61	–80
4,533	3,523	2,338	1,337	673	–22	–48	–70	–85
62	53	46	41	35	–15	–25	–35	–44
18,854	16,856	14,871	13,213	11,713	–11	–21	–30	–38
72,736	62,519	53,821	46,925	41,366	–14	–26	–35	–43
537	456	372	263	144	–15	–31	–51	–73
3,367	2,431	1,787	1,261	910	–28	–47	–63	–73
24	19	15	13	11	–21	–36	–48	–55
809	692	622	597	579	–14	–23	–26	–28

Minerals

Minerals level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan					
2	Albania					
3	Algeria	8,646	8,629	8,608	8,592	8,562
4	Argentina					
5	Armenia					
6	Australia	134,612	130,511	125,156	118,553	110,480
7	Austria					
8	Bahrain					
9	Bangladesh					
10	Barbados					
11	Belgium					
12	Belize					
13	Benin					
14	Bolivia (Plurinational State of)	1,974	1,833	1,690	1,540	1,244
15	Botswana	810	728	635	529	416
16	Brazil	119,869	116,661	113,162	108,884	102,723
17	Bulgaria					
18	Burundi					
19	Cambodia					
20	Cameroon					
21	Canada	35,587	32,285	28,985	26,103	23,429
22	Central African Republic					
23	Chile	58,347	55,683	51,021	45,156	38,805
24	China	139,845	134,018	127,107	118,562	100,003
25	Colombia	2,191	2,081	1,921	1,623	1,377
26	Congo					
27	Costa Rica					
28	Côte d'Ivoire					
29	Croatia*					
30	Cuba	5,324	5,197	4,952	4,661	4,390
31	Cyprus					
32	Czech Republic**					
33	Democratic Republic of the Congo					
34	Denmark					
35	Dominican Republic	1,312	1,136	967	828	766
36	Ecuador					

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				Minerals per capita in millions of constant 2005 US$				Minerals change percentage change with respect to the base year, 1990
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
342	305	282	261	241	–11	–18	–24	–29
7,874	7,203	6,531	5,810	4,961	–9	–17	–26	–37
296	245	203	168	125	–17	–31	–43	–58
586	459	361	282	207	–22	–38	–52	–65
801	721	649	585	527	–10	–19	–27	–34
1,285	1,102	945	809	689	–14	–26	–37	–46
4,424	3,864	3,309	2,770	2,267	–13	–25	–37	–49
122	110	100	91	75	–10	–18	–26	–39
66	57	48	38	30	–13	–27	–43	–55
504	477	446	414	390	–5	–11	–18	–23
182	143	113	89	77	–21	–38	–51	–58

Minerals

Minerals level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	524	518	498	462	398
38	El Salvador					
39	Estonia					
40	Fiji					
41	Finland					
42	France					
43	Gabon					
44	Gambia					
45	Germany					
46	Ghana	2,814	2,614	2,266	1,909	1,469
47	Greece	1,284	1,262	1,243	1,220	1,199
48	Guatemala					
49	Guyana	1,748	1,727	1,703	1,686	1,670
50	Haiti					
51	Honduras					
52	Hungary					
53	Iceland					
54	India	123,148	122,004	120,632	118,390	114,646
55	Indonesia	22,124	21,028	19,097	16,442	13,800
56	Iran (Islamic Republic of)	8,692	8,602	8,462	8,172	7,669
57	Iraq					
58	Ireland	807	706	601	413	219
59	Israel	994	942	875	803	742
60	Italy					
61	Jamaica	4,430	4,318	4,201	4,070	3,950
62	Japan	307	265	224	186	149
63	Jordan	4,882	4,812	4,725	4,627	4,538
64	Kazakhstan*	30,688	30,262	29,643	28,761	27,688
65	Kenya					
66	Kuwait					
67	Kyrgyzstan*					
68	Lao People's Democratic Republic					
69	Latvia					
70	Lesotho					
71	Liberia					
72	Lithuania*					

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
Empty cells represent either missing data or unavailability of the resource in the related countries.

Minerals per capita in millions of constant 2005 US$					Minerals change percentage change with respect to the base year, 1990			
1990	**1995**	**2000**	**2005**	**2010**	**1995**	**2000**	**2005**	**2010**
9	8	7	6	5	–10	–20	–33	–47
190	154	118	88	60	–19	–38	–54	–68
126	118	113	109	106	–6	–10	–14	–16
2,411	2,373	2,323	2,260	2,213	–2	–4	–6	–8
141	126	114	104	94	–10	–19	–26	–34
120	105	89	72	58	–12	–25	–40	–52
158	144	130	117	104	–9	–18	–26	–35
229	196	158	99	49	–14	–31	–57	–79
221	177	145	122	100	–20	–34	–45	–55
1,873	1,754	1,627	1,518	1,441	–6	–13	–19	–23
3	2	2	1	1	–15	–29	–41	–53
1,429	1,098	979	866	733	–23	–32	–39	–49
1,858	1,900	1,982	1,896	1,728	2	7	2	–7

Minerals

Minerals level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg					
74	Malawi					
75	Malaysia	174	146	132	124	118
76	Maldives					
77	Mali					
78	Malta					
79	Mauritania	4,109	3,943	3,767	3,606	3,433
80	Mauritius					
81	Mexico	18,782	17,863	16,723	15,555	14,155
82	Mongolia					
83	Morocco					
84	Mozambique					
85	Myanmar					
86	Namibia					
87	Nepal					
88	Netherlands					
89	New Zealand					
90	Nicaragua					
91	Niger					
92	Nigeria					
93	Norway					
94	Pakistan					
95	Panama					
96	Papua New Guinea	2,186	1,917	1,649	1,348	1,066
97	Paraguay					
98	Peru	35,004	33,880	32,107	29,316	25,977
99	Philippines	1,588	1,536	1,464	1,373	911
100	Poland	8,440	7,987	7,451	6,832	6,279
101	Portugal	58	47	39	38	38
102	Qatar					
103	Republic of Korea					
104	Republic of Moldova					
105	Romania					
106	Russian Federation*	107,666	104,869	101,414	97,287	92,949
107	Rwanda					
108	Saudi Arabia					

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** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
Empty cells represent either missing data or unavailability of the resource in the related countries.

Minerals per capita in millions of constant 2005 US$					Minerals change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
10	7	6	5	4	–26	–41	–50	–56
2,059	1,720	1,425	1,183	992	–16	–31	–43	–52
223	194	167	146	125	–13	–25	–34	–44
526	406	306	221	155	–23	–42	–58	–70
1,614	1,422	1,241	1,064	893	–12	–23	–34	–45
26	22	19	16	10	–14	–26	–38	–62
222	208	195	179	164	–6	–12	–19	–26
6	5	4	4	4	–21	–35	–38	–39
724	705	691	676	650	–3	–5	–7	–10

Minerals

Minerals level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	911	873	837	802	785
110	Serbia					
111	Sierra Leone					
112	Singapore					
113	Slovakia**					
114	Slovenia*					
115	South Africa	30,614	27,011	23,960	21,378	19,323
116	Spain					
117	Sri Lanka					
118	Sudan (former)					
119	Swaziland					
120	Sweden	10,603	10,311	10,005	9,704	9,380
121	Switzerland					
122	Syrian Arab Republic	5,590	5,571	5,537	5,497	5,446
123	Tajikistan*					
124	Thailand	119	103	99	96	95
125	Togo	414	362	314	287	268
126	Trinidad and Tobago					
127	Tunisia	943	828	681	530	381
128	Turkey					
129	Uganda					
130	Ukraine*	71,873	71,312	70,724	70,005	69,153
131	United Arab Emirates					
132	United Kingdom					
133	United Republic of Tanzania					
134	United States of America	56,878	51,334	45,491	40,906	36,760
135	Uruguay					
136	Venezuela (Bolivarian Republic of)	14,157	13,841	13,534	13,198	12,879
137	Vietnam					
138	Yemen					
139	Zambia	6,060	5,629	5,294	4,901	4,276
140	Zimbabwe					

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** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
Empty cells represent either missing data or unavailability of the resource in the related countries.

Minerals per capita in millions of constant 2005 US$					Minerals change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
126	104	88	74	63	–17	–30	–41	–50
832	652	535	447	385	–22	–36	–46	–54
1,239	1,168	1,129	1,075	1,000	–6	–9	–13	–19
454	393	346	297	267	–13	–24	–34	–41
2	2	2	1	1	–17	–25	–31	–34
113	89	65	53	45	–22	–42	–53	–61
115	93	72	53	36	–19	–37	–53	–68
1,391	1,395	1,447	1,492	1,522	0	4	7	9
225	193	161	138	118	–14	–28	–39	–47
719	628	556	495	444	–13	–23	–31	–38
771	631	519	428	327	–18	–33	–45	–58

IWI adjusted

	Country/Year	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj
		average growth rate (in percentage) 1991–1995							average growth rate (in percentage) 1996–2000						
1	Afghanistan	5.3	8.7	-3.5	-0.1	-0.1	15.4	11.7	1.9	2.9	-1.1	-0.1	-0.1	6.1	4.9
2	Albania	-1.0	-0.9	-0.1	-0.1	-0.1	2.4	2.1	-0.2	-0.4	0.2	-0.1	-0.1	-4.6	-4.5
3	Algeria	0.9	2.3	-1.3	-0.1	0.9	2.7	2.1	0.7	1.5	-0.8	-0.1	1.0	-0.8	-0.7
4	Argentina	1.0	1.3	-0.4	-0.1	-0.1	-4.0	-4.5	1.4	1.2	0.2	-0.1	-0.1	-0.5	-0.4
5	Armenia	-1.3	-1.9	0.6	-0.1	-0.4	15.2	15.3	-0.3	-0.9	0.6	-0.1	-0.7	-5.6	-5.7
6	Australia	1.1	1.2	-0.1	0.0	-0.1	-1.3	-1.4	1.3	1.1	0.1	0.0	-0.1	-1.4	-1.4
7	Austria	2.3	0.7	1.6	-0.2	-0.1	0.1	1.4	1.1	0.2	0.9	-0.2	-0.1	-2.3	-1.7
8	Bahrain	4.0	2.6	1.4	-0.2	0.0	-0.7	0.5	3.1	2.7	0.4	-0.2	-0.1	-0.8	-0.6
9	Bangladesh	2.7	2.2	0.5	-0.2	-0.1	-0.3	-0.1	3.8	2.0	1.8	-0.1	-0.1	0.4	2.0
10	Barbados	0.5	0.3	0.2	-0.1	-0.2	1.2	1.2	0.8	0.3	0.4	-0.1	-0.2	-1.4	-1.3
11	Belgium	1.5	0.3	1.3	-0.2	-0.2	0.6	1.6	1.3	0.2	1.1	-0.2	-0.2	-0.6	0.1
12	Belize	1.0	3.0	-2.0	0.0	-0.1	-0.7	-2.9	1.1	2.6	-1.5	0.0	-0.2	-2.9	-4.7
13	Benin	1.1	3.4	-2.3	-0.1	-0.1	-1.6	-4.1	1.6	2.9	-1.3	-0.1	-0.1	-2.3	-3.9
14	Bolivia (Plurinational State of)	-0.1	2.3	-2.5	0.0	0.0	-1.2	-3.7	0.0	2.1	-2.2	0.0	0.0	1.0	-1.2
15	Botswana	1.7	2.8	-1.1	-0.2	-0.1	0.2	-1.1	1.5	2.1	-0.6	-0.2	-0.1	-4.8	-5.7
16	Brazil	1.8	1.6	0.2	-0.1	-0.1	-0.5	-0.4	1.6	1.5	0.1	-0.1	-0.1	0.2	0.1
17	Bulgaria	-0.7	-1.1	0.4	0.0	-0.4	1.9	1.8	-0.5	-0.9	0.3	0.0	-0.4	0.5	0.4
18	Burundi	1.7	1.7	0.0	-0.1	-0.1	5.1	4.8	0.4	0.9	-0.6	-0.1	-0.1	1.6	0.8
19	Cambodia	0.3	3.2	-3.0	-0.1	0.0	-3.5	-6.6	0.5	2.2	-1.7	-0.1	-0.2	-3.5	-5.5
20	Cameroon	0.3	2.7	-2.4	-0.1	0.0	2.8	0.4	0.6	2.4	-1.7	-0.1	0.0	-3.0	-4.8
21	Canada	0.7	1.1	-0.5	0.0	0.6	-0.3	-0.2	1.2	0.9	0.3	0.0	0.7	-2.0	-1.0
22	Central African Republic	0.0	2.5	-2.6	0.0	0.0	1.3	-1.3	-0.1	2.2	-2.2	0.0	0.0	-0.2	-2.4
23	Chile	1.9	1.8	0.1	-0.1	-0.2	-4.1	-4.3	2.3	1.4	0.9	-0.1	-0.3	0.1	0.6
24	China	2.1	1.2	0.9	0.0	-0.1	-7.1	-6.2	2.3	0.9	1.4	0.0	-0.2	-3.2	-2.0
25	Colombia	1.7	1.9	-0.2	-0.1	0.0	-1.2	-1.4	1.5	1.8	-0.2	-0.1	0.0	1.3	1.0
26	Congo	0.1	2.7	-2.7	0.0	0.6	1.9	-0.2	-0.3	2.8	-3.0	0.0	0.7	-0.6	-3.0
27	Costa Rica	2.4	2.5	-0.1	-0.1	-0.2	-2.0	-2.4	3.5	2.5	1.0	-0.1	-0.2	-0.7	0.0
28	Côte d'Ivoire	2.5	3.2	-0.7	-0.2	-0.1	0.9	-0.1	1.7	2.5	-0.7	-0.1	-0.1	-1.5	-2.5
29	Croatia*	0.9	0.7	0.2	0.0	-0.1	2.3	2.4	0.0	-0.7	0.7	0.0	-0.2	-1.2	-0.7
30	Cuba	0.1	0.6	-0.5	-0.1	-0.5	7.7	6.5	0.2	0.4	-0.2	-0.1	-0.6	-4.5	-5.4
31	Cyprus	2.8	2.2	0.6	-0.1	-0.3	-2.2	-2.0	3.1	2.0	1.1	-0.1	-0.3	-1.2	-0.5
32	Czech Republic**	1.9	0.0	1.9	0.0	-0.2	-0.8	0.9	0.9	-0.1	1.0	0.0	-0.2	-1.6	-0.7
33	Democratic Republic of the Congo	0.2	3.9	-3.7	0.0	0.0	9.2	5.6	0.1	2.4	-2.3	0.0	0.0	4.6	2.3
34	Denmark	0.1	0.4	-0.3	-0.2	0.0	-1.8	-2.3	0.8	0.4	0.4	-0.2	0.0	-0.6	-0.5
35	Dominican Republic	2.7	1.9	0.8	-0.1	-0.3	-1.7	-1.3	2.4	1.7	0.8	-0.1	-0.4	-2.1	-1.8
36	Ecuador	0.8	2.1	-1.3	-0.1	0.9	-1.0	-1.5	0.4	1.6	-1.3	-0.1	1.0	0.2	-0.1

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
*** Data in this category are average annual changes expressed as a percentage in wealth.

IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj
average growth rate (in percentage) 2001–2005							average growth rate (in percentage) 2006–2010						
4.2	3.9	0.4	–0.1	–0.1	–11.3	–11.1	3.5	2.6	0.8	–0.1	–0.2	–4.2	–3.7
1.7	0.5	1.2	–0.1	–0.2	–3.9	–3.0	2.0	0.4	1.6	–0.1	–0.2	–3.8	–2.5
0.8	1.5	–0.7	–0.1	1.0	–2.9	–2.7	1.3	1.5	–0.2	–0.1	0.8	–1.1	–0.5
1.6	0.9	0.6	–0.1	–0.1	–0.4	0.1	1.7	0.9	0.8	–0.1	–0.2	–3.3	–2.8
0.9	–0.1	1.0	–0.1	–0.9	–9.1	–9.2	2.0	0.2	1.9	–0.1	–1.1	2.0	2.6
1.8	1.3	0.6	0.0	–0.1	–0.2	0.3	2.5	1.8	0.7	0.0	–0.1	0.5	1.1
1.8	0.6	1.2	–0.2	–0.1	0.4	1.3	1.2	0.4	0.8	–0.2	–0.1	0.2	0.8
3.6	2.6	1.0	–0.2	–0.2	–1.4	–0.8	12.3	11.7	0.6	–0.1	–0.4	2.2	2.2
3.2	1.6	1.6	–0.1	–0.2	0.2	1.5	3.0	1.1	1.8	–0.1	–0.2	–0.6	0.9
1.6	0.2	1.4	–0.1	–0.2	–0.6	0.4	0.6	0.2	0.4	–0.1	–0.2	1.0	1.1
1.7	0.5	1.2	–0.2	–0.2	0.6	1.5	1.1	0.6	0.5	–0.2	–0.2	1.3	1.4
1.3	2.3	–1.0	0.0	–0.4	–2.6	–4.1	1.0	2.1	–1.1	–0.1	–0.4	0.0	–1.5
2.0	3.2	–1.2	–0.1	–0.2	–1.0	–2.6	2.7	3.0	–0.3	–0.1	–0.4	–0.3	–1.1
0.0	1.9	–2.0	0.0	0.0	–0.4	–2.4	–0.1	1.7	–1.8	0.0	0.0	–1.2	–3.1
1.9	1.3	0.6	–0.2	–0.1	–2.7	–2.4	1.7	1.4	0.3	–0.2	–0.2	–1.4	–1.5
1.3	1.3	0.0	–0.1	–0.1	–1.2	–1.4	1.1	0.9	0.1	–0.1	–0.2	–2.0	–2.1
0.4	–0.7	1.0	0.0	–0.4	–4.2	–3.6	1.5	–0.6	2.1	0.0	–0.5	–0.7	0.9
2.8	2.6	0.2	–0.1	–0.2	–0.6	–0.7	2.9	2.9	–0.1	–0.1	–0.1	–3.2	–3.5
0.8	1.4	–0.7	–0.1	–0.3	–4.1	–5.1	1.1	1.1	–0.1	–0.1	–0.4	–0.2	–0.7
0.6	2.3	–1.7	–0.1	0.0	–1.9	–3.8	1.0	2.2	–1.3	–0.1	0.0	–0.6	–2.1
2.1	1.0	1.0	0.0	0.8	0.4	2.3	1.3	1.1	0.3	0.0	1.0	1.7	3.0
–0.1	1.7	–1.7	0.0	0.0	0.9	–0.9	0.0	1.8	–1.9	0.0	0.0	–1.9	–3.8
2.5	1.1	1.3	–0.1	–0.3	–0.2	0.8	3.1	1.0	2.1	–0.1	–0.3	2.4	4.1
2.6	0.6	2.0	0.0	–0.2	–3.4	–1.7	4.1	0.5	3.6	0.0	–0.4	–8.5	–5.2
1.2	1.6	–0.4	–0.1	0.0	–1.9	–2.4	1.9	1.5	0.4	–0.1	–0.1	–0.8	–0.6
–0.2	2.4	–2.7	–0.1	0.7	–2.4	–4.4	0.3	2.7	–2.5	–0.1	0.7	–2.1	–3.9
2.9	1.9	0.9	–0.1	–0.2	–0.3	0.3	2.9	1.6	1.3	–0.1	–0.2	0.3	1.3
1.6	1.7	–0.1	–0.1	–0.1	1.3	1.0	1.2	1.8	–0.6	–0.2	–0.1	–1.3	–2.1
1.0	–0.3	1.3	0.0	–0.2	–1.2	–0.1	1.1	–0.2	1.3	0.0	–0.2	3.0	4.1
0.6	0.3	0.3	–0.1	–0.7	–5.0	–5.5	0.8	0.0	0.8	–0.1	–0.6	–3.8	–3.7
2.3	1.8	0.4	–0.1	–0.4	–0.4	–0.4	3.1	1.3	1.8	–0.1	–0.4	1.2	2.5
1.8	0.0	1.8	0.0	–0.2	–2.1	–0.5	1.1	0.5	0.6	0.0	–0.2	–1.2	–0.9
0.3	3.0	–2.6	0.0	0.0	–3.1	–5.7	0.4	2.8	–2.4	0.0	0.0	–2.0	–4.4
1.2	0.3	0.9	–0.2	0.0	1.3	2.0	1.4	0.5	0.9	–0.2	0.0	2.4	3.1
2.7	1.5	1.2	–0.1	–0.5	0.4	1.0	2.7	1.4	1.3	–0.1	–0.5	–2.3	–1.5
0.7	1.7	–1.0	–0.1	1.2	–3.4	–3.2	1.2	1.5	–0.3	–0.1	1.1	–2.0	–1.2

IWI adjusted

	Country/Year	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj
		average growth rate (in percentage) 1991-1995							average growth rate (in percentage) 1996-2000						
37	Egypt	1.8	1.8	0.0	-0.2	-0.1	-1.0	-1.2	2.4	1.7	0.7	-0.2	-0.2	-1.2	-0.9
38	El Salvador	2.6	1.5	1.2	-0.1	-0.2	-2.8	-2.0	2.2	0.7	1.5	-0.1	-0.3	0.0	1.1
39	Estonia	-0.5	-1.7	1.2	0.0	-0.2	7.3	8.2	1.0	-1.0	1.9	0.0	-0.2	-4.8	-3.1
40	Fiji	2.7	1.3	1.4	-0.1	-0.2	0.5	1.6	0.8	0.9	-0.1	-0.1	-0.3	-1.8	-2.3
41	Finland	0.8	0.5	0.4	-0.1	-0.1	1.4	1.5	0.1	0.3	-0.2	-0.1	-0.1	-3.8	-4.3
42	France	1.5	0.4	1.1	-0.2	-0.1	0.3	1.2	1.7	0.4	1.3	-0.2	-0.1	-0.7	0.3
43	Gabon	0.5	3.2	-2.7	-0.1	0.8	-0.6	-2.7	0.6	2.6	-2.0	-0.1	0.8	2.5	1.3
44	Gambia	2.8	3.1	-0.3	-0.2	-0.3	-0.1	-1.0	1.8	2.9	-1.1	-0.2	-0.3	-2.5	-4.0
45	Germany	2.3	0.7	1.6	-0.2	-0.1	0.5	1.9	1.4	0.1	1.3	-0.2	-0.1	0.1	1.1
46	Ghana	1.4	2.8	-1.4	-0.2	-0.2	-1.4	-3.2	1.4	2.4	-1.1	-0.2	-0.2	-1.9	-3.4
47	Greece	1.4	1.0	0.4	-0.2	-0.2	0.6	0.6	1.2	0.6	0.6	-0.2	-0.3	-2.3	-2.1
48	Guatemala	2.4	2.3	0.0	-0.1	-0.1	-1.7	-1.9	2.7	2.3	0.3	-0.1	-0.2	-0.6	-0.6
49	Guyana	0.1	0.1	0.0	0.0	0.0	-4.1	-4.1	0.1	0.1	0.0	0.0	-0.1	0.0	-0.1
50	Haiti	2.9	2.0	0.9	-0.2	-0.2	5.5	6.0	2.9	1.9	1.1	-0.2	-0.3	-0.1	0.5
51	Honduras	0.9	2.7	-1.8	-0.1	-0.1	-0.4	-2.3	1.6	2.2	-0.6	-0.1	-0.2	0.5	-0.4
52	Hungary	1.5	-0.1	1.6	0.0	-0.2	3.9	5.2	1.0	-0.2	1.2	0.0	-0.2	-1.6	-0.6
53	Iceland	1.0	1.0	0.0	-0.1	-0.1	1.2	1.0	1.1	1.0	0.1	-0.1	-0.1	-2.6	-2.7
54	India	1.9	2.0	-0.1	-0.2	-0.1	-1.4	-1.8	2.4	1.8	0.7	-0.2	-0.2	-1.8	-1.5
55	Indonesia	1.1	1.6	-0.5	-0.1	0.0	-3.7	-4.3	1.5	1.4	0.1	-0.1	-0.1	2.8	2.7
56	Iran (Islamic Republic of)	0.6	1.7	-1.1	0.0	1.9	-1.0	-0.3	0.9	1.8	-0.9	0.0	2.2	-2.0	-0.7
57	Iraq	0.1	3.2	-3.0	0.0	4.1	33.7	34.8	0.0	3.3	-3.3	0.0	5.1	-18.5	-16.7
58	Ireland	1.6	0.4	1.1	-0.2	-0.1	-2.7	-1.9	3.3	1.0	2.3	-0.2	-0.2	-4.2	-2.3
59	Israel	4.8	3.5	1.3	0.0	-0.2	-1.7	-0.6	3.5	2.4	1.1	0.0	-0.3	-0.7	0.2
60	Italy	0.8	0.0	0.8	-0.2	-0.1	-1.0	-0.5	0.9	0.0	0.9	-0.2	-0.2	-1.6	-1.0
61	Jamaica	2.1	0.8	1.3	-0.1	-0.4	-0.1	0.7	1.4	1.0	0.4	-0.1	-0.6	1.7	1.4
62	Japan	2.0	0.4	1.6	0.0	-0.1	-0.3	1.2	1.3	0.2	1.1	0.0	-0.2	-0.3	0.6
63	Jordan	6.7	5.1	1.6	-0.1	-0.8	0.1	0.8	2.3	2.0	0.3	-0.1	-0.9	-0.8	-1.4
64	Kazakhstan*	0.1	-0.9	1.0	0.0	0.8	10.5	12.3	-0.4	-1.2	0.9	0.0	1.2	-2.0	0.0
65	Kenya	3.4	3.2	0.2	-0.2	-0.2	1.4	1.3	2.3	2.6	-0.4	-0.2	-0.3	0.4	-0.4
66	Kuwait	-0.5	-4.8	4.4	0.0	5.0	0.7	10.0	-0.1	3.6	-3.7	-0.1	6.2	1.6	4.1
67	Kyrgyzstan*	0.7	0.8	-0.1	-0.1	-0.6	18.0	17.1	0.8	1.5	-0.7	-0.1	-0.4	-3.4	-4.6
68	Lao People's Democratic Republic	0.0	2.7	-2.7	0.0	0.0	-1.2	-4.0	0.3	2.1	-1.8	0.0	0.0	1.9	0.0
69	Latvia	-0.9	-1.3	0.4	0.0	-0.3	13.2	13.4	0.4	-0.9	1.3	0.0	-0.3	-3.9	-3.0
70	Lesotho	3.4	1.8	1.6	-0.1	-0.1	1.8	3.2	3.0	1.8	1.1	-0.1	-0.1	0.3	1.3
71	Liberia	-0.7	-0.3	-0.4	0.0	-0.1	29.9	29.4	0.0	6.3	-6.3	0.0	-0.1	-21.6	-28.0
72	Lithuania*	-0.2	-0.5	0.3	0.0	-0.4	13.4	13.3	0.2	-0.7	0.9	0.0	-0.3	-3.7	-3.1

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
*** Data in this category are average annual changes expressed as a percentage in wealth.

IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj	IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj
average growth rate (in percentage) 2001-2005							average growth rate (in percentage) 2006-2010						
2.3	1.9	0.4	-0.1	-0.3	0.0	-0.1	3.3	1.8	1.5	-0.2	-0.6	-0.3	0.5
2.5	0.4	2.1	-0.1	-0.4	0.6	2.3	2.0	0.5	1.5	-0.1	-0.4	0.8	1.8
1.6	-0.4	1.9	0.0	-0.2	-3.3	-1.6	1.8	-0.1	1.8	0.0	-0.2	3.5	5.0
1.3	0.3	1.0	-0.1	-0.6	0.2	0.5	1.5	0.9	0.6	-0.1	-0.6	2.2	2.1
2.0	0.3	1.7	-0.1	-0.1	-0.4	1.0	1.3	0.5	0.9	-0.2	-0.1	0.6	1.1
1.7	0.7	1.0	-0.2	-0.1	0.7	1.4	1.6	0.6	1.0	-0.2	-0.1	1.5	2.2
0.7	2.1	-1.4	-0.1	0.8	-0.3	-0.9	1.1	1.9	-0.8	-0.1	0.8	-0.8	-0.8
3.6	3.0	0.6	-0.2	-0.4	5.6	5.7	3.7	2.8	0.9	-0.2	-0.5	5.3	5.6
2.4	0.0	2.4	-0.2	-0.1	1.0	3.1	0.5	-0.1	0.6	-0.2	-0.1	0.0	0.3
1.7	2.5	-0.8	-0.2	-0.3	-2.8	-4.0	2.6	2.4	0.2	-0.2	-0.4	-2.6	-3.0
1.5	0.4	1.1	-0.2	-0.3	-2.2	-1.6	2.2	0.3	1.9	-0.2	-0.3	1.2	2.6
2.5	2.5	0.0	-0.1	-0.2	-0.1	-0.4	3.2	2.5	0.7	-0.1	-0.2	-0.9	-0.6
0.1	0.4	-0.3	0.0	-0.1	0.7	0.3	0.2	0.2	0.0	0.0	-0.1	-1.4	-1.5
2.3	1.6	0.7	-0.2	-0.4	3.2	3.3	2.5	1.3	1.1	-0.2	-0.4	1.4	1.9
1.4	2.0	-0.6	-0.1	-0.3	-2.0	-3.0	2.5	2.0	0.5	-0.1	-0.3	0.1	0.1
1.5	-0.2	1.7	0.0	-0.2	-1.8	-0.3	0.5	-0.2	0.7	0.0	-0.2	1.9	2.4
1.7	1.1	0.6	-0.1	-0.1	-1.3	-0.9	0.9	1.5	-0.6	-0.1	-0.1	1.9	1.0
2.5	1.6	0.9	-0.2	-0.2	-1.9	-1.4	3.0	1.4	1.6	-0.2	-0.3	-0.7	0.5
1.1	1.3	-0.2	-0.1	-0.2	-2.1	-2.6	1.5	1.1	0.4	-0.1	-0.3	-1.7	-1.7
1.2	1.3	-0.1	0.0	2.6	-3.1	-0.7	0.4	1.2	-0.8	0.0	2.9	-0.5	1.6
0.0	2.8	-2.8	0.0	6.4	6.2	9.8	0.2	3.0	-2.8	0.0	7.8	0.6	5.5
3.9	1.8	2.1	-0.2	-0.2	0.3	2.1	2.0	1.5	0.6	-0.2	-0.2	3.6	3.9
2.3	1.9	0.4	0.0	-0.2	0.4	0.6	3.1	2.4	0.7	0.0	-0.2	-0.7	-0.2
1.7	0.6	1.1	-0.2	-0.1	1.0	1.7	1.1	0.6	0.5	-0.2	-0.1	1.9	2.0
1.2	0.8	0.4	-0.1	-0.6	0.5	0.2	1.0	0.4	0.5	-0.1	-0.6	1.4	1.3
0.7	0.1	0.6	0.0	-0.1	-1.0	-0.6	0.4	0.0	0.3	0.0	-0.1	0.0	0.1
2.3	2.0	0.2	-0.1	-0.9	-3.6	-4.4	3.7	3.0	0.7	-0.1	-0.8	-2.2	-2.5
0.1	0.3	-0.2	0.0	1.5	-8.6	-7.4	0.8	1.1	-0.3	0.0	1.7	-4.8	-3.4
3.1	2.6	0.4	-0.1	-0.3	-1.0	-1.0	3.2	2.6	0.5	-0.1	-0.3	0.4	0.5
0.1	3.1	-3.1	-0.1	7.7	-3.6	0.9	0.4	3.9	-3.5	-0.1	9.2	2.2	7.9
0.5	0.4	0.1	-0.1	-0.4	-2.8	-3.2	2.4	1.1	1.3	-0.1	-0.8	-2.2	-1.9
0.4	1.6	-1.2	0.0	0.0	3.3	2.1	1.1	1.5	-0.4	0.0	0.0	0.3	-0.1
2.5	-0.7	3.1	0.0	-0.3	-3.6	-0.7	1.5	-0.5	2.0	0.0	-0.3	4.1	5.7
1.3	1.0	0.2	-0.1	-0.1	-1.5	-1.5	1.6	1.0	0.6	-0.1	-0.1	-1.9	-1.5
-0.3	2.3	-2.6	0.0	-0.1	6.5	3.8	0.5	4.6	-4.2	0.0	-0.2	-3.5	-7.9
1.5	-0.5	1.9	0.0	-0.3	-5.2	-3.6	1.3	-0.5	1.8	0.0	-0.3	1.9	3.4

IWI adjusted

		IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj	IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj
	Country/Year	**average growth rate (in percentage) 1991–1995**							**average growth rate (in percentage) 1996–2000**						
73	Luxembourg	2.1	1.3	0.7	-0.3	-0.3	-1.5	-1.3	2.9	1.3	1.6	-0.3	-0.3	-2.8	-1.7
74	Malawi	0.0	1.1	-1.0	-0.1	-0.1	0.0	-1.3	0.7	2.6	-1.9	-0.1	-0.1	-1.4	-3.6
75	Malaysia	3.7	2.6	1.1	-0.1	0.0	-2.4	-1.4	2.9	2.5	0.4	-0.1	-0.1	0.2	0.4
76	Maldives	4.6	2.5	2.0	-0.2	-0.3	1.5	3.1	5.3	1.9	3.4	-0.1	-0.4	0.0	2.8
77	Mali	1.0	2.5	-1.5	-0.1	0.0	-1.8	-3.4	1.2	2.8	-1.6	-0.1	0.0	-1.3	-3.1
78	Malta	2.2	1.0	1.2	-0.1	-0.3	-0.3	0.4	2.8	0.6	2.2	-0.1	-0.4	0.1	1.7
79	Mauritania	2.6	2.8	-0.2	-0.1	-0.6	-2.9	-3.9	2.3	2.9	-0.6	-0.1	-0.7	-2.9	-4.3
80	Mauritius	2.0	1.4	0.6	-0.1	-0.3	0.8	0.9	1.9	1.0	0.9	-0.1	-0.4	-1.6	-1.2
81	Mexico	2.3	1.8	0.5	-0.1	-0.3	1.3	1.4	2.2	1.6	0.6	-0.1	-0.3	-2.4	-2.2
82	Mongolia	-0.5	1.0	-1.5	0.0	-0.1	4.3	2.7	0.6	0.9	-0.3	0.0	-0.1	-0.9	-1.3
83	Morocco	3.0	1.7	1.3	-0.1	-0.2	2.2	3.2	2.0	1.3	0.7	-0.1	-0.3	-0.8	-0.5
84	Mozambique	0.1	3.3	-3.2	0.0	0.0	0.0	-3.3	0.2	2.7	-2.5	0.0	0.0	-4.1	-6.6
85	Myanmar	-0.6	1.4	-2.0	0.0	0.0	-0.9	-2.9	-0.6	1.3	-1.9	0.0	-0.1	-2.3	-4.3
86	Namibia	1.4	3.1	-1.7	0.0	-0.1	-2.3	-4.1	1.2	2.8	-1.6	0.0	-0.1	-1.2	-2.8
87	Nepal	-0.3	2.5	-2.8	-0.1	-0.1	-2.7	-5.6	0.3	2.5	-2.2	-0.1	-0.1	-2.2	-4.6
88	Netherlands	1.4	0.7	0.7	-0.2	-0.2	-0.8	-0.4	1.5	0.6	1.0	-0.2	-0.2	-1.4	-0.8
89	New Zealand	1.5	1.6	-0.1	0.0	-0.1	-1.1	-1.3	1.6	1.0	0.7	0.0	-0.2	-1.3	-0.8
90	Nicaragua	0.7	2.4	-1.7	-0.1	-0.2	0.3	-1.7	1.6	1.8	-0.2	-0.1	-0.3	-1.9	-2.5
91	Niger	1.6	3.3	-1.8	-0.1	-0.1	0.1	-2.0	2.1	3.5	-1.4	-0.1	-0.1	-2.1	-3.8
92	Nigeria	0.2	2.4	-2.2	-0.1	1.6	0.2	-0.5	0.3	2.4	-2.1	-0.1	1.9	-2.8	-3.1
93	Norway	0.5	0.5	-0.1	-0.2	0.5	-2.7	-2.5	0.8	0.6	0.2	-0.2	0.4	-2.0	-1.6
94	Pakistan	3.1	2.6	0.5	-0.1	-0.3	-0.7	-0.6	2.8	2.6	0.3	-0.1	-0.3	-0.2	-0.4
95	Panama	2.8	2.1	0.7	-0.1	-0.7	-1.4	-1.5	2.1	2.0	0.1	-0.1	-0.7	-0.9	-1.6
96	Papua New Guinea	-0.3	2.6	-2.9	0.0	0.0	-5.6	-8.5	-0.3	2.7	-3.0	0.0	0.0	2.1	-0.9
97	Paraguay	0.8	2.5	-1.7	0.0	-0.1	-0.5	-2.3	1.1	2.2	-1.1	0.0	-0.1	2.0	0.7
98	Peru	0.6	1.9	-1.3	0.0	-0.1	-3.6	-5.0	1.1	1.7	-0.6	0.0	-0.1	-0.2	-0.9
99	Philippines	2.6	2.4	0.2	-0.2	-0.4	0.7	0.4	3.0	2.2	0.7	-0.1	-0.5	-0.1	0.0
100	Poland	1.1	0.2	0.9	0.0	-0.1	-0.3	0.4	1.3	0.0	1.4	0.0	-0.1	-1.2	-0.1
101	Portugal	1.5	0.4	1.1	-0.1	-0.1	0.6	1.4	1.9	0.4	1.5	-0.1	-0.2	-1.0	0.2
102	Qatar	0.2	1.1	-1.0	-0.1	3.4	-1.0	1.4	0.6	3.3	-2.8	-0.1	4.1	-7.2	-5.9
103	Republic of Korea	4.0	0.8	3.2	-0.2	-0.4	-0.1	2.6	3.0	0.6	2.4	-0.1	-0.4	0.3	2.2
104	Republic of Moldova	-0.6	-0.1	-0.5	0.0	-0.5	22.4	21.3	-1.2	-1.1	-0.1	0.0	-0.3	2.5	2.2
105	Romania	0.6	-0.5	1.1	0.0	-0.2	3.1	3.9	0.7	-0.4	1.2	0.0	-0.2	1.3	2.2
106	Russian Federation*	-0.2	0.0	-0.2	0.0	0.1	8.2	8.1	0.0	-0.3	0.3	0.0	0.2	-0.3	0.1
107	Rwanda	-3.5	-4.7	1.2	-0.2	-0.3	14.7	15.4	7.4	7.8	-0.4	-0.2	-0.3	-6.5	-7.4
108	Saudi Arabia	1.6	2.8	-1.2	-0.1	2.9	0.2	1.9	0.4	1.6	-1.2	-0.1	3.3	-1.0	1.1

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
*** Data in this category are average annual changes expressed as a percentage in wealth.

IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj	IWI	Popu-lation	IWI per capita	Carbon dama-ges***	Oil capital gains***	TFP	IWI adj
average growth rate (in percentage) 2001–2005							average growth rate (in percentage) 2006–2010						
3.0	1.0	2.0	–0.2	–0.3	–0.4	1.0	3.9	2.1	1.8	–0.2	–0.3	1.9	3.1
1.2	2.7	–1.5	–0.1	–0.2	–1.0	–2.8	2.2	3.0	–0.8	–0.1	–0.2	–2.9	–4.0
1.9	2.2	–0.3	–0.1	–0.1	–1.6	–2.0	2.3	1.7	0.6	–0.1	–0.2	–1.0	–0.7
4.9	1.6	3.3	–0.1	–0.8	4.4	6.8	5.7	1.4	4.3	–0.1	–0.8	3.6	7.0
1.1	3.1	–2.0	–0.1	0.0	–3.7	–5.9	1.7	3.1	–1.4	–0.1	0.0	–1.6	–3.1
2.2	0.6	1.6	–0.1	–0.4	2.7	3.8	2.0	0.4	1.6	–0.1	–0.6	0.4	1.2
4.1	2.9	1.2	–0.1	–0.6	1.2	1.6	3.4	2.6	0.8	–0.1	–0.4	2.0	2.3
2.7	1.0	1.7	–0.1	–0.5	0.9	2.0	2.7	0.7	2.0	–0.1	–0.5	0.0	1.4
2.7	1.3	1.4	–0.1	–0.3	1.3	2.3	2.5	1.3	1.2	–0.1	–0.3	1.4	2.1
–1.1	1.1	–2.2	0.0	–0.1	–4.1	–6.4	0.7	1.6	–0.9	0.0	–0.1	0.3	–0.7
2.4	1.1	1.3	–0.1	–0.3	–1.3	–0.3	2.2	1.0	1.2	–0.1	–0.4	–0.3	0.5
0.4	2.7	–2.3	0.0	–0.1	–3.5	–5.9	0.5	2.4	–1.9	–0.1	–0.1	–2.0	–4.0
–0.3	0.6	–0.9	0.0	–0.1	–2.4	–3.5	0.2	0.7	–0.5	–0.1	–0.2	1.8	1.2
1.8	1.9	–0.1	0.0	–0.1	–2.5	–2.8	2.1	1.9	0.2	0.0	–0.2	–0.3	–0.3
1.0	2.3	–1.2	–0.1	–0.1	–0.7	–2.2	1.7	1.9	–0.2	–0.1	–0.2	–0.9	–1.4
1.5	0.6	0.9	–0.2	–0.2	1.0	1.5	1.5	0.4	1.1	–0.2	–0.2	0.7	1.4
2.1	1.4	0.7	0.0	–0.2	–0.7	–0.2	1.8	1.1	0.7	0.0	–0.2	1.0	1.5
1.1	1.3	–0.3	–0.1	–0.4	–1.2	–2.0	1.0	1.3	–0.4	–0.1	–0.5	–1.4	–2.2
2.4	3.5	–1.1	–0.1	–0.1	–3.0	–4.3	3.6	3.6	0.0	–0.1	–0.1	–1.1	–1.3
0.8	2.5	–1.7	–0.1	2.2	–8.7	–8.3	1.2	2.5	–1.4	–0.1	2.5	–0.3	0.7
1.3	0.6	0.7	–0.2	0.3	–0.4	0.5	1.5	1.1	0.4	–0.2	0.2	1.2	1.7
3.0	1.9	1.1	–0.1	–0.3	–2.4	–1.7	2.6	1.8	0.8	–0.1	–0.3	–0.7	–0.3
2.4	1.8	0.6	–0.1	–0.7	–1.4	–1.6	2.8	1.7	1.1	–0.1	–0.8	–1.7	–1.5
–0.2	2.5	–2.7	0.0	–0.1	1.5	–1.3	–0.1	2.4	–2.5	0.0	–0.1	–2.5	–5.2
0.8	2.0	–1.2	0.0	–0.2	–1.5	–2.9	1.2	1.8	–0.6	0.0	–0.2	–3.5	–4.3
0.5	1.3	–0.8	0.0	–0.1	–3.0	–3.9	1.4	1.1	0.3	0.0	–0.1	–2.8	–2.7
2.2	2.0	0.1	–0.1	–0.5	–1.8	–2.3	2.7	1.7	0.9	–0.1	–0.4	–1.9	–1.5
0.7	–0.1	0.7	0.0	–0.2	–0.4	0.1	1.5	0.1	1.5	0.0	–0.2	–0.8	0.4
1.1	0.4	0.7	–0.1	–0.2	2.0	2.4	1.0	0.2	0.8	–0.1	–0.2	1.2	1.7
2.6	6.9	–4.3	–0.1	4.7	–0.9	–0.6	8.2	16.5	–8.3	–0.1	4.2	–4.0	–8.3
2.6	0.5	2.1	–0.1	–0.4	–0.7	0.9	2.2	0.5	1.7	–0.1	–0.4	–2.5	–1.3
–1.4	–1.7	0.3	0.0	–0.3	–7.8	–7.8	–1.5	–1.1	–0.4	0.0	–0.4	–5.8	–6.7
–0.2	–0.4	0.1	0.0	–0.2	–4.4	–4.5	1.5	–0.3	1.7	0.0	–0.2	0.4	1.8
–0.1	–0.4	0.4	0.0	0.2	–5.6	–5.1	0.0	–0.1	0.1	0.0	0.2	–2.3	–2.0
3.0	2.6	0.4	–0.2	–0.2	–3.4	–3.4	4.3	2.9	1.4	–0.2	–0.2	–0.4	0.6
1.4	3.7	–2.3	–0.1	3.8	–0.9	0.5	1,83	2,69	–0,86	–0,06	4,12	2,01	5,22

IWI adjusted

		IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj
	Country/Year	average growth rate (in percentage) 1991–1995							average growth rate (in percentage) 1996–2000						
109	Senegal	1.1	2.9	−1.9	−0.1	−0.2	0.9	−1.3	1.6	2.6	−1.0	−0.1	−0.3	−1.6	−3.0
110	Serbia	1.9	1.3	0.7	0.0	0.0	17.3	18.0	0.2	−0.1	0.3	0.0	0.0	−1.2	−0.9
111	Sierra Leone	−0.6	−0.4	−0.2	−0.1	−0.2	5.2	4.7	0.4	1.2	−0.8	−0.1	−0.2	10.7	9.5
112	Singapore	4.5	2.9	1.6	0.0	−0.9	−4.4	−3.7	4.9	2.4	2.5	0.0	−1.1	−1.6	−0.2
113	Slovakia**	1.1	0.3	0.8	0.0	−0.2	−3.4	−2.8	1.2	0.1	1.0	0.0	−0.2	−2.7	−1.9
114	Slovenia*	2.3	0.4	1.9	0.0	−0.1	0.4	2.1	1.5	0.2	1.3	0.0	−0.2	−1.7	−0.6
115	South Africa	2.9	2.4	0.5	−0.1	−0.2	2.2	2.4	0.7	1.6	−0.8	−0.1	−0.2	−1.5	−2.6
116	Spain	2.9	0.3	2.6	−0.2	−0.1	1.3	3.6	2.7	0.4	2.2	−0.2	−0.2	−0.9	1.0
117	Sri Lanka	2.1	1.0	1.0	−0.1	−0.2	−2.1	−1.3	2.7	0.6	2.2	−0.1	−0.3	−1.1	0.7
118	Sudan (former)	0.0	2.6	−2.6	−0.1	0.5	−1.8	−4.1	0.5	2.6	−2.1	−0.1	0.6	−0.6	−2.2
119	Swaziland	3.4	2.2	1.2	−0.1	−0.1	0.7	1.6	2.1	2.0	0.1	−0.1	−0.1	−1.3	−1.3
120	Sweden	0.6	0.6	0.0	−0.2	−0.1	0.2	−0.1	0.7	0.1	0.7	−0.2	−0.1	−2.0	−1.7
121	Switzerland	0.9	1.0	−0.1	−0.2	−0.1	1.0	0.6	0.7	0.4	0.3	−0.2	−0.1	−0.5	−0.5
122	Syrian Arab Republic	2.5	2.8	−0.3	−0.1	−0.1	−4.4	−4.9	2.2	2.4	−0.2	−0.1	−0.2	−1.0	−1.6
123	Tajikistan*	0.1	1.6	−1.5	−0.1	−0.6	26.5	24.2	−0.2	1.3	−1.6	−0.1	−0.8	2.1	−0.5
124	Thailand	3.2	0.9	2.3	−0.1	−0.4	−5.4	−3.6	2.0	1.1	0.8	−0.1	−0.5	1.2	1.4
125	Togo	0.8	2.2	−1.4	−0.1	−0.1	1.6	−0.1	2.5	3.2	−0.7	−0.1	−0.2	−0.8	−1.8
126	Trinidad and Tobago	0.1	0.7	−0.6	−0.1	0.3	−0.1	−0.5	0.8	0.5	0.3	−0.1	0.4	−4.9	−4.3
127	Tunisia	2.6	1.7	0.9	−0.1	−0.1	−1.1	−0.4	2.4	1.1	1.2	−0.1	−0.1	−2.7	−1.7
128	Turkey	2.9	1.7	1.2	−0.1	−0.2	1.3	2.2	2.1	1.6	0.5	−0.1	−0.2	−0.4	−0.2
129	Uganda	1.8	3.3	−1.6	−0.3	−0.1	−4.2	−6.1	2.6	3.1	−0.5	−0.2	−0.1	−2.3	−3.2
130	Ukraine*	0.5	−0.3	0.7	0.0	−0.3	19.3	19.6	−0.9	−0.9	0.0	0.0	−0.2	1.6	1.3
131	United Arab Emirates	2.3	5.4	−3.1	−0.1	3.0	1.6	1.5	2.6	5.3	−2.6	−0.1	3.3	−1.6	−1.0
132	United Kingdom	0.3	0.3	0.1	−0.2	−0.1	−1.1	−1.2	1.4	0.3	1.1	−0.2	−0.1	−1.9	−1.1
133	United Republic of Tanzania	0.3	3.3	−3.0	−0.1	−0.1	−0.4	−3.6	0.0	2.6	−2.6	−0.1	−0.1	−3.0	−5.8
134	United States of America	1.2	1.0	0.2	0.0	−0.2	−0.5	−0.5	1.9	1.2	0.7	0.0	−0.2	−1.1	−0.6
135	Uruguay	1.0	0.7	0.3	−0.1	−0.2	−2.4	−2.3	1.7	0.6	1.1	−0.1	−0.2	0.4	1.2
136	Venezuela (Bolivarian Republic of)	0.6	2.3	−1.7	0.0	1.8	−1.3	−1.2	0.8	2.0	−1.2	0.0	2.2	1.2	2.1
137	Vietnam	2.5	2.0	0.6	−0.1	0.0	−0.9	−0.5	3.7	1.3	2.5	−0.1	−0.1	1.0	3.2
138	Yemen	3.2	4.9	−1.7	−0.1	0.6	−1.6	−2.8	3.5	3.2	0.3	−0.1	0.5	−3.3	−2.5
139	Zambia	−0.1	2.6	−2.6	0.0	0.0	1.6	−1.1	0.1	2.7	−2.6	0.0	0.0	0.4	−2.2
140	Zimbabwe	0.2	2.2	−2.0	−0.1	−0.2	0.9	−1.4	−0.1	1.4	−1.5	−0.1	−0.2	1.4	−0.4

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.
*** Data in this category are average annual changes expressed as a percentage in wealth.

IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj	IWI	Population	IWI per capita	Carbon damages***	Oil capital gains***	TFP	IWI adj
average growth rate (in percentage) 2001–2005							average growth rate (in percentage) 2006–2010						
1.6	2.7	–1.1	–0.1	–0.4	–1.4	–3.0	2.5	2.7	–0.2	–0.1	–0.4	0.7	–0.1
0.3	–0.6	0.8	0.0	0.0	–3.1	–2.3	1.1	0.0	1.1	0.0	–0.2	1.1	1.9
2.9	4.5	–1.6	–0.1	–0.3	–9.3	–11.3	1.6	2.6	–1.0	–0.1	–0.3	–1.9	–3.3
3.5	1.7	1.8	0.0	–1.1	–2.4	–1.7	5.4	3.6	1.8	0.0	–1.4	–3.2	–2.7
1.5	0.0	1.5	0.0	–0.2	–3.0	–1.8	1.3	0.2	1.2	0.0	–0.2	–2.3	–1.4
1.7	0.2	1.5	0.0	–0.2	–0.2	1.1	1.1	0.3	0.8	0.0	–0.2	1.5	2.1
1.9	1.3	0.6	–0.1	–0.2	–1.6	–1.3	1.1	1.0	0.2	–0.1	–0.2	0.5	0.3
2.7	1.5	1.2	–0.1	–0.2	0.6	1.5	2.8	1.2	1.6	–0.1	–0.2	2.4	3.7
1.3	1.1	0.2	–0.1	–0.3	–0.4	–0.6	2.4	1.0	1.4	–0.1	–0.3	–1.6	–0.6
1.3	2.4	–1.0	–0.1	0.6	2.9	2.3	1.8	2.5	–0.8	–0.1	0.5	0.0	–0.3
1.2	0.8	0.4	–0.1	–0.1	–3.0	–2.8	1.0	1.4	–0.4	–0.1	–0.1	–2.8	–3.4
1.3	0.4	0.9	–0.2	–0.1	–0.6	0.1	1.7	0.8	0.9	–0.2	–0.1	1.1	1.7
1.3	0.7	0.6	–0.2	–0.1	0.6	0.9	1.6	0.7	1.0	–0.2	–0.1	0.0	0.7
2.0	2.9	–1.0	–0.1	–0.3	–1.9	–3.3	2.3	2.0	0.3	–0.1	–0.5	–1.0	–1.3
0.3	0.9	–0.6	–0.1	–1.3	–6.9	–8.9	0.6	1.3	–0.7	–0.1	–1.3	–4.6	–6.7
1.7	1.1	0.6	–0.1	–0.6	–3.0	–3.0	2.0	0.7	1.3	–0.1	–0.7	–1.7	–1.3
2.3	2.4	–0.2	–0.1	–0.4	–0.6	–1.2	2.0	2.2	–0.2	–0.1	–0.4	–1.6	–2.3
0.9	0.4	0.5	–0.1	0.3	–5.7	–5.0	–0.7	0.4	–1.1	–0.1	0.2	–3.7	–4.7
2.0	0.9	1.0	–0.1	–0.2	–1.5	–0.8	2.6	1.1	1.4	–0.1	–0.2	–1.7	–0.5
1.9	1.4	0.5	–0.1	–0.2	–1.1	–0.9	2.8	1.3	1.5	–0.1	–0.2	0.8	2.0
2.9	3.3	–0.4	–0.2	–0.2	–1.9	–2.8	4.4	3.3	1.1	–0.2	–0.3	0.4	1.1
–0.4	–0.8	0.5	0.0	–0.2	–7.2	–7.0	–0.1	–0.6	0.5	0.0	–0.2	–0.8	–0.6
3.7	6.1	–2.4	–0.1	3.6	–1.5	–0.4	8.4	13.1	–4.7	–0.1	3.2	2.8	1.2
1.9	0.4	1.4	–0.2	–0.1	–0.6	0.6	1.5	0.6	0.9	–0.2	–0.1	1.7	2.3
0.5	2.7	–2.1	–0.1	–0.1	–4.5	–6.9	1.3	2.9	–1.7	–0.1	–0.2	–5.0	–7.0
2.0	1.0	1.0	0.0	–0.2	1.1	1.8	1.5	0.9	0.6	0.0	–0.2	1.5	1.8
0.2	0.0	0.2	–0.1	–0.2	0.7	0.6	1.6	0.3	1.3	–0.1	–0.3	–2.8	–1.9
0.8	1.8	–1.0	0.0	2.5	–1.2	0.2	1.1	1.7	–0.6	0.0	2.9	–0.9	1.4
3.3	1.1	2.2	–0.1	–0.3	–0.2	1.6	3.6	1.1	2.5	–0.1	–0.5	1.2	3.1
3.0	3.1	–0.1	–0.1	0.3	–1.2	–1.1	2.9	3.1	–0.2	–0.1	0.2	–2.0	–2.1
0.3	2.4	–2.1	0.0	0.0	0.1	–2.1	0.5	2.7	–2.2	0.0	–0.1	–0.3	–2.6
0.1	0.1	0.0	–0.1	–0.2	6.3	6.0	–1.0	0.0	–1.0	–0.1	–0.1	–2.0	–3.3

Population

	Country/Year	Population in thousands 1990	1995	2000	2005	2010	Population change percentage change with respect to the base year, 1990 1995	2000	2005	2010
1	Afghanistan	13,032	19,790	22,856	27,615	31,412	52	75	112	141
2	Albania	3,289	3,141	3,072	3,142	3,204	–5	–7	–4	–3
3	Algeria	25,299	28,292	30,534	32,888	35,468	12	21	30	40
4	Argentina	32,642	34,855	36,931	38,681	40,412	7	13	18	24
5	Armenia	3,545	3,223	3,076	3,066	3,092	–9	–13	–14	–13
6	Australia	17,096	18,118	19,164	20,404	22,268	6	12	19	30
7	Austria	7,671	7,936	8,005	8,232	8,394	3	4	7	9
8	Bahrain	493	559	638	725	1,262	13	29	47	156
9	Bangladesh	105,256	117,487	129,592	140,588	148,692	12	23	34	41
10	Barbados	260	263	268	271	273	2	3	4	5
11	Belgium	9,949	10,080	10,176	10,414	10,712	1	2	5	8
12	Belize	190	220	251	281	312	16	32	48	64
13	Benin	4,773	5,651	6,518	7,634	8,850	18	37	60	85
14	Bolivia (Plurinational State of)	6,658	7,471	8,307	9,147	9,930	12	25	37	49
15	Botswana	1,382	1,586	1,758	1,876	2,007	15	27	36	45
16	Brazil	149,650	161,848	174,425	185,987	194,946	8	17	24	30
17	Bulgaria	8,819	8,357	8,006	7,739	7,494	–5	–9	–12	–15
18	Burundi	5,602	6,087	6,374	7,251	8,383	9	14	29	50
19	Cambodia	9,532	11,169	12,447	13,358	14,138	17	31	40	48
20	Cameroon	12,181	13,940	15,678	17,554	19,599	14	29	44	61
21	Canada	27,701	29,302	30,667	32,283	34,017	6	11	17	23
22	Central African Republic	2,935	3,328	3,702	4,018	4,401	13	26	37	50
23	Chile	13,188	14,409	15,420	16,302	17,114	9	17	24	30
24	China	1,145,195	1,213,987	1,269,117	1,307,593	1,341,335	6	11	14	17
25	Colombia	33,203	36,453	39,764	43,041	46,295	10	20	30	39
26	Congo	2,389	2,733	3,136	3,533	4,043	14	31	48	69
27	Costa Rica	3,070	3,469	3,919	4,309	4,659	13	28	40	52
28	Côte d'Ivoire	12,518	14,677	16,582	18,021	19,738	17	32	44	58
29	Croatia*	4,548	4,669	4,506	4,442	4,403	3	–1	–2	–3
30	Cuba	10,570	10,901	11,104	11,254	11,258	3	5	6	7
31	Cyprus	767	855	943	1,033	1,104	12	23	35	44
32	Czech Republic**	10,314	10,319	10,243	10,221	10,493	0	–1	–1	2
33	Democratic Republic of the Congo	36,406	44,067	49,626	57,421	65,966	21	36	58	81
34	Denmark	5,141	5,233	5,340	5,419	5,550	2	4	5	8
35	Dominican Republic	7,195	7,916	8,592	9,264	9,927	10	19	29	38
36	Ecuador	10,261	11,385	12,345	13,426	14,465	11	20	31	41

* Data for this country are available from 1991, thus all data refer to 1991 instead of 1990.
** Data for this country are available from 1992, thus all data refer to 1992 instead of 1990.

	Country/Year	1990	1995	2000	2005	2010	1995	2000	2005	2010
					Population in thousands		Population change percentage change with respect to the base year, 1990			
37	Egypt	56,843	62,064	67,648	74,203	81,121	9	19	31	43
38	El Salvador	5,333	5,733	5,940	6,051	6,193	8	11	13	16
39	Estonia	1,568	1,441	1,371	1,346	1,341	−8	−13	−14	−14
40	Fiji	728	776	812	823	861	6	11	13	18
41	Finland	4,986	5,108	5,173	5,244	5,365	2	4	5	8
42	France	56,708	57,845	59,048	60,997	62,787	2	4	8	11
43	Gabon	929	1,087	1,235	1,371	1,505	17	33	48	62
44	Gambia	966	1,126	1,297	1,504	1,728	17	34	56	79
45	Germany	79,098	81,929	82,349	82,541	82,302	4	4	4	4
46	Ghana	14,793	16,997	19,165	21,640	24,392	15	30	46	65
47	Greece	10,161	10,672	10,987	11,183	11,359	5	8	10	12
48	Guatemala	8,923	10,016	11,237	12,717	14,389	12	26	43	61
49	Guyana	725	728	733	746	754	0	1	3	4
50	Haiti	7,125	7,878	8,645	9,347	9,993	11	21	31	40
51	Honduras	4,889	5,575	6,218	6,879	7,601	14	27	41	55
52	Hungary	10,376	10,331	10,211	10,087	9,984	0	−2	−3	−4
53	Iceland	255	267	281	297	320	5	10	16	26
54	India	873,785	964,486	1,053,898	1,140,043	1,224,614	10	21	30	40
55	Indonesia	184,346	199,400	213,395	227,303	239,871	8	16	23	30
56	Iran (Islamic Republic of)	54,871	59,757	65,342	69,732	73,974	9	19	27	35
57	Iraq	17,374	20,288	23,857	27,359	31,672	17	37	57	82
58	Ireland	3,531	3,611	3,804	4,158	4,470	2	8	18	27
59	Israel	4,500	5,332	6,015	6,605	7,418	18	34	47	65
60	Italy	56,832	56,968	56,986	58,671	60,551	0	0	3	7
61	Jamaica	2,365	2,462	2,582	2,682	2,741	4	9	13	16
62	Japan	122,251	124,487	125,720	126,393	126,536	2	3	3	4
63	Jordan	3,416	4,382	4,827	5,342	6,187	28	41	56	81
64	Kazakhstan*	16,513	15,926	14,957	15,172	16,026	−4	−9	−8	−3
65	Kenya	23,447	27,426	31,254	35,615	40,513	17	33	52	73
66	Kuwait	2,088	1,628	1,941	2,264	2,737	−22	−7	8	31
67	Kyrgyzstan*	4,442	4,592	4,955	5,042	5,334	3	12	14	20
68	Lao People's Democratic Republic	4,192	4,795	5,317	5,753	6,201	14	27	37	48
69	Latvia	2,664	2,492	2,385	2,306	2,252	−6	−10	−13	−15
70	Lesotho	1,639	1,795	1,964	2,066	2,171	9	20	26	32
71	Liberia	2,127	2,095	2,847	3,183	3,994	−2	34	50	88
72	Lithuania*	3,698	3,629	3,500	3,416	3,324	−2	−5	−8	−10

Population

		Population in thousands					Population change percentage change with respect to the base year, 1990			
	Country/Year	1990	1995	2000	2005	2010	1995	2000	2005	2010
73	Luxembourg	381	408	435	457	507	7	14	20	33
74	Malawi	9,381	9,883	11,229	12,823	14,901	5	20	37	59
75	Malaysia	18,209	20,721	23,415	26,100	28,401	14	29	43	56
76	Maldives	219	249	273	295	316	13	24	35	44
77	Mali	8,673	9,825	11,295	13,177	15,370	13	30	52	77
78	Malta	368	387	397	409	417	5	8	11	13
79	Mauritania	1,996	2,292	2,643	3,047	3,460	15	32	53	73
80	Mauritius	1,060	1,137	1,196	1,257	1,299	7	13	19	23
81	Mexico	84,307	92,273	99,960	106,484	113,423	9	19	26	35
82	Mongolia	2,193	2,306	2,411	2,547	2,756	5	10	16	26
83	Morocco	24,781	26,929	28,793	30,392	31,951	9	16	23	29
84	Mozambique	13,547	15,933	18,201	20,770	23,391	18	34	53	73
85	Myanmar	39,268	42,133	44,958	46,321	47,963	7	14	18	22
86	Namibia	1,415	1,651	1,896	2,080	2,283	17	34	47	61
87	Nepal	19,081	21,595	24,401	27,282	29,959	13	28	43	57
88	Netherlands	14,892	15,422	15,863	16,305	16,613	4	7	9	12
89	New Zealand	3,398	3,675	3,858	4,134	4,368	8	14	22	29
90	Nicaragua	4,121	4,637	5,074	5,424	5,788	13	23	32	40
91	Niger	7,788	9,179	10,922	12,994	15,512	18	40	67	99
92	Nigeria	97,552	110,015	123,689	139,823	158,423	13	27	43	62
93	Norway	4,241	4,359	4,491	4,623	4,883	3	6	9	15
94	Pakistan	111,845	127,347	144,522	158,645	173,593	14	29	42	55
95	Panama	2,416	2,677	2,956	3,238	3,517	11	22	34	46
96	Papua New Guinea	4,158	4,716	5,379	6,095	6,858	13	29	47	65
97	Paraguay	4,244	4,795	5,344	5,898	6,455	13	26	39	52
98	Peru	21,686	23,827	25,862	27,559	29,077	10	19	27	34
99	Philippines	61,629	69,255	77,310	85,546	93,261	12	25	39	51
100	Poland	38,056	38,392	38,302	38,165	38,277	1	1	0	1
101	Portugal	9,925	10,125	10,336	10,544	10,676	2	4	6	8
102	Qatar	474	501	591	821	1,759	6	25	73	271
103	Republic of Korea	42,980	44,662	45,988	47,044	48,184	4	7	9	12
104	Republic of Moldova	4,364	4,339	4,107	3,767	3,573	–1	–6	–14	–18
105	Romania	23,207	22,681	22,192	21,772	21,486	–2	–4	–6	–7
106	Russian Federation*	148,674	148,699	146,758	143,843	142,958	0	–1	–3	–4
107	Rwanda	7,110	5,570	8,098	9,202	10,624	–22	14	29	49
108	Saudi Arabia	16,139	18,492	20,045	24,041	27,448	15	24	49	70

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		Population in thousands					Population change percentage change with respect to the base year, 1990			
	Country/Year	1990	1995	2000	2005	2010	1995	2000	2005	2010
109	Senegal	7,242	8,369	9,506	10,872	12,434	16	31	50	72
110	Serbia	9,569	10,204	10,134	9,856	9,856	7	6	3	3
111	Sierra Leone	3,982	3,898	4,143	5,153	5,868	–2	4	29	47
112	Singapore	3,017	3,482	3,919	4,266	5,086	15	30	41	69
113	Slovakia**	5,315	5,369	5,405	5,415	5,462	1	2	2	3
114	Slovenia*	1,935	1,966	1,985	2,002	2,030	2	3	3	5
115	South Africa	36,794	41,402	44,760	47,793	50,133	13	22	30	36
116	Spain	38,889	39,427	40,288	43,395	46,077	1	4	12	18
117	Sri Lanka	17,337	18,229	18,745	19,843	20,860	5	8	14	20
118	Sudan (former)	26,494	30,141	34,188	38,410	43,552	14	29	45	64
119	Swaziland	863	964	1,064	1,105	1,186	12	23	28	37
120	Sweden	8,559	8,827	8,860	9,029	9,380	3	4	5	10
121	Switzerland	6,674	7,019	7,168	7,415	7,664	5	7	11	15
122	Syrian Arab Republic	12,324	14,171	15,989	18,484	20,411	15	30	50	66
123	Tajikistan*	5,419	5,775	6,173	6,453	6,879	7	14	19	27
124	Thailand	57,072	59,650	63,155	66,698	69,122	5	11	17	21
125	Togo	3,666	4,085	4,794	5,408	6,028	11	31	48	64
126	Trinidad and Tobago	1,215	1,261	1,292	1,315	1,341	4	6	8	10
127	Tunisia	8,215	8,936	9,456	9,912	10,481	9	15	21	28
128	Turkey	54,130	58,865	63,628	68,143	72,752	9	18	26	34
129	Uganda	17,700	20,831	24,213	28,431	33,425	18	37	61	89
130	Ukraine*	51,666	51,122	48,892	46,924	45,448	–1	–5	–9	–12
131	United Arab Emirates	1,809	2,349	3,033	4,069	7,512	30	68	125	315
132	United Kingdom	57,214	57,997	58,874	60,203	62,036	1	3	5	8
133	United Republic of Tanzania	25,479	29,944	34,038	38,831	44,841	18	34	52	76
134	United States of America	253,339	266,324	282,496	296,820	310,384	5	12	17	23
135	Uruguay	3,109	3,223	3,319	3,323	3,369	4	7	7	8
136	Venezuela (Bolivarian Republic of)	19,685	22,035	24,348	26,664	28,980	12	24	35	47
137	Vietnam	67,102	74,008	78,758	83,161	87,848	10	17	24	31
138	Yemen	11,948	15,148	17,723	20,649	24,053	27	48	73	101
139	Zambia	7,860	8,919	10,202	11,462	13,089	13	30	46	67
140	Zimbabwe	10,469	11,685	12,509	12,571	12,571	12	19	20	20

GDP

GDP level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
1	Afghanistan	5,025	3,977	3,068	6,840	9,840
2	Albania	5,322	4,782	6,136	8,159	10,488
3	Algeria	68,873	69,761	81,385	103,234	117,517
4	Argentina	109,779	146,181	166,010	183,196	253,746
5	Armenia	4,062	2,145	2,754	4,900	5,915
6	Australia	451,430	531,385	644,740	764,765	874,477
7	Austria	216,398	240,294	280,623	304,984	327,206
8	Bahrain	6,446	8,224	10,049	13,459	17,821
9	Bangladesh	27,881	34,316	44,235	57,628	77,891
10	Barbados	3,046	2,917	3,383	3,685	3,719
11	Belgium	279,844	302,853	348,623	377,253	399,921
12	Belize	518	640	857	1,115	1,259
13	Benin	2,290	2,814	3,565	4,358	5,231
14	Bolivia (Plurinational State of)	5,665	6,925	8,201	9,549	11,954
15	Botswana	4,275	5,396	7,937	10,256	11,845
16	Brazil	598,399	696,020	768,855	882,044	1,092,556
17	Bulgaria	26,246	22,996	22,131	28,894	32,932
18	Burundi	1,190	1,070	1,006	1,117	1,404
19	Cambodia	2,086	2,851	4,027	6,293	8,694
20	Cameroon	11,706	10,993	13,827	16,588	19,027
21	Canada	749,884	816,662	999,927	1,133,757	1,203,888
22	Central African Republic	1,268	1,328	1,381	1,350	1,611
23	Chile	51,765	78,512	96,236	118,250	138,703
24	China	531,890	948,490	1,433,854	2,283,671	3,883,522
25	Colombia	94,460	117,224	122,698	146,566	183,182
26	Congo	4,330	4,428	4,988	6,087	7,878
27	Costa Rica	9,845	12,846	16,341	19,965	24,760
28	Côte d'Ivoire	12,815	13,878	16,330	16,354	18,026
29	Croatia*	33,241	30,530	36,034	44,821	46,895
30	Cuba	38,539	26,732	33,378	42,644	55,262
31	Cyprus	9,291	11,983	14,427	16,902	19,019
32	Czech Republic**	89,680	97,174	106,445	130,066	148,578
33	Democratic Republic of the Congo	10,239	7,100	5,817	7,166	9,400
34	Denmark	187,355	210,307	242,097	257,676	258,095
35	Dominican Republic	15,678	20,204	28,206	33,542	47,247
36	Ecuador	22,659	26,788	28,691	36,942	43,859

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GDP per capita in millions of constant 2005 US$					GDP change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
386	201	134	248	313	–48	–65	–36	–19
1,618	1,522	1,998	2,597	3,273	–6	23	61	102
2,722	2,466	2,665	3,139	3,313	–9	–2	15	22
3,363	4,194	4,495	4,736	6,279	25	34	41	87
1,146	665	895	1,598	1,913	–42	–22	39	67
26,405	29,328	33,643	37,482	39,270	11	27	42	49
28,212	30,280	35,057	37,048	38,983	7	24	31	38
13,077	14,710	15,745	18,569	14,123	12	20	42	8
265	292	341	410	524	10	29	55	98
11,737	11,073	12,645	13,623	13,605	–6	8	16	16
28,128	30,045	34,260	36,225	37,334	7	22	29	33
2,723	2,904	3,422	3,968	4,039	7	26	46	48
480	498	547	571	591	4	14	19	23
851	927	987	1,044	1,204	9	16	23	41
3,092	3,403	4,515	5,468	5,902	10	46	77	91
3,999	4,300	4,408	4,743	5,604	8	10	19	40
2,976	2,752	2,764	3,734	4,394	–8	–7	25	48
213	176	158	154	167	–17	–26	–28	–21
219	255	324	471	615	17	48	115	181
961	789	882	945	971	–18	–8	–2	1
27,071	27,870	32,606	35,119	35,391	3	20	30	31
432	399	373	336	366	–8	–14	–22	–15
3,925	5,449	6,241	7,254	8,105	39	59	85	106
464	781	1,130	1,746	2,895	68	143	276	523
2,845	3,216	3,086	3,405	3,957	13	8	20	39
1,813	1,620	1,591	1,723	1,949	–11	–12	–5	7
3,206	3,703	4,169	4,633	5,315	15	30	44	66
1,024	946	985	907	913	–8	–4	–11	–11
7,309	6,539	7,998	10,090	10,650	–11	9	38	46
3,646	2,452	3,006	3,789	4,909	–33	–18	4	35
12,118	14,008	15,294	16,369	17,233	16	26	35	42
8,695	9,417	10,392	12,726	14,160	8	20	46	63
281	161	117	125	143	–43	–58	–56	–49
36,443	40,186	45,341	47,546	46,502	10	24	30	28
2,179	2,552	3,283	3,621	4,759	17	51	66	118
2,208	2,353	2,324	2,751	3,032	7	5	25	37

GDP

GDP level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
37	Egypt	48,637	61,120	78,838	94,461	127,480
38	El Salvador	9,702	13,093	15,219	17,094	18,352
39	Estonia	10,163	7,121	9,841	13,903	13,898
40	Fiji	2,091	2,319	2,737	3,006	2,957
41	Finland	140,212	135,908	171,860	195,626	206,858
42	France	1,623,841	1,725,643	1,973,037	2,136,555	2,208,616
43	Gabon	7,511	8,756	8,713	9,459	10,432
44	Gambia	388	435	535	630	797
45	Germany	2,216,250	2,448,688	2,685,203	2,766,254	2,945,784
46	Ghana	8,719	10,740	13,335	17,198	23,251
47	Greece	156,255	166,243	196,959	240,076	243,230
48	Guatemala	15,661	19,313	23,442	27,211	32,481
49	Guyana	788	1,110	1,270	1,315	1,615
50	Haiti	4,308	3,504	3,912	3,807	3,963
51	Honduras	5,625	6,695	7,773	9,757	11,576
52	Hungary	86,539	77,802	89,959	110,322	109,265
53	Iceland	10,277	10,413	13,216	16,286	16,399
54	India	350,886	451,010	597,744	837,299	1,251,603
55	Indonesia	150,091	218,808	226,917	285,869	377,282
56	Iran (Islamic Republic of)	105,572	127,013	155,413	205,586	241,248
57	Iraq	12,257	6,040	17,713	18,164	25,354
58	Ireland	82,700	103,382	159,786	203,280	202,325
59	Israel	68,727	94,311	120,913	133,968	164,136
60	Italy	1,453,346	1,548,111	1,700,969	1,777,694	1,743,957
61	Jamaica	8,997	10,407	10,383	11,163	11,061
62	Japan	3,794,070	4,068,395	4,265,774	4,552,191	4,578,543
63	Jordan	5,833	7,894	9,244	12,589	16,732
64	Kazakhstan*	44,727	30,835	34,877	57,124	76,805
65	Kenya	12,995	14,059	15,570	18,739	23,450
66	Kuwait	39,310	51,472	54,707	80,798	90,039
67	Kyrgyzstan*	2,825	1,555	2,043	2,460	3,029
68	Lao People's Democratic Republic	1,096	1,495	2,016	2,739	4,380
69	Latvia	15,413	8,327	10,735	15,938	15,399
70	Lesotho	795	972	1,178	1,355	1,638
71	Liberia	579	162	730	578	803
72	Lithuania*	23,660	14,436	17,939	26,100	27,466

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GDP per capita in millions of constant 2005 US$					GDP change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
856	985	1,165	1,273	1,571	15	36	49	84
1,819	2,284	2,562	2,825	2,963	26	41	55	63
6,483	4,943	7,179	10,330	10,363	–24	11	59	60
2,870	2,990	3,372	3,655	3,436	4	18	27	20
28,119	26,608	33,220	37,302	38,560	–5	18	33	37
28,635	29,832	33,414	35,028	35,176	4	17	22	23
8,084	8,053	7,053	6,901	6,929	0	–13	–15	–14
401	386	412	419	461	–4	3	4	15
28,019	29,888	32,608	33,514	35,792	7	16	20	28
589	632	696	795	953	7	18	35	62
15,379	15,578	17,927	21,468	21,412	1	17	40	39
1,755	1,928	2,086	2,140	2,257	10	19	22	29
1,087	1,525	1,732	1,763	2,141	40	59	62	97
605	445	453	407	397	–26	–25	–33	–34
1,151	1,201	1,250	1,418	1,523	4	9	23	32
8,340	7,531	8,810	10,937	10,944	–10	6	31	31
40,335	38,929	46,996	54,884	51,224	–3	17	36	27
402	468	567	734	1,022	16	41	83	155
814	1,097	1,063	1,258	1,573	35	31	54	93
1,924	2,125	2,378	2,948	3,261	10	24	53	70
706	298	742	664	801	–58	5	–6	13
23,420	28,630	42,007	48,888	45,264	22	79	109	93
15,273	17,687	20,102	20,284	22,126	16	32	33	45
25,573	27,175	29,849	30,299	28,802	6	17	18	13
3,804	4,228	4,022	4,163	4,035	11	6	9	6
31,035	32,681	33,931	36,016	36,184	5	9	16	17
1,708	1,801	1,915	2,357	2,704	5	12	38	58
2,709	1,936	2,332	3,765	4,792	–29	–14	39	77
554	513	498	526	579	–8	–10	–5	4
18,830	31,618	28,188	35,688	32,900	68	50	90	75
636	339	412	488	568	–47	–35	–23	–11
261	312	379	476	706	19	45	82	170
5,786	3,341	4,501	6,913	6,838	–42	–22	19	18
485	542	600	656	754	12	24	35	55
272	77	256	182	201	–72	–6	–33	–26
6,398	3,978	5,126	7,641	8,264	–38	–20	19	29

GDP

GDP level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
73	Luxembourg	19,315	23,446	31,570	37,659	41,300
74	Malawi	1,929	2,044	2,449	2,755	3,980
75	Malaysia	55,084	86,608	109,442	137,954	171,826
76	Maldives	286	397	592	750	1,025
77	Mali	2,700	3,365	4,026	5,486	6,899
78	Malta	3,412	4,456	5,721	5,981	6,653
79	Mauritania	1,287	1,504	1,742	2,184	2,829
80	Mauritius	3,331	4,211	5,516	6,489	8,121
81	Mexico	547,801	590,980	770,735	846,095	922,307
82	Mongolia	1,851	1,604	1,843	2,523	3,454
83	Morocco	36,941	38,837	46,686	59,524	75,410
84	Mozambique	2,340	2,746	4,309	6,579	9,324
85	Myanmar	3,294	4,374	6,514	11,931	20,310
86	Namibia	3,956	4,971	5,708	7,261	8,852
87	Nepal	4,271	5,499	6,960	8,259	10,261
88	Netherlands	437,826	490,389	597,952	638,471	685,082
89	New Zealand	69,760	81,075	93,774	113,058	121,298
90	Nicaragua	2,989	3,265	4,171	4,872	5,563
91	Niger	2,143	2,307	2,702	3,369	4,290
92	Nigeria	56,419	57,836	67,851	112,248	122,349
93	Norway	188,114	225,884	270,651	302,013	315,275
94	Pakistan	58,161	72,921	85,596	109,213	134,328
95	Panama	7,643	9,986	12,524	15,465	22,978
96	Papua New Guinea	2,790	4,213	4,374	4,866	6,421
97	Paraguay	5,631	6,650	6,587	7,473	9,764
98	Peru	43,529	57,183	64,657	79,389	112,100
99	Philippines	62,103	69,129	82,358	103,072	131,138
100	Poland	180,139	200,601	261,094	303,912	382,761
101	Portugal	137,268	149,369	183,643	191,176	196,251
102	Qatar	15,215	17,344	29,927	44,530	104,255
103	Republic of Korea	360,297	526,721	678,270	844,866	1,017,571
104	Republic of Moldova	6,101	2,405	2,122	2,988	3,497
105	Romania	85,267	76,580	75,104	99,173	111,921
106	Russian Federation*	711,344	524,113	567,392	764,016	905,248
107	Rwanda	1,712	1,099	1,783	2,581	3,854
108	Saudi Arabia	200,420	230,832	262,042	315,583	359,749

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GDP per capita in millions of constant 2005 US$					GDP change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
50,666	57,533	72,493	82,370	81,388	14	43	63	61
206	207	218	215	267	1	6	5	30
3,025	4,180	4,674	5,286	6,050	38	55	75	100
1,304	1,596	2,168	2,540	3,243	22	66	95	149
311	343	356	416	449	10	14	34	44
9,285	11,527	14,396	14,612	15,972	24	55	57	72
645	656	659	717	818	2	2	11	27
3,143	3,703	4,612	5,163	6,251	18	47	64	99
6,498	6,405	7,710	7,946	8,132	−1	19	22	25
844	695	764	991	1,253	−18	−9	17	48
1,491	1,442	1,621	1,959	2,360	−3	9	31	58
173	172	237	317	399	0	37	83	131
84	104	145	258	423	24	73	207	405
2,796	3,010	3,011	3,491	3,877	8	8	25	39
224	255	285	303	342	14	27	35	53
29,401	31,798	37,695	39,157	41,238	8	28	33	40
20,530	22,061	24,306	27,348	27,769	7	18	33	35
725	704	822	898	961	−3	13	24	33
275	251	247	259	277	−9	−10	−6	0
578	526	549	803	772	−9	−5	39	34
44,351	51,819	60,267	65,324	64,564	17	36	47	46
520	573	592	688	774	10	14	32	49
3,164	3,730	4,237	4,776	6,534	18	34	51	107
671	893	813	798	936	33	21	19	40
1,327	1,387	1,233	1,267	1,513	5	−7	−5	14
2,007	2,400	2,500	2,881	3,855	20	25	44	92
1,008	998	1,065	1,205	1,406	−1	6	20	40
4,734	5,225	6,817	7,963	10,000	10	44	68	111
13,830	14,753	17,767	18,132	18,383	7	28	31	33
32,118	34,593	50,642	54,240	59,277	8	58	69	85
8,383	11,793	14,749	17,959	21,119	41	76	114	152
1,398	554	517	793	979	−60	−63	−43	−30
3,674	3,376	3,384	4,555	5,209	−8	−8	24	42
4,785	3,525	3,866	5,311	6,332	−26	−19	11	32
241	197	220	281	363	−18	−9	16	51
12,418	12,483	13,072	13,127	13,107	1	5	6	6

GDP

GDP level
in millions of constant 2005 US$

	Country/Year	1990	1995	2000	2005	2010
109	Senegal	5,127	5,498	6,934	8,708	10,298
110	Serbia	38,758	18,559	19,632	25,231	29,523
111	Sierra Leone	1,799	1,393	817	1,491	1,904
112	Singapore	49,663	74,851	99,282	125,429	170,969
113	Slovakia**	27,500	31,501	37,697	47,895	60,184
114	Slovenia*	22,679	24,178	29,901	35,718	39,034
115	South Africa	170,914	178,412	204,703	247,052	288,441
116	Spain	730,335	787,041	962,433	1,130,170	1,180,660
117	Sri Lanka	12,021	15,678	20,044	24,406	33,252
118	Sudan (former)	14,180	17,935	25,262	35,183	51,663
119	Swaziland	1,715	1,983	2,321	2,596	2,889
120	Sweden	263,843	272,953	324,508	370,580	397,080
121	Switzerland	313,927	315,491	349,046	372,477	411,657
122	Syrian Arab Republic	12,567	18,570	22,208	28,397	36,043
123	Tajikistan*	3,557	1,455	1,457	2,312	3,166
124	Thailand	88,907	134,468	137,515	176,352	210,077
125	Togo	1,817	1,793	1,989	2,110	2,462
126	Trinidad and Tobago	7,025	7,527	10,834	15,982	19,186
127	Tunisia	16,450	19,885	26,040	32,272	40,476
128	Turkey	269,684	315,856	386,584	482,986	564,315
129	Uganda	3,726	5,337	7,296	10,040	13,729
130	Ukraine*	125,433	65,598	59,344	86,142	90,700
131	United Arab Emirates	81,923	101,625	139,151	180,617	211,214
132	United Kingdom	1,525,105	1,654,441	1,979,324	2,280,538	2,330,011
133	United Republic of Tanzania	6,852	8,326	10,310	14,492	20,154
134	United States of America	7,962,600	9,019,900	11,158,100	12,564,300	13,017,000
135	Uruguay	12,653	15,453	17,205	17,363	23,493
136	Venezuela (Bolivarian Republic of)	104,316	123,574	128,279	145,513	172,851
137	Vietnam	17,751	26,331	36,846	52,917	74,268
138	Yemen	7,276	9,495	14,188	17,872	22,927
139	Zambia	5,384	5,034	5,759	7,271	9,890
140	Zimbabwe	7,372	7,826	7,749	6,223	6,462

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GDP per capita in millions of constant 2005 US$					GDP change percentage change with respect to the base year, 1990			
1990	1995	2000	2005	2010	1995	2000	2005	2010
708	657	729	801	828	–7	3	13	17
4,051	1,819	1,937	2,560	2,995	–55	–52	–37	–26
452	357	197	289	324	–21	–56	–36	–28
16,463	21,499	25,332	29,402	33,613	31	54	79	104
5,174	5,867	6,975	8,844	11,019	13	35	71	113
11,719	12,297	15,060	17,840	19,232	5	29	52	64
4,645	4,309	4,573	5,169	5,754	–7	–2	11	24
18,780	19,962	23,889	26,044	25,624	6	27	39	36
693	860	1,069	1,230	1,594	24	54	77	130
535	595	739	916	1,186	11	38	71	122
1,988	2,058	2,182	2,349	2,436	4	10	18	23
30,827	30,923	36,626	41,042	42,334	0	19	33	37
47,039	44,950	48,696	50,233	53,711	–4	4	7	14
1,020	1,310	1,389	1,536	1,766	29	36	51	73
656	252	236	358	460	–62	–64	–45	–30
1,558	2,254	2,177	2,644	3,039	45	40	70	95
496	439	415	390	408	–11	–16	–21	–18
5,780	5,967	8,385	12,150	14,302	3	45	110	147
2,002	2,225	2,754	3,256	3,862	11	38	63	93
4,982	5,366	6,076	7,088	7,757	8	22	42	56
210	256	301	353	411	22	43	68	95
2,428	1,283	1,214	1,836	1,996	–47	–50	–24	–18
45,296	43,272	45,871	44,385	28,118	–4	1	–2	–38
26,656	28,526	33,620	37,881	37,559	7	26	42	41
269	278	303	373	449	3	13	39	67
31,431	33,868	39,498	42,330	41,938	8	26	35	33
4,070	4,794	5,184	5,226	6,974	18	27	28	71
5,299	5,608	5,268	5,457	5,965	6	–1	3	13
265	356	468	636	845	34	77	141	220
609	627	801	866	953	3	31	42	57
685	564	565	634	756	–18	–18	–7	10
704	670	619	495	514	–5	–12	–30	–27

Country classification by region

	Africa	Asia	Europe
1	**Eastern Africa**	**Eastern Asia**	**Eastern Europe**
2	Burundi	China	Bulgaria
3	Kenya	Japan	Czech Republic
4	Malawi	Mongolia	Hungary
5	Mauritius	Republic of Korea	Poland
6	Mozambique	**South-Central Asia**	Republic of Moldova
7	Rwanda	Afghanistan	Romania
8	Uganda	Bangladesh	Russian Federation
9	United Republic of Tanzania	India	Slovakia
10	Zambia	Iran (Islamic Republic of)	Ukraine
11	Zimbabwe	Kazakhstan	**Northern Europe**
12	**Middle Africa**	Kyrgyzstan	Denmark
13	Cameroon	Maldives	Estonia
14	Central African Republic	Nepal	Finland
15	Congo	Pakistan	Iceland
16	Democratic Republic of the Congo	Sri Lanka	Ireland
17	Gabon	Tajikistan	Latvia
18	**Northern Africa**	**South-Eastern Asia**	Lithuania
19	Algeria	Cambodia	Norway
20	Egypt	Indonesia	Sweden
21	Morocco	Lao People's Democratic Republic	United Kingdom
22	Sudan (former)	Malaysia	**Southern Europe**
23	Tunisia	Myanmar	Albania
24	**Southern Africa**	Philippines	Croatia
25	Botswana	Singapore	Greece
26	Lesotho	Thailand	Italy
27	Namibia	Vietnam	Malta
28	South Africa	**Western Asia**	Portugal
29	Swaziland	Armenia	Serbia
30	**Western Africa**	Bahrain	Slovenia
31	Benin	Cyprus	Spain
32	Côte d'Ivoire	Iraq	**Western Europe**
33	Gambia	Israel	Austria
34	Ghana	Jordan	Belgium
35	Liberia	Kuwait	France
36	Mali	Qatar	Germany
37	Mauritania	Saudi Arabia	Luxembourg
38	Niger	Syrian Arab Republic	Netherlands
39	Nigeria	Turkey	Switzerland
40	Senegal	United Arab Emirates	
41	Sierra Leone	Yemen	
42	Togo		

	Latin America and the Caribbean	Northern America	Oceania
43	**Caribbean**	**Northern America**	**Australia/New Zealand**
44	Barbados	Canada	Australia
45	Cuba	United States of America	New Zealand
46	Dominican Republic		Melanesia
47	Haiti		Fiji
48	Jamaica		Papua New Guinea
49	Trinidad and Tobago		
50	**Central America**		
51	Belize		
52	Costa Rica		
53	El Salvador		
54	Guatemala		
55	Honduras		
56	Mexico		
57	Nicaragua		
58	Panama		
59	**South America**		
60	Argentina		
61	Bolivia (Plurinational State of)		
62	Brazil		
63	Chile		
64	Colombia		
65	Ecuador		
66	Guyana		
67	Paraguay		
68	Peru		
69	Uruguay		
70	Venezuela (Bolivarian Republic of)		

Country classification by income levels

	High income	Upper middle income	Lower middle income	Low income
1	Australia	Algeria	Albania	Afghanistan
2	Austria	Argentina	Armenia	Bangladesh
3	Bahrain	Botswana	Belize	Benin
4	Barbados	Brazil	Bolivia (Plurinational State of)	Burundi
5	Belgium	Bulgaria	Cameroon	Cambodia
6	Canada	Chile	Congo	Central African Republic
7	Croatia	China	Côte d'Ivoire	Democratic Republic of the Congo
8	Cyprus	Colombia	Egypt	Gambia
9	Czech Republic	Costa Rica	El Salvador	Haiti
10	Denmark	Cuba	Fiji	Kenya
11	Estonia	Dominican Republic	Ghana	Kyrgyzstan
12	Finland	Ecuador	Guatemala	Liberia
13	France	Gabon	Guyana	Malawi
14	Germany	Iran (Islamic Republic of)	Honduras	Mali
15	Greece	Jamaica	India	Mauritania
16	Hungary	Jordan	Indonesia	Mozambique
17	Iceland	Kazakhstan	Iraq	Myanmar
18	Ireland	Latvia	Lao People's Democratic Republic	Nepal
19	Israel	Lithuania	Lesotho	Niger
20	Italy	Malaysia	Mongolia	Rwanda
21	Japan	Maldives	Morocco	Sierra Leone
22	Kuwait	Mauritius	Nicaragua	Tajikistan
23	Luxembourg	Mexico	Nigeria	Togo
24	Malta	Namibia	Pakistan	Uganda
25	Netherlands	Panama	Papua New Guinea	United Republic of Tanzania
26	New Zealand	Peru	Paraguay	Zimbabwe
27	Norway	Romania	Philippines	
28	Poland	Russian Federation	Republic of Moldova	
29	Portugal	Serbia	Senegal	
30	Qatar	South Africa	Sri Lanka	
31	Republic of Korea	Thailand	Sudan (former)	
32	Saudi Arabia	Tunisia	Swaziland	
33	Singapore	Turkey	Syrian Arab Republic	
34	Slovakia	Uruguay	Ukraine	
35	Slovenia	Venezuela (Bolivarian Republic of)	Viet Nam	
36	Spain		Yemen	
37	Sweden		Zambia	
38	Switzerland			
39	Trinidad and Tobago			
40	United Arab Emirates			
41	United Kingdom			
42	United States of America			

Glossary of terms

Absolute decoupling: refers to a situation of an overall reduction in required material inputs or pollution outputs, even while the economy grows, whether through productivity improvements or through a decrease in pollution, or a combination of both.

Adjusted net savings: a measure of net change in the value of a country's capital stocks, including produced, human, and natural capital.

Adjusted Inclusive Wealth Index (IWadj): a measure of wealth that results from the accounting for those factors that affect the size of a country's productive base. In this report, we take into account the following three components: carbon damages, oil capital gains, and total factor productivity.

Biodiversity: the variability among living organisms from all sources and the ecological complexes which they are part of, including diversity within species, between species, and of ecosystems.

Biosphere: a limited space made up of air, earth, and water, which is capable to support life.

Carbon emissions: the release of carbon dioxide gas into the atmosphere.

Comprehensive wealth: the shadow value of all capital assets in a country. See inclusive wealth.

Decoupling: a decline in the ratio of the amount used of a certain resource, or of the environmental impact, to the value generated or otherwise involved in the resource use or environmental impact.

Dematerialization: an absolute decrease in the quantity of resources, measured by mass, used by an economy.

Ecological capital: ecosystems considered capital assets.

Ecosystem: a mesh of human and natural resources interacting with one another at a multitude of speeds and across often overlapping spatial scales.

Ecosystem services: ecosystem services cover the provision of ecosystem inputs, the assimilative capacity of the environment, and the provision of biodiversity.

Educational attainment: refers to the highest level of schooling which each student has attended and completed successfully. In this report it is represented by the average years of total schooling per person.

Energy security: the uninterrupted availability of energy sources at an affordable price.

Environmental sustainability: the maintenance of the minimum thresholds of natural capital that are required to sustain important environmental functions.

Externalities: the effects of activities on the well-being of people who have not been part of the negotiations that led to those activities.

Food security: the state that all people at all times have physical and economic access to sufficient, safe, and nutritious food to maintain a healthy and active life.

Fossil fuels: fuels such as natural gas, coal, and petroleum that are formed in the earth from plant or animal remains.

Global genuine saving rate: the world's gross savings plus educational expenditures minus produced capital depreciation and the values of natural resource depletion and the damages resulting from carbon emissions.

Gross domestic product: the market value of all final goods and services produced within an economy within a year.

Health capital: in this report, health capital comprises the three components: direct well-being, productivity, and longevity. As accepted empirical estimates of the first two components are lacking, it is here essentially measured by the extensions (reductions) in the individual's life expectancy. Such changes are basically analyzed by calculating the expected discounted years of life remaining of a given population.

Human capital: the knowledge, skills, competencies, and attributes embodied in individuals that facilitate the creation of personal, social, and economic well-being

Human Development Index: a measure of development designed by the United Nations Development Programme that combines indicators of life expectancy, educational attainment, and income.

Inclusive investment: the measurement of the physical changes in the assets of the economy, while holding shadow prices constant.

Inclusive wealth: the shadow value of all capital assets in a country. In this report comprehensive wealth and inclusive wealth are used interchangeably.

Inclusive Wealth Index (IWI): a measure of intertemporal social welfare to assess nations' social progress by taking human, natural, and produced capital into account.

Infrastructure capital: is a subset of produced capital, and is commonly defined as the built civic assets essential for the functioning of an economy and society.

Produced capital: traditionally considered as capital, consisting of roads, buildings, ports, machinery, and equipment. The latter manufactured assets, which remain within the production system for more than one accounting period – e.g. year –, are used to produce other goods and services.

Microclimate: the climate of a small, specific place within an area as contrasted with the climate of the entire area.

Millennium Ecosystem Assessment: a pioneering study from 2005 of the services humanity enjoys from ecosystems.

Natural capital: everything in nature (biotic and abiotic) capable of providing human beings with well-being, either directly or through the production process.

Non-renewable resources: natural resources that cannot be regenerated or grown at a sustainable rate to meet demand, including fossil fuels, metals, and minerals.

Oil capital gains: measure of a change in wealth due to changes in price given a fixed quantity of oil.

Manufactured capital: see produced capital.

Relative decoupling: refers to a situation where productivity/efficiency improvements have been realized but total inputs, or pollution outputs, continue to increase as economic output increases.

Renewable resources: natural resources that, after exploitation, can return to their previous stock levels by natural processes of growth or replenishment. Conditionally renewable resources are those whose exploitation eventually reaches a level beyond which regeneration will become impossible. Such is the case with the clear cutting of tropical forests.

Rental prices: market prices minus production costs of resources.

Satellite accounts: provide a framework linked to the to central (national or regional) accounts, allowing attention to be focused on a certain field or aspect of economic and social life in the context of national accounts; common examples are satellite accounts for the environment, or tourism, or unpaid household work.

Shadow price: the shadow price of a capital asset is the forecast contribution of a marginal unit of this asset to human well-being.

Social capital: aspects of social structure that facilitate action, in terms of the importance of obligations and expectations, information channels, and social norms to education.

Sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Sustainability gap: indicates the degree of consumption of natural capital, either in the past or present, that is in excess of what is required for environmental sustainability.

System of National Accounts: is an internationally agreed-upon standard statistical framework that provides a comprehensive, consistent, and flexible set of macroeconomic accounts suitable for measuring, monitoring, and analyzing the economy and its constituents, so as to assist national policy planning processes.

Total factor productivity: the proportion of output not explained by the amount of inputs used in production. It captures the effect of technical progress, the efficiency with which inputs are used, institutional conditions, and the impact of environmental factors such as climate.

Value of statistical life: an approach measuring a society's willingness to pay to avoid additional occurrences of death.

Value of statistical life year: the value of statistical life year is the value of statistical life divided by the expected discounted years of life remaining and thus represents a per-year valuation of the reduction in risk of mortality.

Contributing organizations

UNU–IHDP

The International Human Dimensions Programme on Global Environmental Change (IHDP) was an interdisciplinary science programme that worked toward a better understanding of human interaction with and within their natural environment. Until its closure in June 2014, the programme facilitated dialogue between science and policy to ensure that research results fed into policy-planning and law-making processes, and offered education and training to future leaders in the field.

IHDP was founded by the International Council for Science (ICSU) and the International Social Science Council (ISSC) of UNESCO in 1996. Its Secretariat (UNU-IHDP) was hosted by the United Nations University (UNU) in Bonn who joined as third sponsor in 2007. IHDP's research was guided by an international Scientific Committee comprised of renowned scientists from various disciplinary and regional backgrounds.

UNEP

The United Nations Environment Programme (UNEP) is the voice for the environment within the United Nations system. Established in 1972, UNEP's mission is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and people to improve their quality of life without compromising that of future generations. UNEP acts as a catalyst, advocate, educator, and facilitator promoting the wise use and sustainable development of the global environment. UNEP works with a wide range of partners, including United Nations entities, international organizations, national governments, non-governmental organizations, the private sector, and the civil society.

UNEP's work involves providing support for environmental assessment and reporting; legal and institutional strengthening and environmental policy development; sustainable use and management of natural resources; integration of economic development and environmental protection; and promoting public participation in environmental management. For more information, please visit: www.unep.org.

UNESCO–MGIEP

UNESCO-MGIEP is a specialized international UNESCO Category 1 Institute on Education for Peace and Sustainable Development (EPSD). Its mission is to build capacities of Member States and relevant stakeholders, and strengthen international policy to integrate EPSD into knowledge, education, and learning, in order to foster global citizenship. The institute was announced jointly by the President of India and the Director-General of UNESCO in 2011 and is located in New Delhi, India.

UNESCO-MGIEP's work supports the United Nations Secretary General's Education First Initiative, the post-2015 global education agenda, and the Sustainable Development Goals by strengthening education systems to nurture generations of global citizens with the understanding and skills required to build a more peaceful, sustainable, and inclusive future.

ASCENT

ASCENT is an innovative think tank in Nairobi, Kenya which focuses on sustainability, rule of law, social transformation, and economic empowerment through engagement of governments, private sector and civil society. The institute aims to move beyond traditional approaches, to harness the growth momentum for the youthful population of Africa to develop and support fresh ideas and technological adaptations that address scarcity and hardship as well as advance social progress.

The institute is inspired by the ancient African Adinkra adage Boa me na me mmoa wo, meaning, “help me help you”, in other words, we believe that the best way to address challenges and provide a healthy and sustainable future in Africa is by creating an environment of cooperation, partnership and interdependence. www.africasustianability.org.

MIGHT

The Malaysian Industry-Government Group for High Technology (MIGHT) was formed in 1993 as Malaysia embarked on its drive to encourage its industries to accelerate the adoption of high technology, thus enabling the country to remain competitive in the face of growing globalization and trade liberalization.

MIGHT is an independent and not-for-profit organization driven by key players from both the public and private sectors. The synergies arising from these engagements form the basis for efforts in prospecting cutting-edge technological know-how and opportunities that can be nurtured into viable businesses for wealth creation.

Science to Action

Science to Action (S2A) is a national initiative announced by YAB Prime Minister of Malaysia in 2013, to be led by the Office of the Science Advisor and anchored by the Malaysian Industry-Government Group for High Technology (MIGHT). The objectives of the initiative are twofold: to identify S&T programs that will enable nation-building, and raising the profile of S&T in national development. Implementation of the S2A initiative will be undertaken parallel to the following targets:

- Global Competitiveness Index - targeting Malaysia as a top 10 nation;
- Global Innovation Index - Malaysia firmly recognized as a top 10 nation;
- Gross Domestic Expenditure on R&D - increasing the country's GERD to 2%.

The S2A is a comprehensive effort that will enable Malaysia to sustain its growth beyond 2020. It is complementary in nature and innately supports various existing initiatives that have already been undertaken by the government, while at the same time ensuring that the nation is able to maximize its potential through the use of S&T. Ultimately, S2A will enable the nation to generate new and vibrant programs, through strategies that strengthen the STI governance and development ecosystem. It will also be focusing on selected target areas, as well as enabling active participations from the private sector to lead initiatives in STI.

Ministry of Environment – Government of Japan

The Ministry of the Environment is the government body responsible for environmental protection in Japan. Established in 1971 as the Environment Agency, it has worked on policy-making in global environmental issues, pollution control, and nature conservation.

UNU–IAS

The United Nations University Institute for the Advanced Study of Sustainability (UNU-IAS) is a leading research and teaching institute based in Tokyo, Japan. Its mission is to advance efforts towards a more sustainable future, through policy-oriented research and capacity development focused on sustainability and its social, economic and environmental dimensions. UNU-IAS serves the international community, making valuable and innovative contributions to high-level policymaking and debates within the UN system.

The Science and Technology Alliance for Global Sustainability

The Science and Technology Alliance for Global Sustainability is a partnership of international organizations working strategically in critical science, education, technology, and innovation research areas. Through its members, the Alliance represents a global community of researchers, science policy-makers, and funders committed to transformative research that leads to strategic action on global sustainability.

Drawing on their respective networks and resources, Alliance members join forces to develop transformative research agendas that use critical scientific knowledge to drive strategic global sustainability actions by decision-makers, policy-shapers, practitioners, the private sector, and the civil society.

The Alliance's first flagship initiative is Future Earth, an international program of integrated, solutions-oriented research for global sustainability. Please visit www.futureearth.info for more information.