I-WAVES
Training on Macroeconomic Indicators

Session 1b: World Bank – Wealth Accounts Data

WAVES

Wealth Accounting and the Valuation of Ecosystem Services
www.wavespartnership.org

WORLD BANK GROUP

WORLD BANK DATA ON NATURAL CAPITAL ACCOUNTING

Introduction

The World Bank has been in the forefront of wealth accounting initiatives, through the development of methodology, datasets, and publications

In this session we will consider some of the approaches, issues and results

World Bank Data on Natural Capital Accounting

World Bank has had several initiatives involving calculation of adjusted national income, adjusted national savings, and comprehensive wealth

"Where is the Wealth of Nations", 2006

"Changing Wealth of Nations", 2011

"Changing Wealth of Nations" (updated), 2018

Closely associated with the WAVES project

Estimates of key adjusted income, savings and wealth indicators for approx. 150 countries

Wealth estimates for 1995, 2000, 2005, 2010, 2014

Income & savings indicators 1970-2015

WORLD BANK ESTIMATES OF ADJUSTED NATIONAL SAVINGS

Adjusting National Accounts Aggregates

How can the costs of using up or damaging the environment be reflected in national accounts aggregates (e.g., GDP, GNI, Gross Saving)?

One measure that the World Bank calculates:

- **Adjusted Net Saving** (ANS)

Adjusted Net Saving

ANS =

Gross National Saving
- – Consumption of Fixed Capital
- + Investment in Human Capital
- – Depletion of Natural Capital
- – Pollution Damages

More inclusive measure of changes in a comprehensive set of capital assets that constitute a nation's wealth base, by accounting for physical capital, human capital, natural capital, and environmental degradation.

But beyond the SNA asset boundary

Adjusted Net Saving
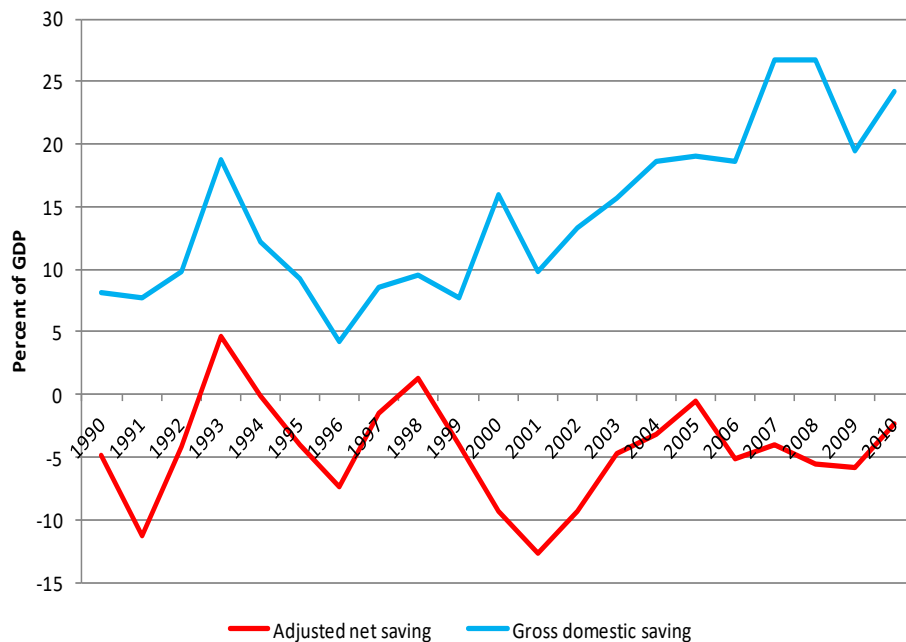
Interpretation, as measure of sustainability:

Positive ANS indicates an investment in the future—that a nation is accumulating the assets needed to build up its wealth and ensure its economic growth over the longer term

Years of negative ANS suggest that a country is running down its capital stock and is on an unsustainable growth path
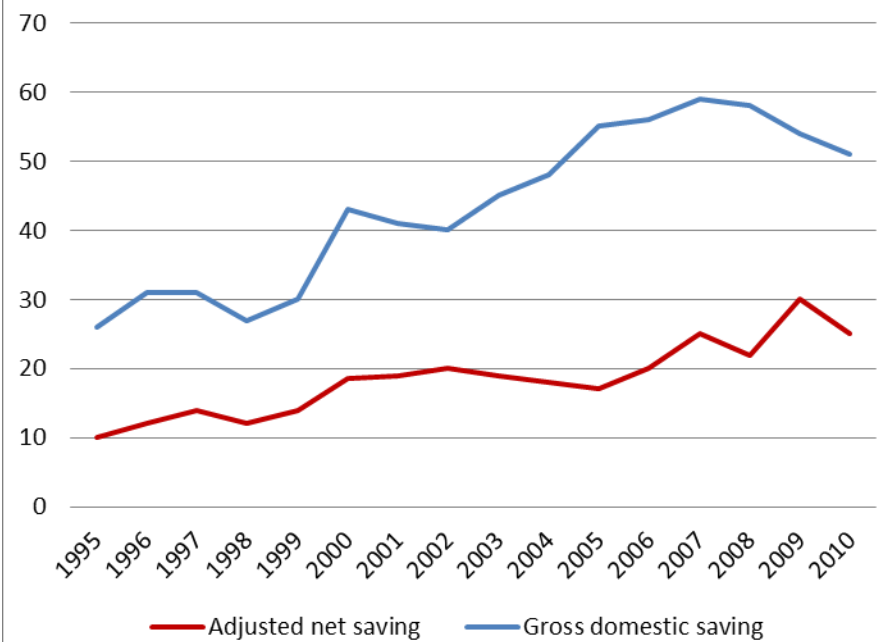
Indicator of sustainability: Trends

SUDAN, finding oil boosted gross saving, but not enough to offset depletion of oil… ANS is negative

ALGERIA: Public + private savings more than offsets depletion. ANS is positive

Gross and adjusted net saving in Sudan

Gross and Adjusted Net Saving, Algeria

Measuring Adjusted Net Saving

GROSS SAVING	Difference between GNI and public and private consumption plus net current transfers.	
CONSUMPTION OF FIXED CAPITAL	Replacement value of capital used up in the process of production.	
INVESTMENT IN HUMAN CAPITAL	Proxy: Education expenditures	
DEPLETION OF NATURAL CAPITAL	Subsoil Depletion (10 minerals, 4 energy resources)	Estimated directly
	Net Forest Depletion	Estimated directly
POLLUTION DAMAGES	CO_2 emissions damages	Estimated directly
	Damages from exposure to air pollution	Estimated directly
ADJUSTED NET SAVING	ANS = Gross Saving – Consumption of Fixed Capital + Investment in Human Capital – Depletion of Natural Capital – Pollution Damages	

Gross National Saving

Definition: Gross national savings are calculated as gross national income less total consumption, plus net transfers.

Available at the national level

Note: WB does not gap-fill missing data. So if a country does not have GNS for a given year, then we cannot calculate Adjusted Net Saving.

Data Requirements	Data Source
Gross National Saving	*World Development Indicators, WDI* *http://data.worldbank.org/indicator/NY.GNS.ICTR.CD* *Source: World Bank national accounts data, and OECD National Accounts data files.*

Consumption of Fixed Capital

Definition: Replacement value of capital used up in the process of production.

- A standard item in the SNA, consumption of fixed capital (CFC) represents the "decline…in the current value of the stock of fixed assets owned and used by a producer as a result of physical deterioration, normal obsolescence or normal accidental damage" (UN 2008: 123). Fixed assets are limited to manufactured capital used in the production process and exclude natural assets such as land.

Data Requirements	Primary Data Source
Consumption of Fixed Capital	*UN Statistics Division, National Accounts Official Country Data, Table 1.3 http://data.un.org*

Consumption of Fixed Capital

World Bank Methodology for Gap-Filling

- Country-reported data from the UN and OECD are given first priority.

- Where UN/OECD data are unavailable, the Penn World Table (PWT) estimates are used.

- Where PWT estimates are unavailable, regression-based estimates are used.

Investment in Human Capital
Various approaches to measuring human capital

- **Cost-based**

- **Income-based**

- **Other related indicators (e.g., educational attainment, outcomes)**

The WB's ANS Framework uses a proxy indicator:
Current public expenditure on education

Note: SNA treats education expenditure as consumption, but we count it as investment in human capital, therefore it is explicitly added in the measure of Adjusted Net Saving

Investment in Human Capital

Proxy indicator: Current public expenditure on education (% of GNI)

- Includes spending on: staff salaries, pensions and benefits; contracted or purchased services; other resources including books and teaching materials; welfare services; and other current expenditure, such as subsides to students and households, furniture and minor equipment, minor repairs, fuel, telecommunications, travel, insurance and rents. It is expenditure on goods and services consumed within the current year and which may need to be renewed for subsequent year(s).

Data Requirements	Data Source
Current public expenditure on education	*United Nations Educational, Scientific, and Cultural Organization (UNESCO)*

[WB] Education Expenditures: Issues

Limitations in WB cost-based measure for investment in human capital:

- Does not include private education expenditures (e.g., households, private entities)

- Link between investment and education outcomes?

This is being explored further with an income-based approach to human capital. This would value human capital in terms of what it can earn (rate of return), rather than what it cost.

Depletion of Natural Capital

What natural resources are included in the 2008 SNA asset boundary?

- Land

- Mineral and energy resources

- Non-cultivated biological resources (e.g., timber, fisheries)

- Water resources

- Other natural resources (e.g., radio spectra)

World Bank approach for ANS covers:

- Mineral and energy resources (i.e., subsoil assets)

- Timber resources

What is Depletion?

(Monetary) depletion of natural resources:

- (Non-Renewable) The depletion of natural resources covers the reduction in the value of deposits of subsoil assets as a result of the physical removal and using up of the assets.

- (Renewable) The depletion of natural forests, fish stocks in the open seas and other uncultivated biological resources included in the asset boundary as a result of harvesting, forest clearance, or other use beyond sustainable levels of extraction should be included here.

Source: SNA 2008.

Why Measure Depletion?

- The SNA treats the gradual using up of produced capital - buildings, structures, machines and other equipment - as a **cost of production**

- However, in standard measures of income, the using up (depletion) of natural capital (e.g., mineral resources, forests, fish stocks), is not regarded as a cost of production

- Incomes generated from exploiting natural capital may appear high in the short term, but <u>may not be sustainable in the long run</u>

Depletion, a Component of Resource Rent

Table 5.4.1 Relationships between different flows and income components

Output (sales of extracted environmental assets at basic prices, includes all subsidies on products, excludes taxes on products)

Less Operating costs

    Intermediate consumption (input costs of goods and services at purchasers' prices, including

    Compensation of employees (input costs for labour)

    Other taxes on production plus Other subsidies on production

Equals **Gross Operating Surplus – SNA basis***

Less Specific subsidies on extraction

Plus Specific taxes on extraction

Equals **Gross Operating Surplus – for the derivation of resource rent**

Less **User costs of produced assets**

    Consumption of fixed capital (depreciation) + Return to produced assets

Equals **Resource rent**

    Depletion + Net return to environmental assets**

Source: SEEA, 2012

Natural Capital Depletion: WB Approach

As illustrated in following slides, WB takes a simplified approach to measuring depletion of natural capital.

- **WB methodology is constrained by the following objectives:**

  - Produce annual estimates

  - Global country coverage

  - Publically available datasets

[WB] Energy and Mineral Resources

Energy Resources

- Oil

- Natural Gas

- Hard Coal

- Soft Coal

Note on omitted resources:
We are limited by data availability, especially information on reserves and production costs, as well as time constraints in producing a global and annual data series.

Metal and Mineral Resources

- Bauxite

- Copper

- Gold

- Iron Ore

- Lead

- Nickel

- Phosphate

- Silver

- Tin

- Zinc

[WB] Energy/Mineral: Methodology

Calculations per commodity:

- **Resource Rents** = Production x Unit Rent
  = Production x (Unit Price – Unit Cost)

  - If Unit Rent < 0, then cap at 0.

- **Exhaustion time =** years to depletion (or, life of resource) (reserves/current production)

- **"Wealth"** = Net Present Value of Resource Rents, discounted at 4%, over exhaustion time

  - Assumes that future rents are constant and equal to current rent

- **Depletion = "Wealth" / Exhaustion time**

Energy/Mineral Reserves

SEEA: Mineral deposits are classified according to:

- Economic and social viability

- Field project status and feasibility

- Geological knowledge

Knowledge deposits are categorized into three classes:

- Class A: Commercially Recoverable Resources

- Class B: Potentially Commercially Recoverable Resources

- Class C: Non-Commercial and Other Known Deposits

For valuation, SEEA methodology uses **Class A: Commercial Recoverable Resources**. WB also uses proven reserves

[WB] Energy and Mineral Depletion: Suggested Improvements

Extraction costs ideally assessed at the mine-level

- Problems with unit cost (average) approach

- But significant data challenges for WB objectives of annual estimates

Expand beyond proven reserves for estimation of exhaustion time

- BUT careful to be consistent with SEEA

Expand list of commodities (e.g., diamonds, platinum metals)

Timber Resources

Forest resources are renewable, making them fundamentally different from non-renewable resources.

- Because forests can regrow, the extraction of wood is not necessarily a disinvestment in the future.

- What is a disinvestment is **unsustainable extraction of wood** beyond natural rates of forest growth and resource replacement

Depletion of Timber Resources

Depletion of forest resources is the value of that portion of wood extraction which exceeded natural incremental growth in the country for a particular year.

- If natural incremental growth is greater than timber harvest in a given year, then net forest depletion is zero.

Forest depletion should not be confused as being a monetary value of deforestation. The harvesting of timber is different from deforestation, which represents a permanent change in land use.

[WB] Net Forest Depletion: Methodology

Calculations:

Revenue ($) = Production x Unit Price

Resource Rent ($) = Revenue x Rental Rate, where

- Rental Rate = (Unit Price – Unit Cost) / Unit Price

Unit rent ($/m3) = Resource Rent / Production

Natural Growth (m3) = annual commercial increment x forest productive area

Overharvest (m3) = Production – Natural Growth

- If negative, then replaced with 0.

Depletion ($) = Overharvest x Unit Rent

[WB] Net Forest Depletion: Data

RENT	Frequency	Coverage	Data Source(s)
Annual Production (<u>3 categories</u>: industrial roundwood (coniferous), industrial roundwood (non-coniferous), wood fuel) (m3)	Updated Annually	All countries	*FAO*
Unit Price per wood category (export value/export quantity) ($/m3)	Updated Annually	All countries	*FAO*
Rental Rate	Based on previous literature review	Regional (derived averages of country case studies)	*Fortech, 1997; Whiteman, 1996; Tay et al, 2001; Lopina et al, 2003: Haripriya, 1998; Global Witness, 2001; Eurostat, 2002.*

[WB] Net Forest Depletion: Data

NATURAL GROWTH	Frequency	Coverage	Data Source(s)
Forest Productive Area (ha)	Updated every five years	All countries	*Table 7: Designated functions of forest – total area with function. Source: Global Forest Resources Assessment (FRA), FAO*
Annual Commercial Increment (m3/ha/yr)	Based on previous literature review; not updated since	All countries	*Source: "Potential Productivity" map (Figure 2.3, A. Mather, Global Forest Resources, Belhaven Press, London, 1990) and other country specific studies and data sources; under the guidance of a WB forestry expert.*

[WB] Net Forest Depletion: Suggested Improvements (near future)

Improve price estimates associated with timber production

- Use country domestic prices

Improve country-specific rental rates

- GTAP model results

CO2 Damages

Value the economic cost of damages due to CO2 emissions

Stepping outside of SNA/SEEA boundaries, into more "experimental" estimates

CO2 Damages

Current World Bank guidance recommends a **social cost of carbon (SCC) of US$ 30 per tCO$_2$e emitted in 2015** (year 2014 prices) for the economic analysis of benefits from projects that reduce GHG. The SCC is the present value of the expected future damages to the world economy caused by an additional ton of carbon emitted into the atmosphere.

Under the <u>polluter pays principle</u>, global damages from CO2 emissions are charged to the emitting countries, with the assumption that countries suffering from the effects of climate change have a property right to a clean and healthy environment (Hamilton and Clemens 1999).

CO2 Damages

Data Requirements	Data Source (WB Methodology)
CO2 emissions (kt)	*World Development Indicators, World Bank* Source: Carbon Dioxide Information Analysis Center of the Oak Ridge National Laboratory, United States (CDIAC)
Social cost of carbon	World Bank (2014), adjusted by U.S. GDP Deflator (US\$ 30 per tCO_2e emitted in 2015 (year 2014 prices))

CO2 Damages = CO2 emissions x social cost of CO2

- **Gap-filling**: Data on CO2 emissions are lagged by a couple of years, so the latest years are projected based on observed trends in the emissions intensity of economic activity (tons of CO2 emitted per unit of GDP)

Further work

- Appropriate social cost of carbon

- Distribution of CO2 damages? (contrast to polluter-pays-principle)

Air Pollution (PM) Damages

Value the economic cost of damages due to exposure to air pollution (PM2.5 and ozone)

Stepping outside of SNA/SEEA boundaries, into more "experimental" estimates

What is PM2.5?

Particulate matter, or PM, is the term for particles found in the air.

- Particles less than 10 micrometers in diameter (PM10) pose a health concern because they can be inhaled into and accumulate in the respiratory system.

- Particles less than 2.5 micrometers in diameter (PM2.5) are referred to as "fine" particles and are believed to pose the greatest health risks.

The World Bank used to estimate and report exposure to PM10; we now report exposure to PM2.5, using data directly from the Global Burden of Disease study.

Exposure to PM2.5 Pollution, 1990-2010

Ambient PM$_{2.5}$ pollution, population-weighted exposure (micrograms per cubic meter)
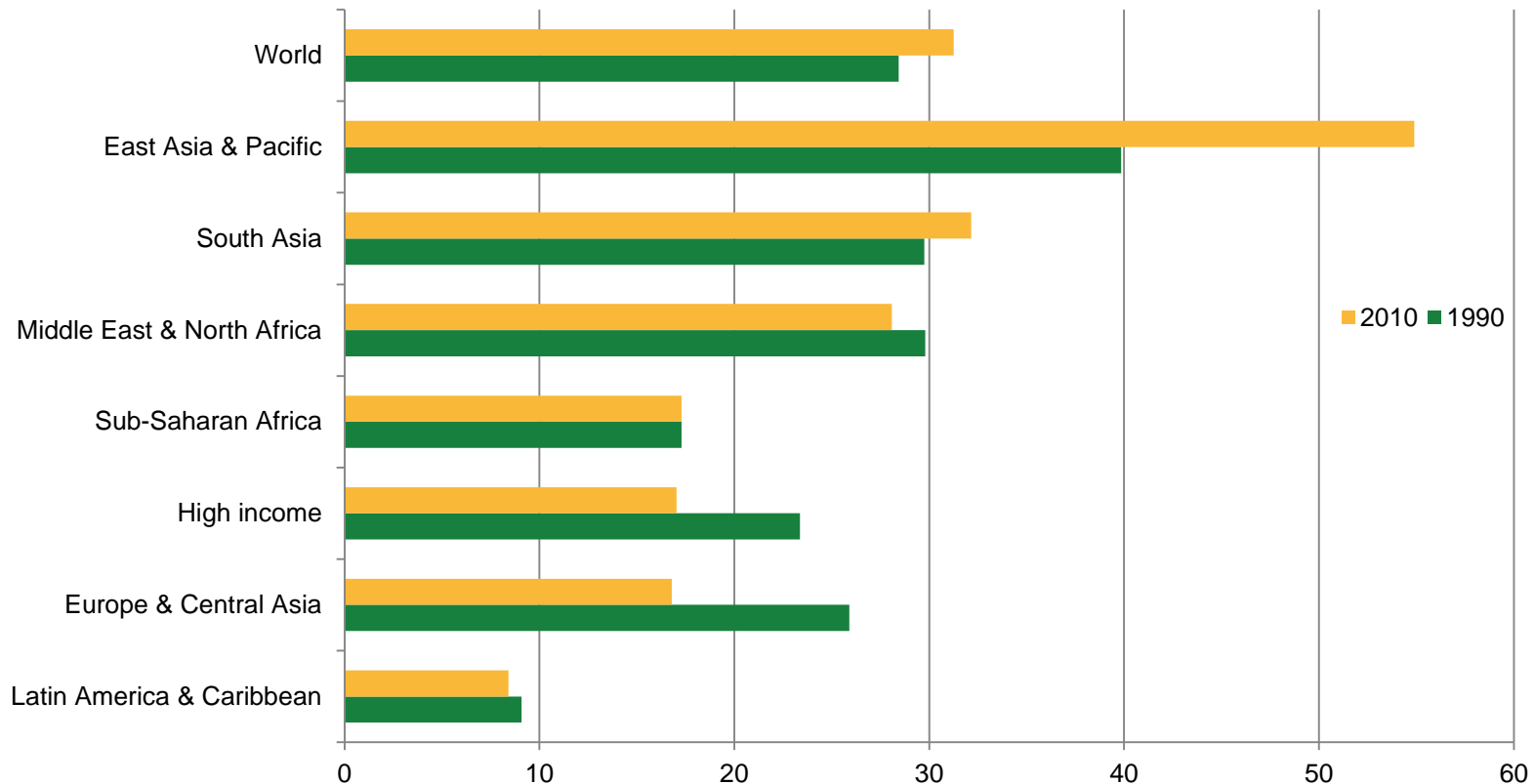
Source: *World Development Indicators 2015,* **table 3**

- **WHO Air Quality Guideline is 10 microgram per cubic meter (annual average)**

Air Pollution (PM) Damages

Estimate the economic cost of damages due to exposure to PM2.5 and ozone

- **World Bank recently revised methodology**

  Rely directly on the results from the Global Burden of Disease project, which publishes **health impacts** from exposure to **ambient air pollution** and **household air pollution and ozone**

  - Premature mortality and years lived with disability (morbidity) from pollution exposure

Air Pollution (PM) Damages

Damage estimated as workers' lost productivity

- Working-age population (15-64) and children under 15

- Both premature deaths and morbidity (disability) are valued

Premature mortality: present value of lost future income, by age group

- I_0 is average wage income in the present year ($i = 0$)

- n is average life expectancy in working age for that particular age group

- g is the rate of annual growth in real income, assumed to be 2.5% for all countries and years

- r is the social discount rate, assumed to be 4% for all countries and years

Air Pollution (PM) Damages

Morbidity: reduced labor productivity due to non-fatal illnesses

$$D_0 = y_0 \cdot I_0$$

- y_0 are years lived with disability
- I_0 is average wage income

Calculation of Adjusted net savings (Genuine National Savings) - WB

Gross National Savings

- Deduct: consumption of fixed capital

= Net National Savings

- Add: expenditure on education (investment in human capital)
- Deduct: natural resource depletion (minerals, energy, forests etc.)
- Deduct: pollution damage (CO_2, particulate emissions)

= Adjusted Net Savings (Genuine National Savings)

- Monitoring changes in wealth each year

World Bank datasets

The World Bank wealth accounting dataset is available from

http://data.worldbank.org/data-catalog/wealth-accounting

The main datasets are:

http://databank.worldbank.org/data/download/Adjusted-Net-Savings_EXCEL.zip

http://databank.worldbank.org/data/download/Wealth-Accounts_EXCEL.zip

These contains all of the variables required for calculating ANS and Comprehensive Wealth

Exercise

Using the World Bank dataset on ANS, choose 3 countries and prepare two charts as on the following slides, and comment as follows:

- Chart 1: Plot Gross National Savings (GNS) and Adjusted National Savings (ANS)

  - *Which country has the <u>lowest level</u> of ANS?*

  - *Which country has the <u>largest gap</u> between gross savings and ANS?*

- Chart 2: For each country, plot the adjustment items (subtracting from or adding to GNS)?

  - *Are there differences between the types and magnitudes of adjustment items in each of the 3 countries?*

  - *What can you tell about the pattern of economic development in each of the 3 countries (e.g., mining led, forestry, highly polluting)?*

Exercise: Dataset Notes

Dataset is: Data_Extract_From_Adjusted_Net_Savings.xslx

Country name is in column A

Data series name is in column C

Data runs from 1970 to 2015, but some years may be missing. Use 2015 if available.

Use the data expressed in units "% of GNI", for the variables:

GNS and ANS
Adjusted savings: gross savings (% of GNI)
Adjusted net savings, including particulate emission damage (% of GNI)
Adjustment items
Adjusted savings: carbon dioxide damage (% of GNI)
Adjusted savings: consumption of fixed capital (% of GNI)
Adjusted savings: education expenditure (% of GNI)
Adjusted savings: energy depletion (% of GNI)
Adjusted savings: mineral depletion (% of GNI)
Adjusted savings: net forest depletion (% of GNI)
Adjusted savings: particulate emission damage (% of GNI)

Adjustments to national savings 1 – GNS ANS
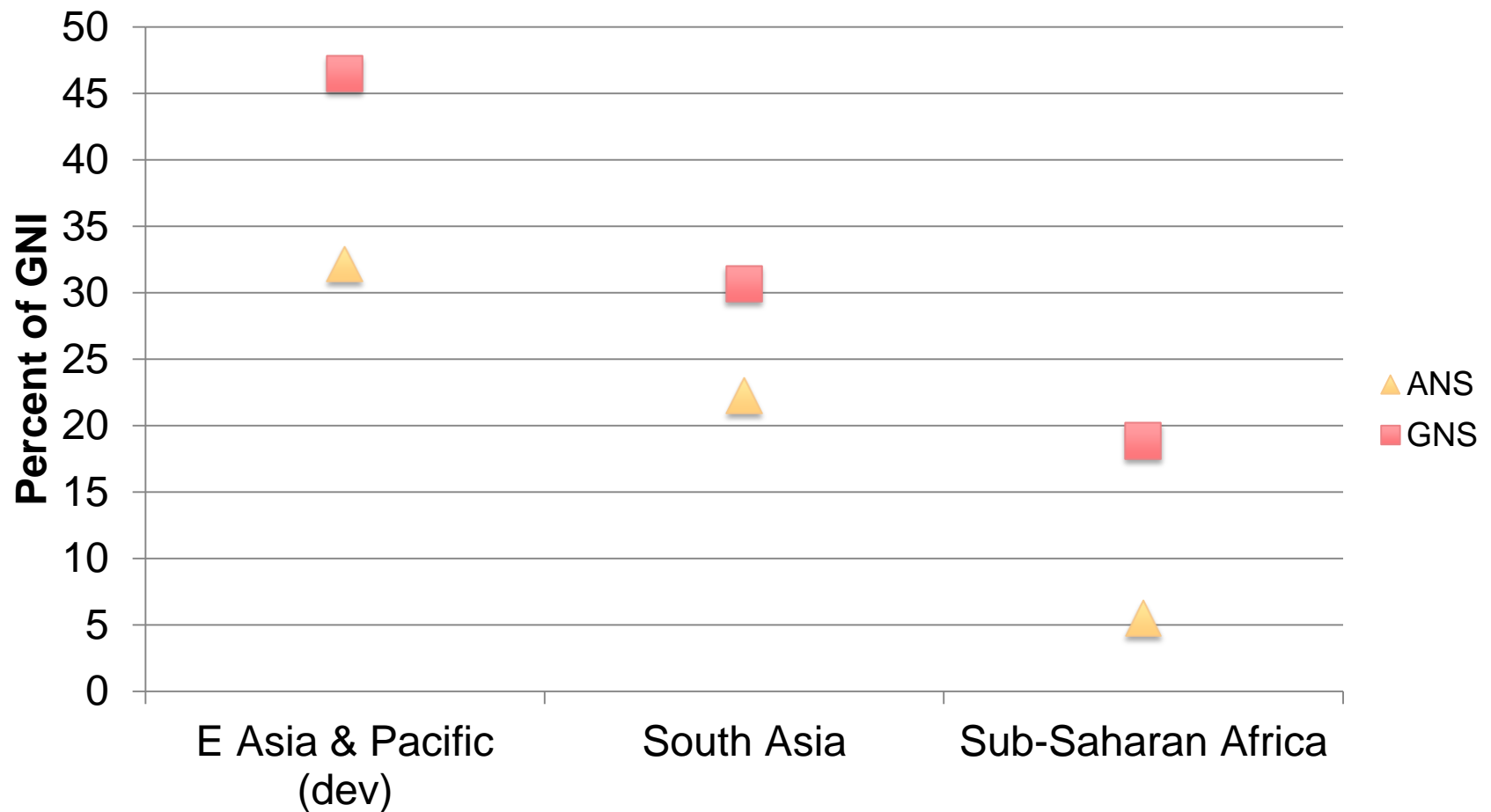
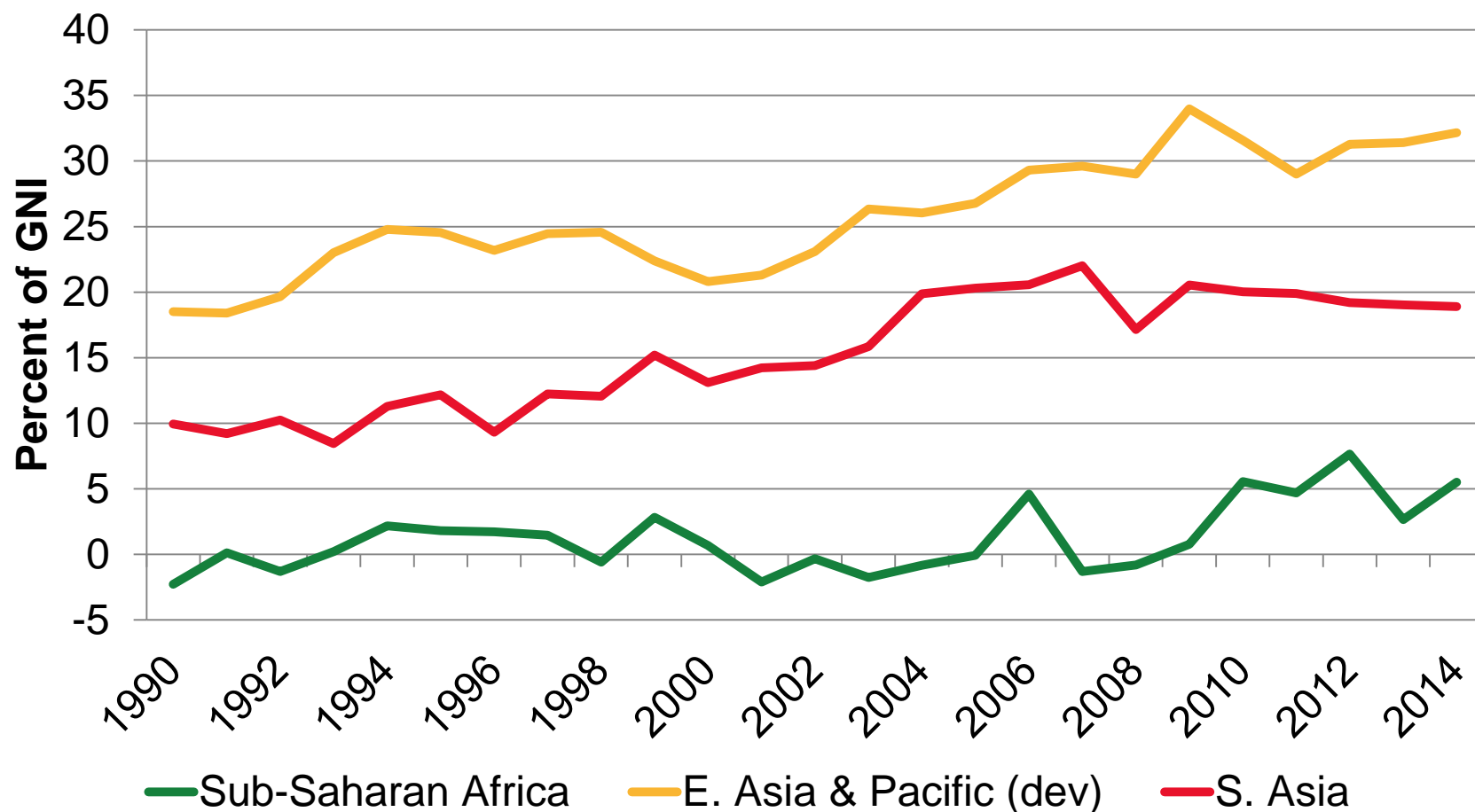# Adjustments to national savings 2 – adjustment items
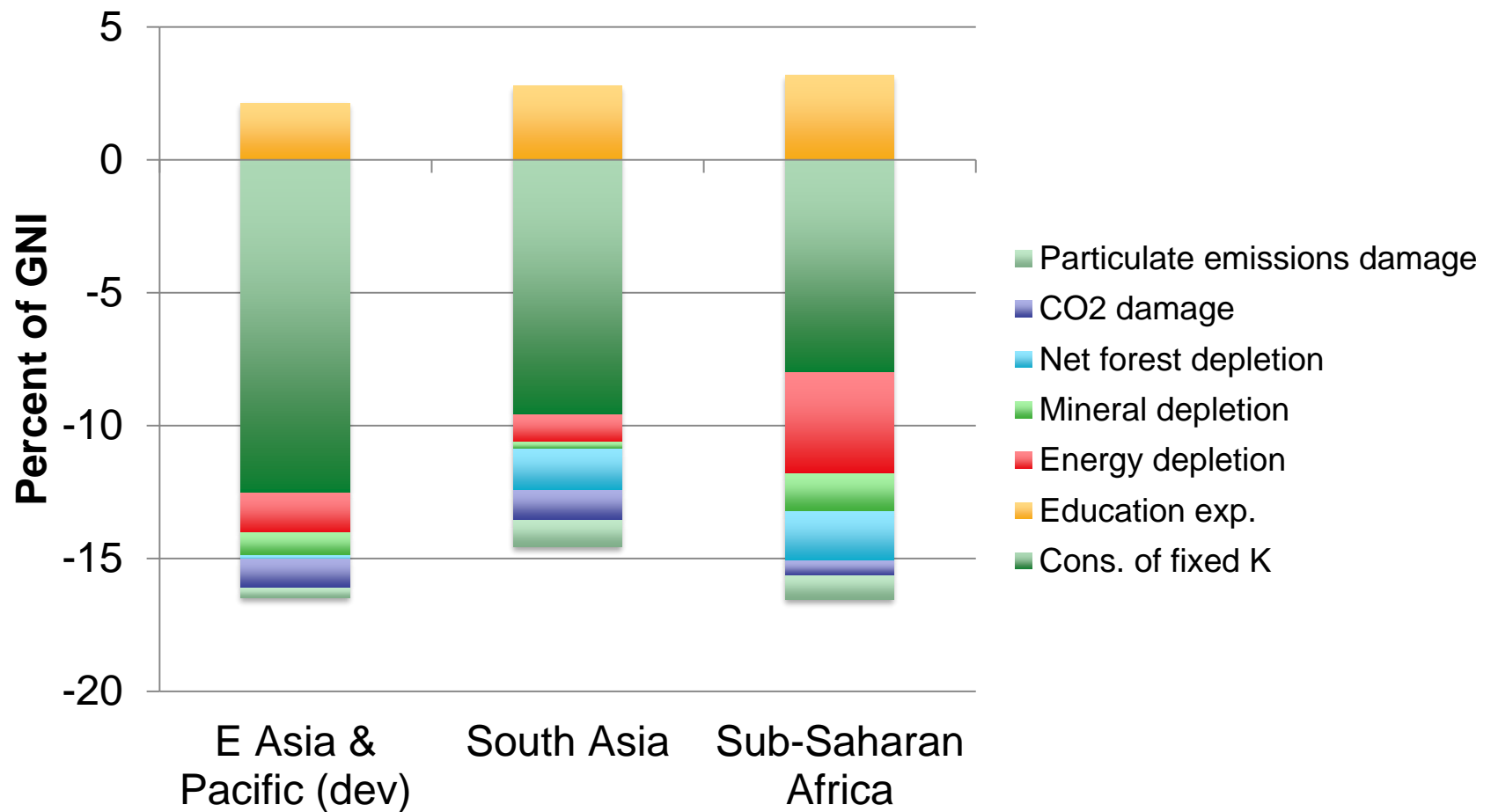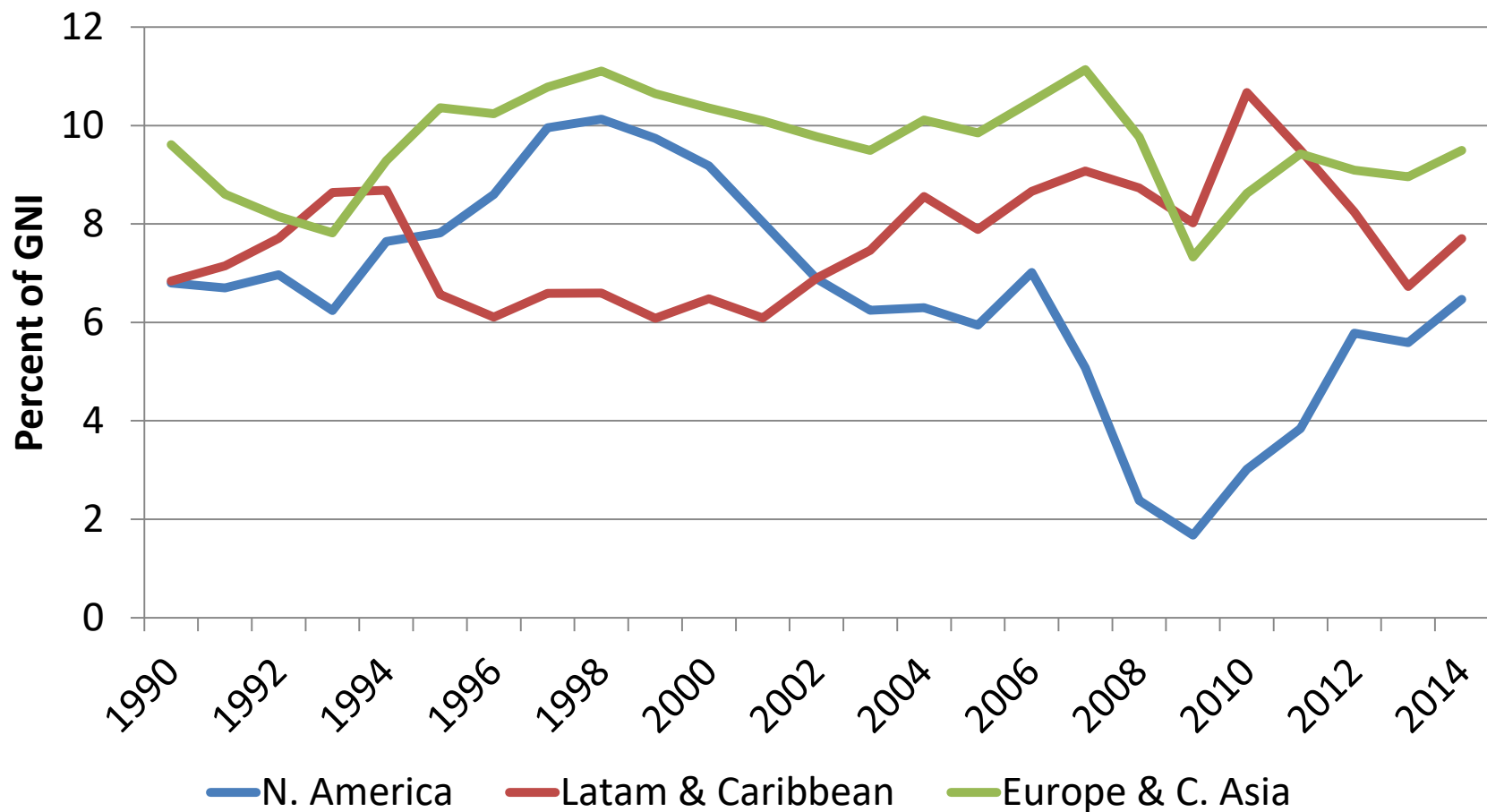
East Asia: adjusted net savings, 2014
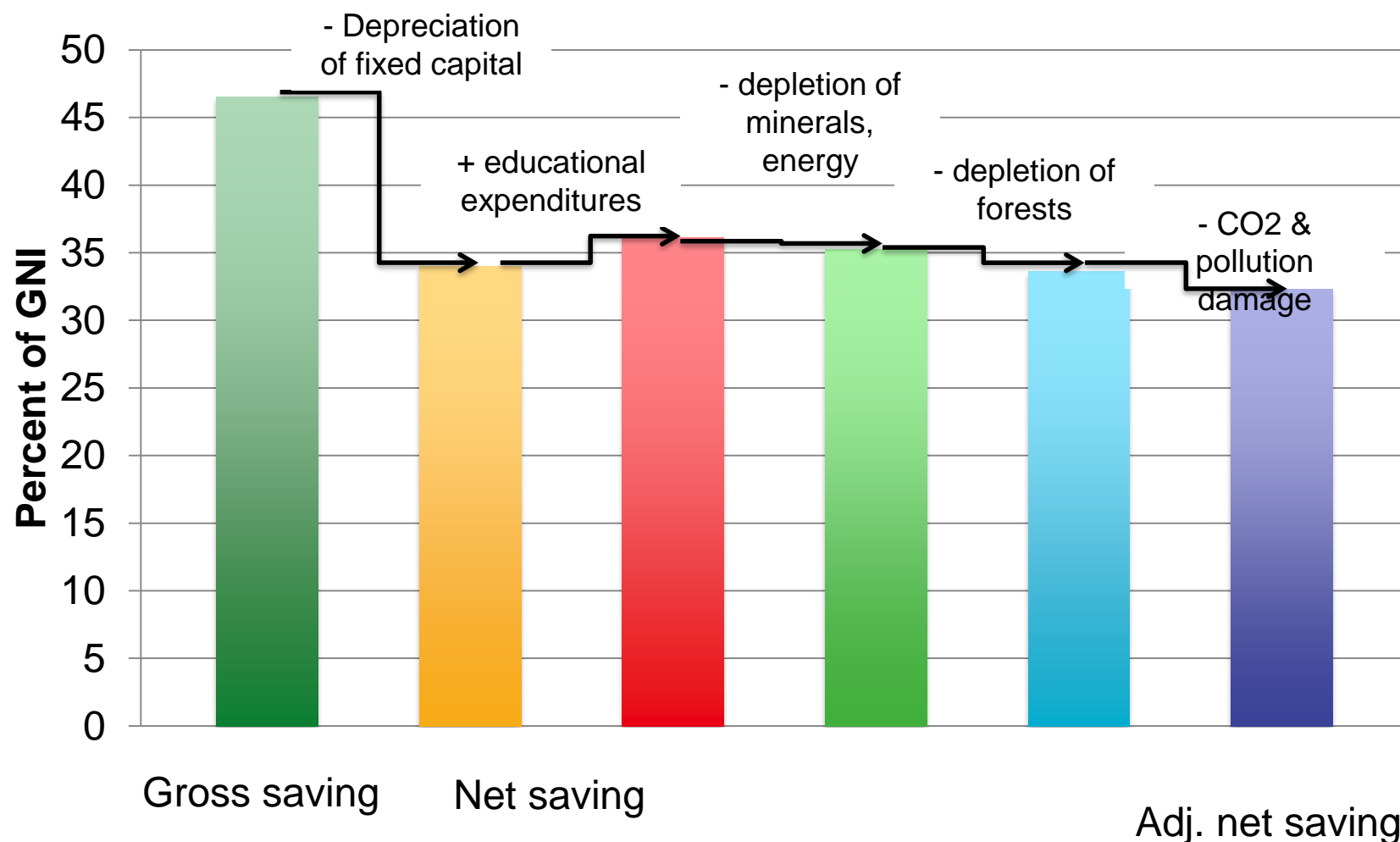
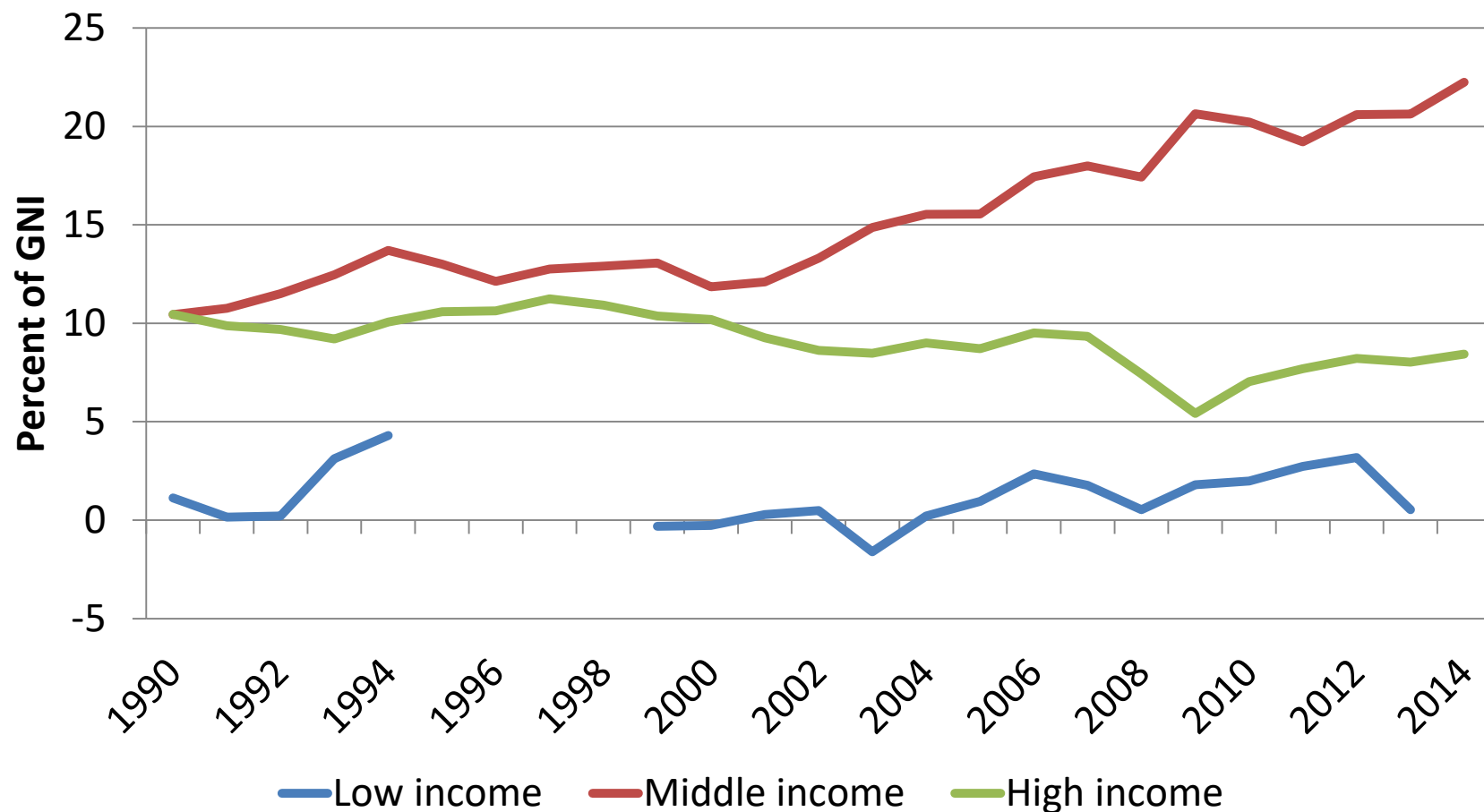# Sub-Saharan Africa: adjusted net savings, 2014
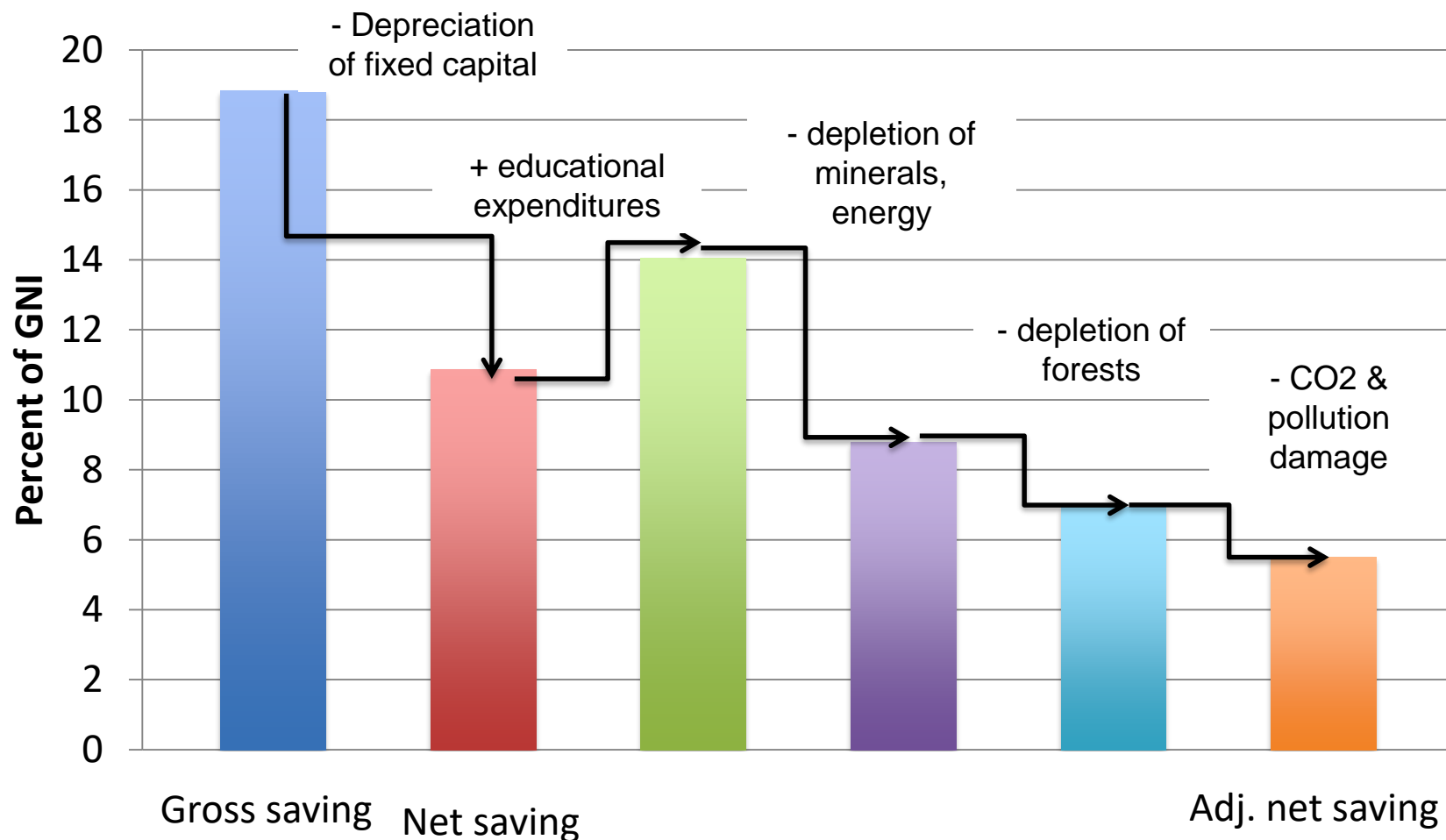
Long-run trends in Adjusted Net Savings (E. Asia, S. Asia, SS Africa)

Long-run trends in Adjusted Net Savings (LAC, Europe, N. America)

Long-run trends in Adjusted Net Savings (Low, Middle and High Income)

WORLD BANK ESTIMATES OF ADJUSTED NET NATIONAL INCOME

Adjusted Net National Income

ANNI =

Gross National Income
- Consumption of Fixed Capital
- Depletion of Natural Capital *(Energy, Minerals, Timber)*

ANNI is a measure of the available income that can be consumed or invested to increase the nation's future consumption

ANNI is within the SNA asset boundaries

Adjusted Net National Income (ANNI) - WB

Gross Domestic Product (GDP)

- *Add*: net receipts from compensation of employees from abroad
- *Add*: net property income from abroad

Gross National Income (GNI)

- *Deduct*: consumption of fixed capital (depreciation)

Net National Income (NNI)

- *Deduct*: consumption of natural capital (energy, minerals, timber resource depletion)

Adjusted Net National Income (ANNI)

Measuring Adjusted Net National Income

Gross National Income	Sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.	
Consumption of Fixed Capital	Replacement value of capital used up in the process of production.	
Depletion of Natural Capital	Subsoil Depletion (10 minerals, 4 energy resources)	Estimated directly
	Net Forest Depletion	Estimated directly
Adjusted Net National Income (ANNI)	ANNI = Gross National Income – Consumption of Fixed Capital – Depletion of Natural Capital	

Adjustments to GNI - ANNI

Globally, GNI is reduced by 17.4% by negative adjustments

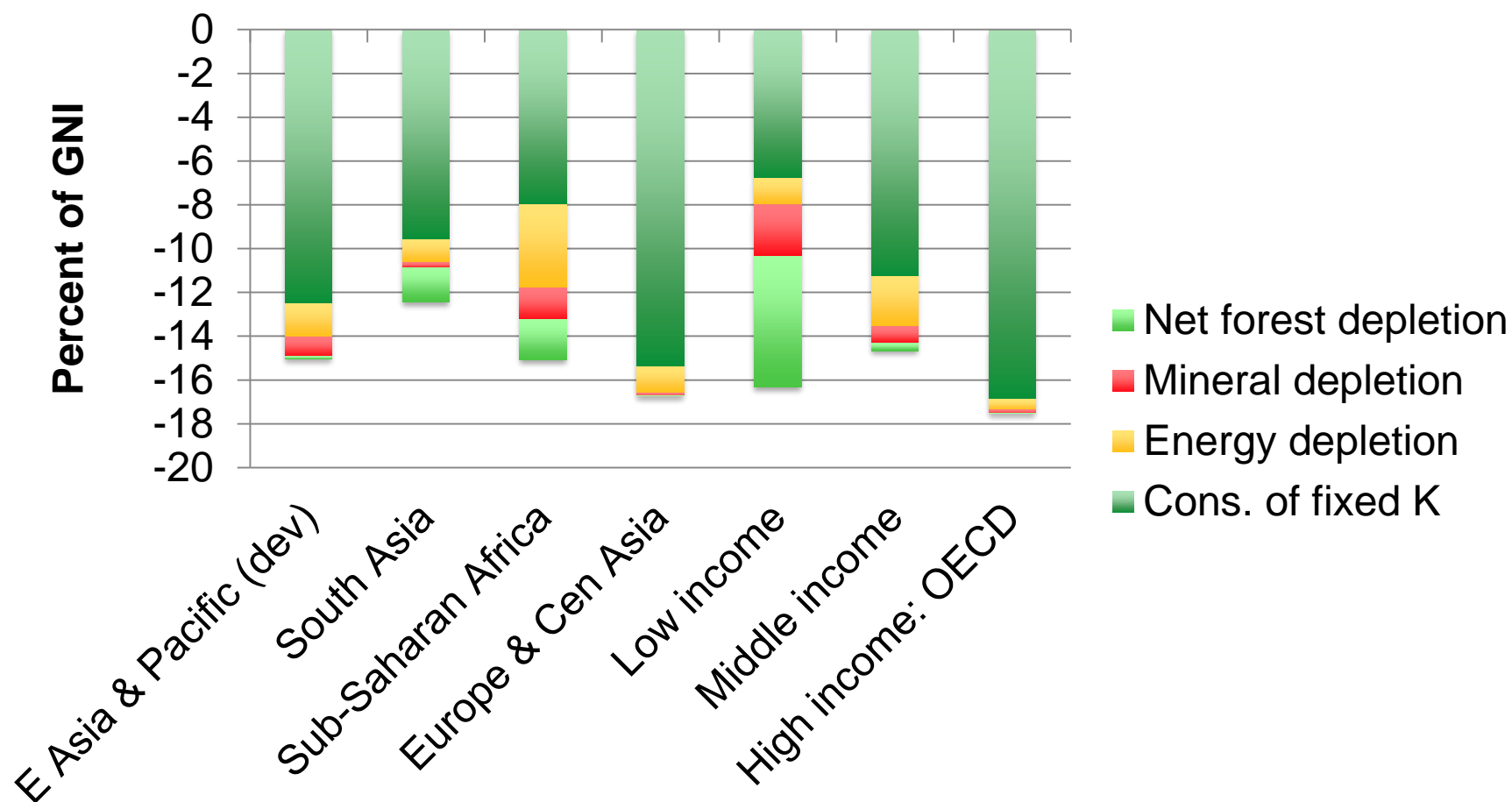**Most of the negative adjustment is from consumption of fixed capital**

But the contributions vary across country groups

Low income countries much more affected by energy, mineral and forest depletion

Adjustment	Amount (% of GNI)
Cons. of fixed K	-15.7
Energy depletion	-1.4
Mineral depletion	-0.4
Net forest depletion	-0.1

Average figures, 2006-2015)

Adjustments to GNI - ANNI

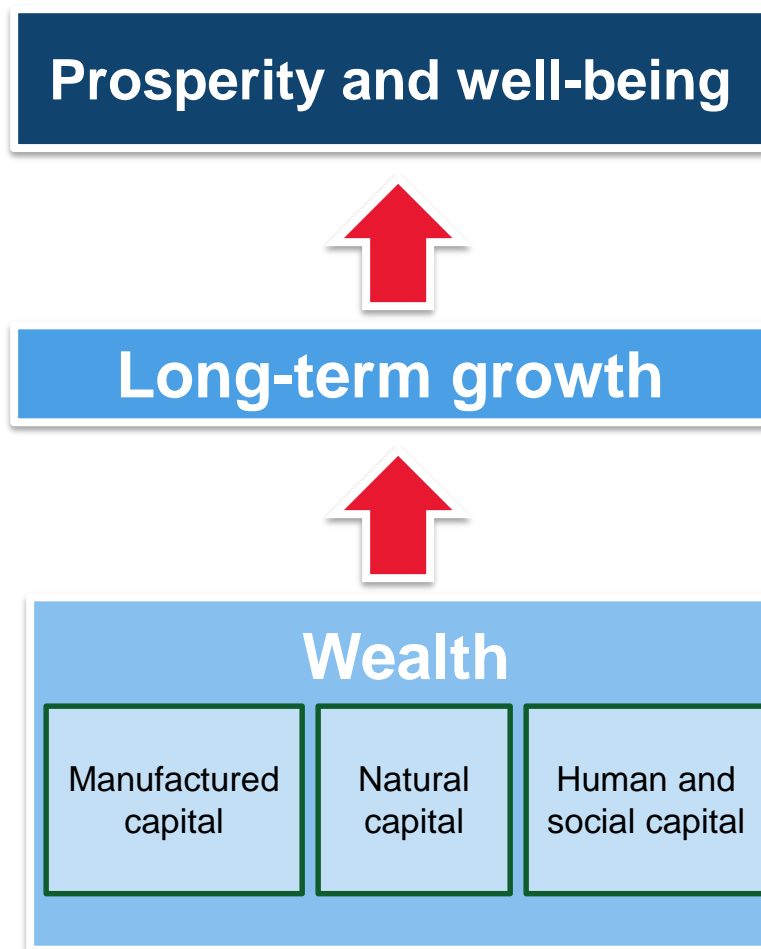# WORLD BANK ESTIMATES OF COMPREHENSIVE WEALTH

Why Measure Wealth?

Change in GDP tells us if growth is occurring, **changes in wealth tell us if growth is sustainable**—that is, whether this is long-term growth.

Economic development is a process of **building wealth** and managing this portfolio of assets

Only a small number of countries compile **wealth accounts**, and even **fewer include natural capital**

Prosperity and well-being

↑

Long-term growth

↑

Wealth

| Manufactured capital | Natural capital | Human and social capital |

World Bank – Wealth Estimates

World Bank estimates of national wealth cover:

Human capital

Financial capital (net foreign assets)

Produced capital

Natural capital (crop and pasture land, forests etc.)

Mineral wealth (sub-soil assets)

World Bank Methodology (2014)

Produced Capital

Based on Perpetual Inventory Method (PIM) (described in detail later in this training exercise)

Uses national accounts data on gross fixed investment (GFCF)

Financial Assets

Net Foreign Assets (from balance of payments)

Mineral Assets and other Natural Capital

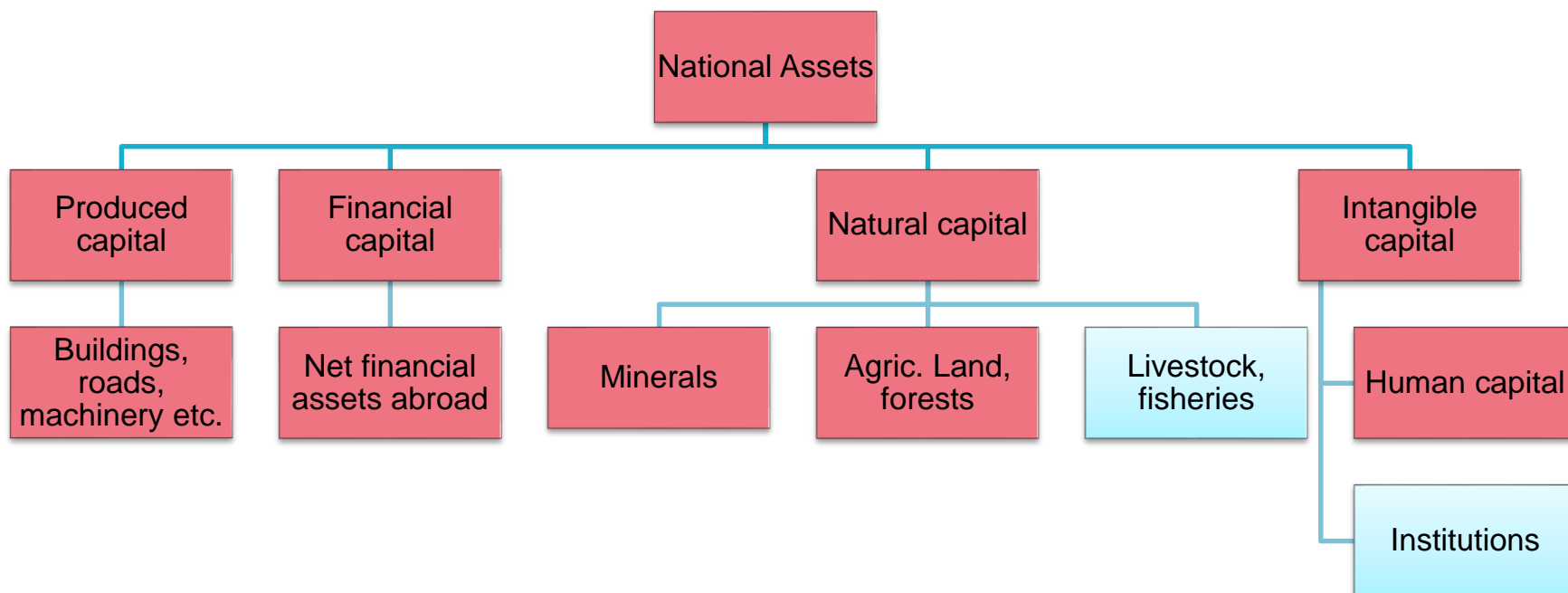Based on calculation of PV of mineral / resource rents
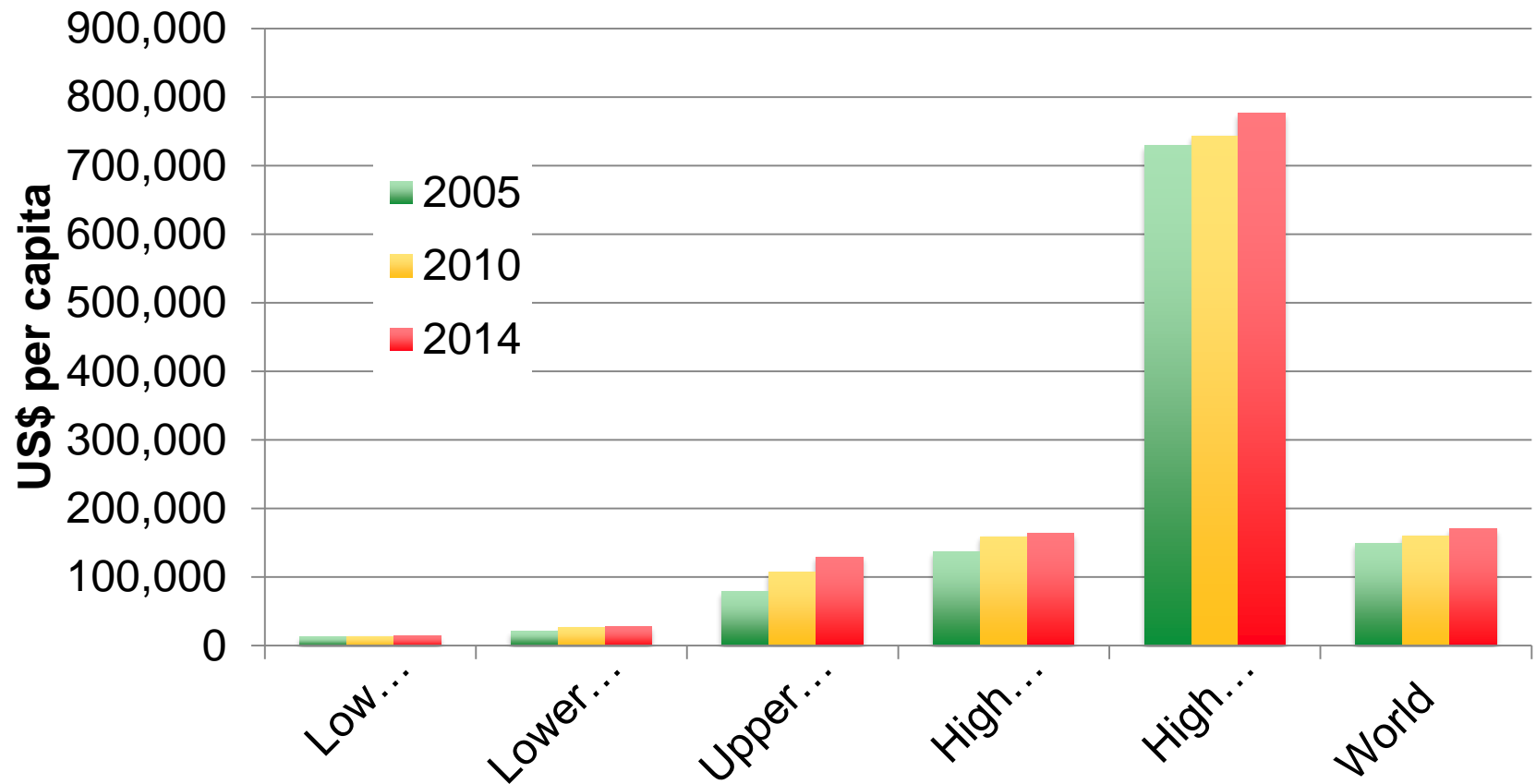
Human capital

Based on PV of wages

Total capital (wealth)

Sum of the above
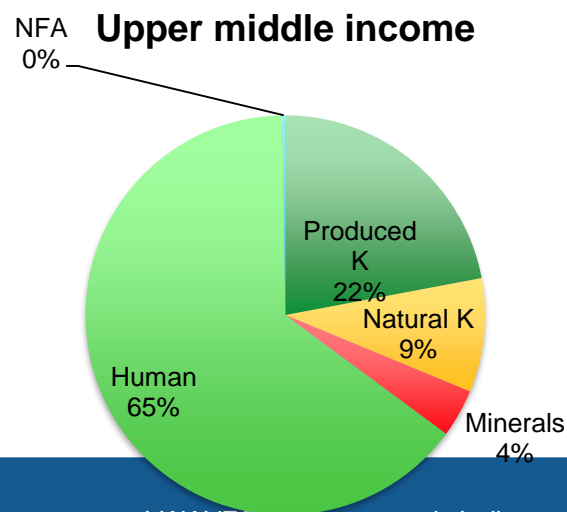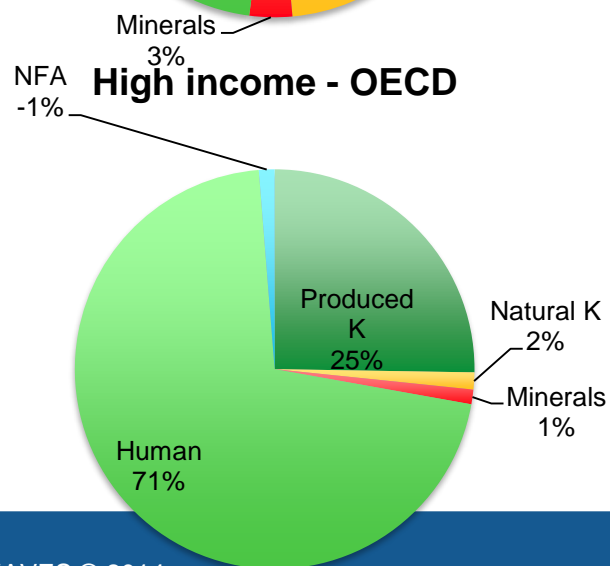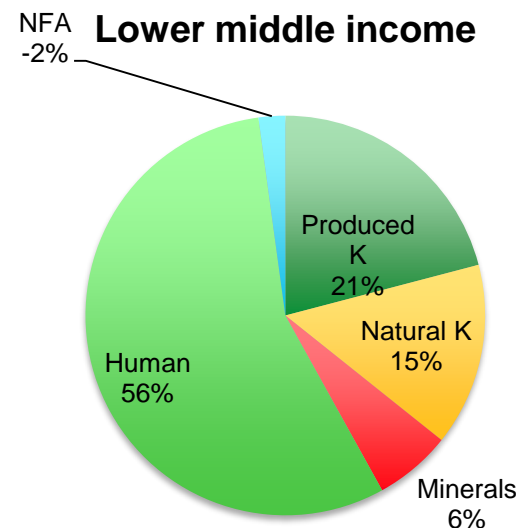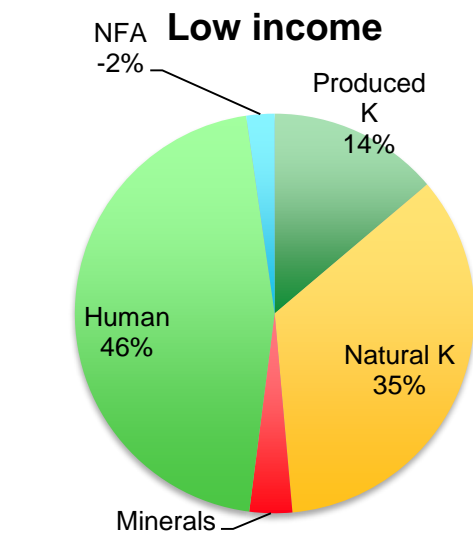
National Balance Sheet

The latest World Bank dataset covers most forms of capital (excludes intangible capital – institutions and livestock, fisheries)

Estimates of Comprehensive Wealth per capita (2014)

Composition of wealth – by country income level grouping (excl. NFA)

Low income

- NFA -2%
- Produced K 14%
- Natural K 35%
- Minerals 3%
- Human 46%

Lower middle income

- NFA -2%
- Produced K 21%
- Natural K 15%
- Minerals 6%
- Human 56%

High income - OECD

- NFA -1%
- Produced K 25%
- Natural K 2%
- Minerals 1%
- Human 71%

Upper middle income

- NFA 0%
- Produced K 22%
- Natural K 9%
- Minerals 4%
- Human 65%

Comments on composition of wealth

Natural capital is most important in low-income countries – more than twice as high as produced capital

In lower & upper middle income countries, produced K is more important – similar in magnitude to natural K

Human capital becomes more important as income level rises

High income (OECD) countries depend little on natural/mineral wealth

Changes in per capita wealth, 2005-14

Country Grouping	Change in real wealth
Low income	17.1%
Lower middle income	34.9%
Upper middle income	65.1%
High income: non-OECD	20.1%
High income: OECD	6.6%
East Asia & Pacific	89.8%
Europe & Central Asia	8.0%
Latin America & Caribbean	13.1%
Middle East & North Africa	15.0%
North America	2.4%
South Asia	44.8%
Sub-Saharan Africa	11.4%
World	14.4%

Composition of wealth – Africa & Asia
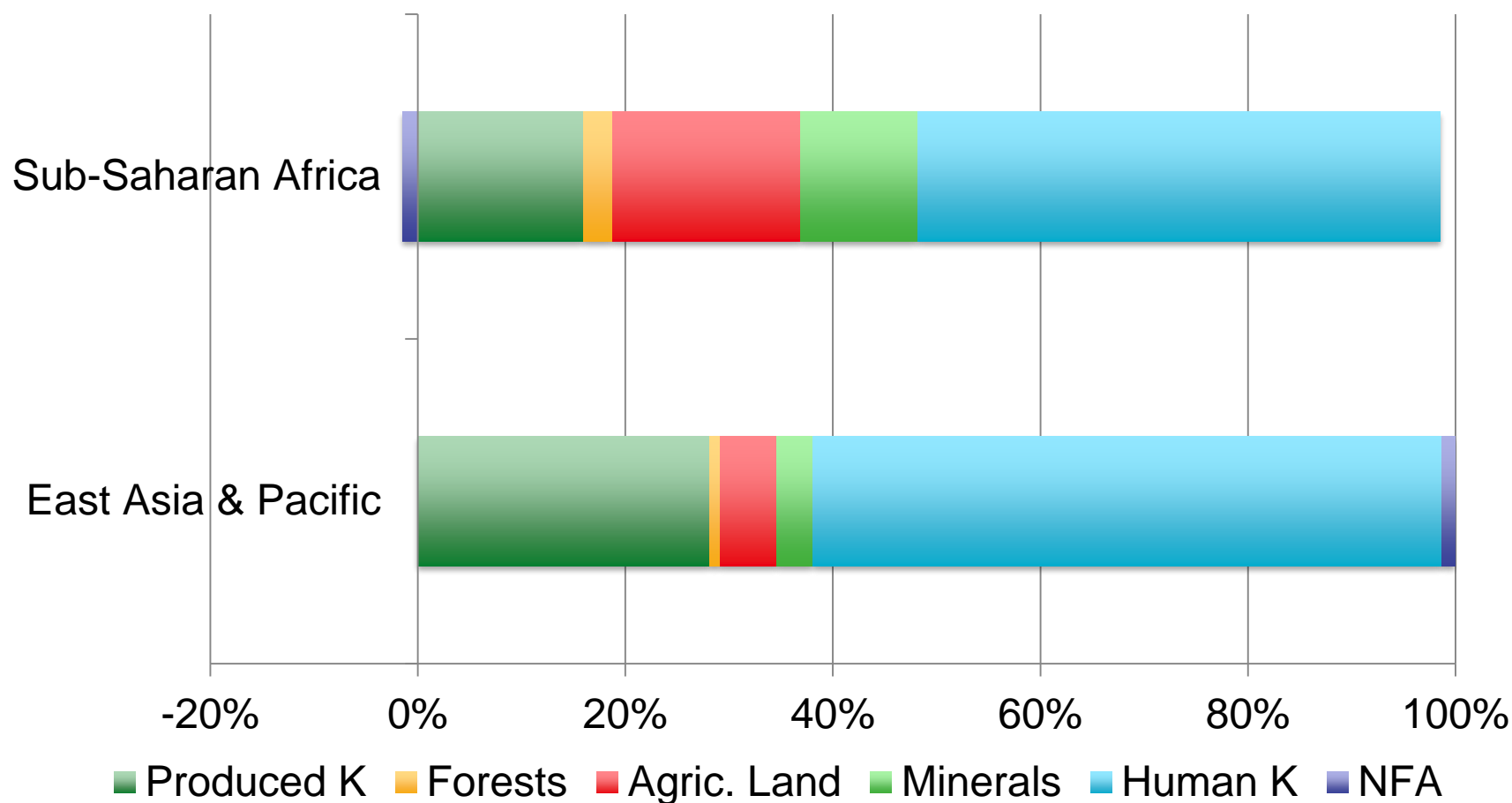
Exercise

Using the World Bank Data Extract from Wealth Accounts:

For each of the 3 countries you have chosen, extract data from the wealth accounts dataset, and prepare bar charts showing the comprehensive wealth **per capita** for each country in 2014.

Categories: Produced Capital, Sub-soil assets (minerals), Agricultural Land, Forests, Human capital, Net Financial Assets

What differences can you see in the composition of comprehensive wealth across the three countries?

END OF DAY ONE!