I-WAVES
Training on Macroeconomic Indicators

Session 3a: Building Comprehensive Wealth Accounts in Indonesia

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Wealth Accounting and the Valuation of Ecosystem Services
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Outline

Contribution to total wealth – conventional assets

Net foreign assets

- **Methodology and data trends**

Produced capital

- **Data sources & methodology for calculation**

Extending to other assets – natural and human capital – using World Bank data

Mineral and energy wealth

Human capital

Land

Calculating overall national wealth

BUILDING CONVENTIONAL WEALTH ACCOUNTS

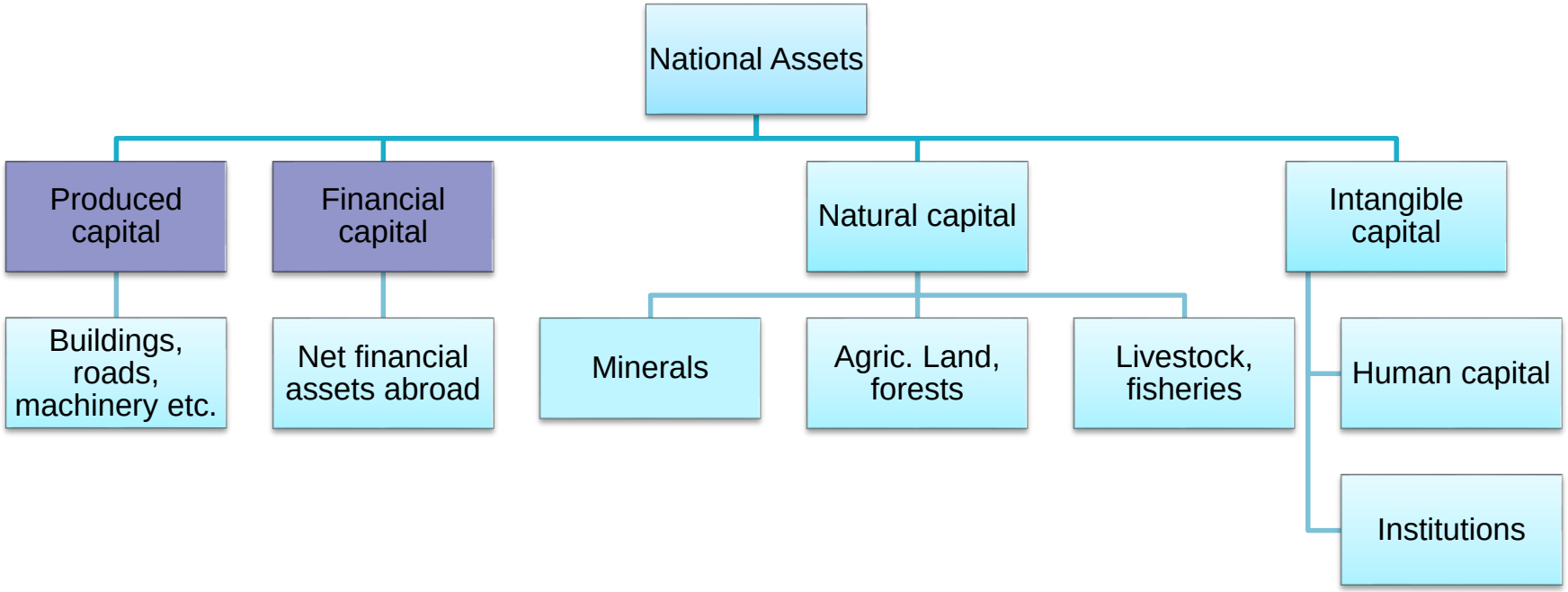
Conventional Wealth Accounts

Some data are available to construct conventional wealth accounts for Indonesia, notably:

Financial assets: International Investment Position

Produced Capital Stock (Government and Private Capital)

National Balance Sheet



Conventional wealth accounts focus on Produced Capital and Financial Assets. We will start with these before extending to include elements of natural and human capital.

Description of Asset Classes

Asset class	Comments / Data
Produced capital	• Not available from national sources [?] • Estimates from various international sources

(Net) Financial assets	• Assets held abroad by Indonesian residents (govt., firms, individuals)
	  • Mainly official foreign exchange reserves and external pension fund assets
	• Net of liabilities to non-residents
	  • Mainly inward FDI and govt. borrowing abroad

NB Financial assets do not include domestic assets, as each asset is offset by an equal liability (so the net amount is zero)

Conventional National Balance Sheet

	Produced capital assets
Plus:	Financial Assets
Equals:	Total Assets
Less:	Financial Liabilities
Equals:	Net Worth

We will consider:
- Calculation of the values of the different components
- The composition of total net worth (division between types of assets)
- Trends in total and individual assets (in real terms and relative to GNI)
- Changes in total assets

CALCULATING PRODUCED CAPITAL

Calculating Produced Capital

Produced Capital or Fixed Capital (FC) comprises various types of fixed assets used in the production of goods and services in an economy.

This includes:

Buildings – industrial/commercial & residential

Other construction (roads etc.)

Machinery (e.g. factory equipment)

Transport equipment (vehicles, trains, planes, ships etc.)

Agricultural capital (orchards, plantations etc.)

Produced Capital is a crucial input to the production process, as well as an important component of national assets (comprehensive wealth).

Calculating Produced Capital

The accumulation of Produced Capital results from investment

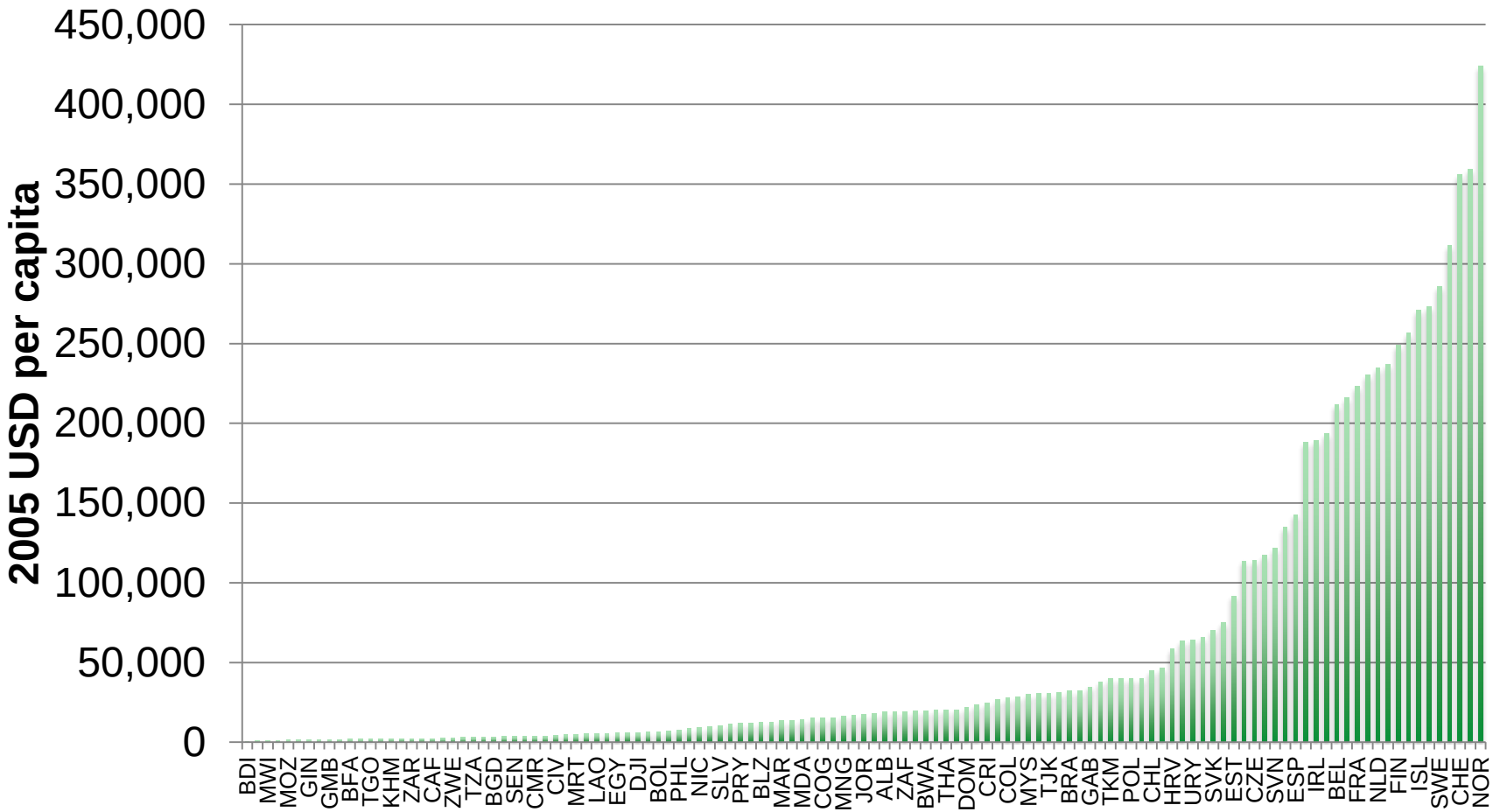
often referred to as Gross Fixed Capital Formation (GFCF), a component of GDP by expenditure

Investment (= capital accumulation), is an important driver of economic development

Higher levels of produced capital (per capita) are closely associated with higher levels of income

FC is also depleted by being consumed during the production process, and by disposals at the end of useful economic life.

Produced capital per capita, 2014



Calculating Produced Capital

Cannot easily be measured directly – has to be estimated indirectly

Capital stock (K) changes each year due to new investment (+), consumption of capital (-), and disposals (-), i.e.

$$K_1 = K_0 + Inv_1 – K\ cons_1 – K\ disp_1$$

Can estimate K at the end of a period if we have information on Investment, Capital Consumption, and Disposals.

Investment (GFCF) is part of the national accounts

Termed the Perpetual Inventory Method (PIM).

Consumption of Capital

Capital is consumed - used up - during production

Amount of annual capital consumption is related to the useful service life of capital assets

Similar to the use of depreciation in accounting

Varies between types of asset, e.g. buildings last longer than computers

But service lives vary from country to country and can be difficult to define

Corporate depreciation rates are driven by tax rules and may not reflect economic lives

Typical Service Lives of Capital Assets

Type of Asset	OECD	Australia	South Africa
Residential dwellings	50-75	40-90	50
Industrial buildings	40-60	50-65	50
Other construction	35	10-100	30-80
Transport equipment	10-25	15-30	8
Machinery	15-30	15-30	8-16
Computers	5-15	--	
Other	10-40	--	

Source: Statistics Netherlands, Perpetual Inventory Method; Australian Bureau of Statistics; SA Reserve Bank

Calculation of Capital Stock

- Capital stock calculations are generally done in real terms (constant price series)
- The resulting capital stock figures are then revalued to current prices using an appropriate price index
- In the absence of a capital stock price series, we can use the GFCF deflator to construct an asset price index series

Produced capital stock data for Indonesia

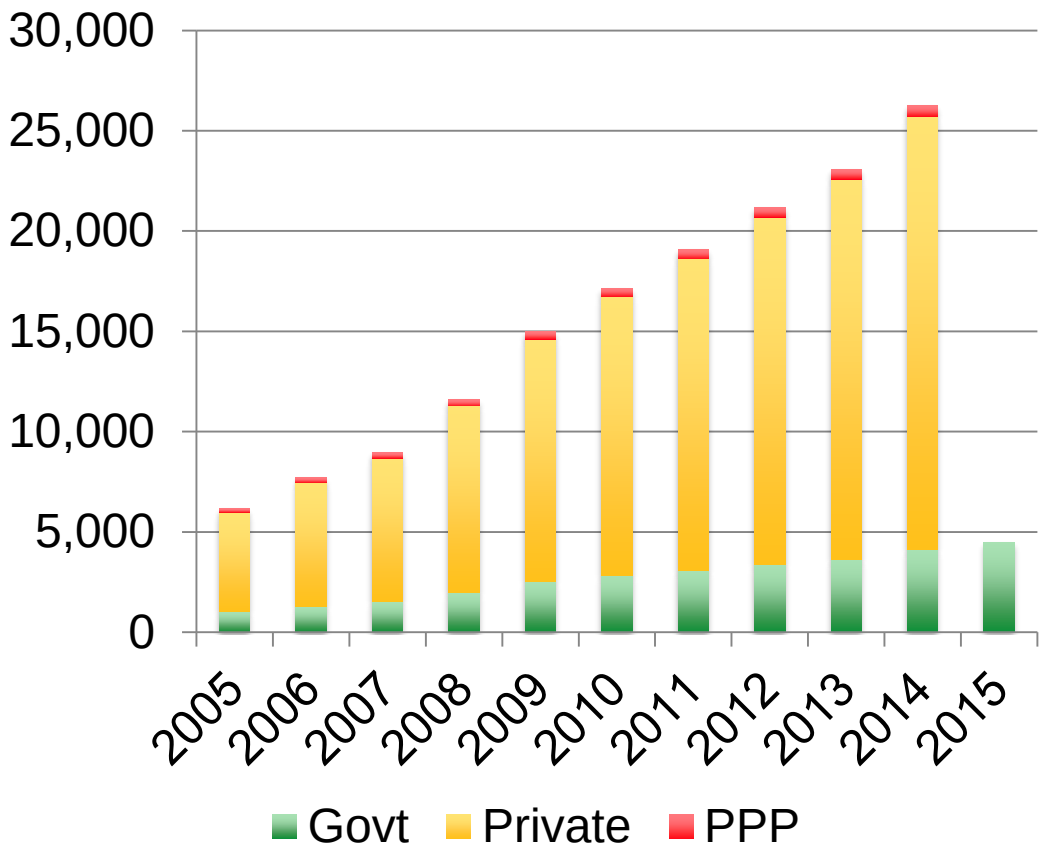
No data available from BPS?

Data available from IMF Investment and Capital Stock database, covering the period 1970-2015

Divided into:

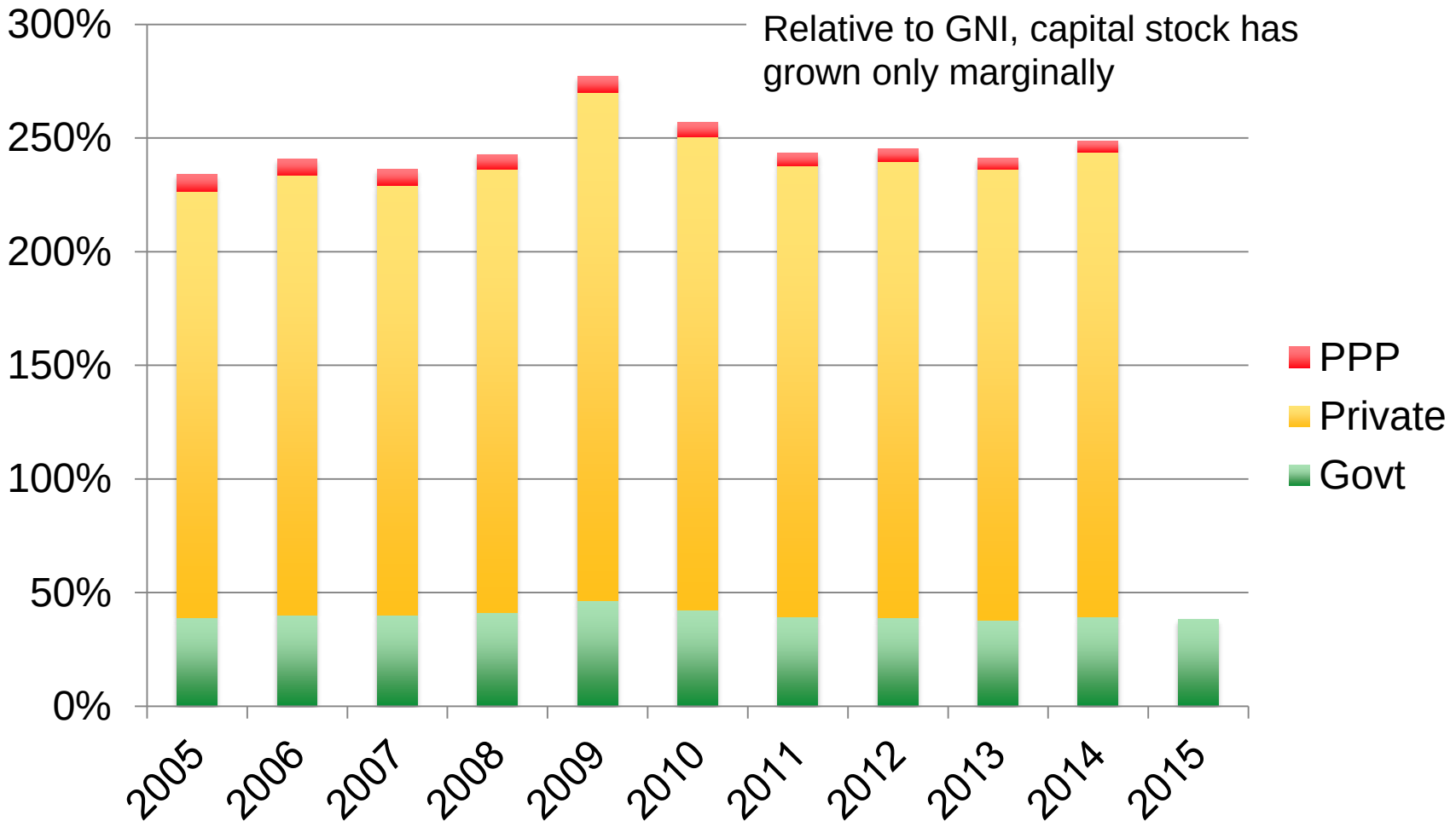
- Private capital stock
- Public capital stock
- Public-private JV capital stock

IMF Capital Stock Data series for Indonesia, 2005-15 (IDR trn)



- Majority of capital stock (produced capital) is private (avg. 81%)
- Rapid growth in capital stock – averaging 18% annual growth
- But GDP was also growing, so was K stock growing faster than GDP?

IMF Capital Stock Data series for Indonesia, 2005-15 (% GNI)



NET FOREIGN ASSETS (INTERNATIONAL INVESTMENT POSITION)

Net Foreign Assets (International Investment Position - IIP)

Calculated by the Central Bank as part of the balance payments

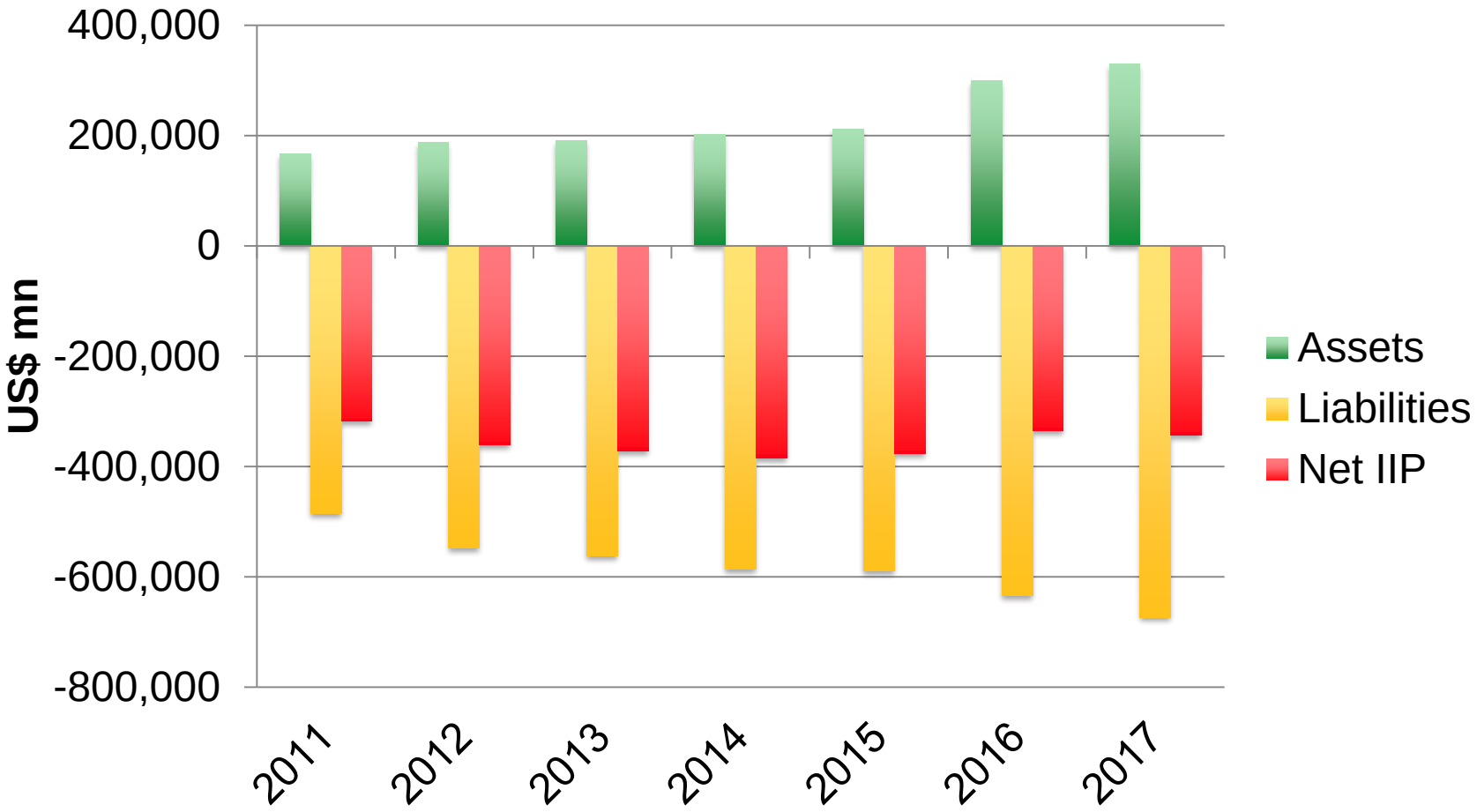
Assets held abroad by Indonesian residents (govt., firms, individuals)

- Mainly foreign exchange reserves and external pension fund assets

Net of liabilities to non-residents

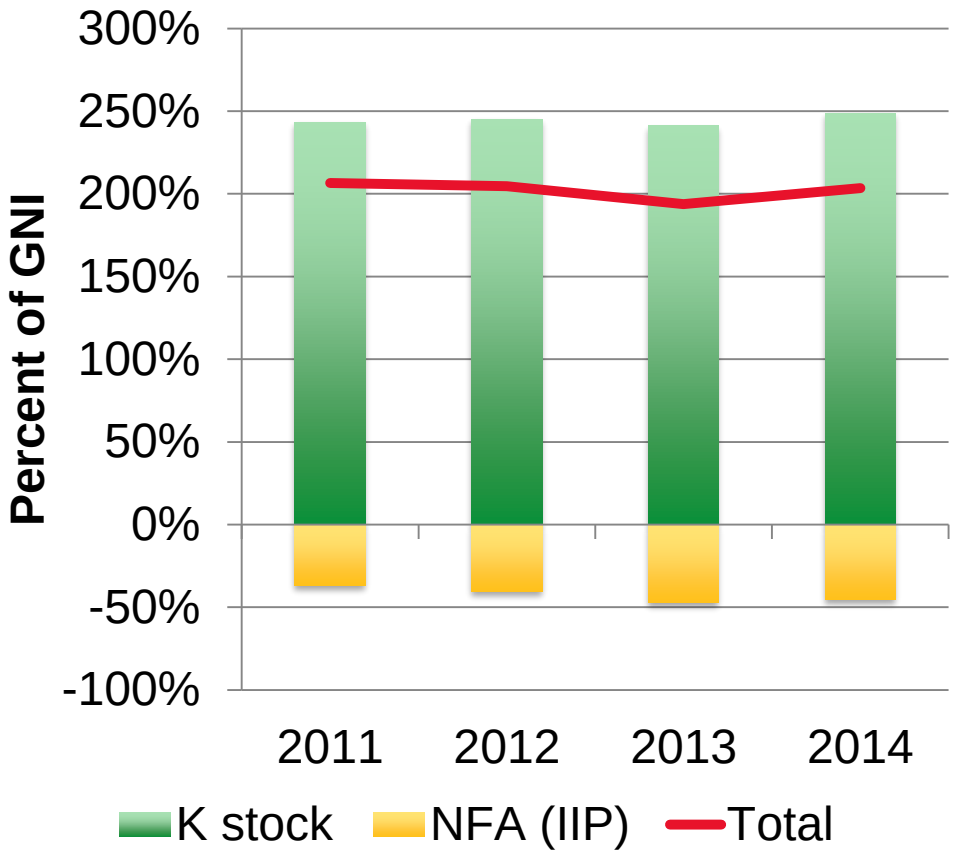
- Mainly inward FDI and govt. borrowing abroad

NFA - IIP


400,000
200,000
0
-200,000
-400,000
-600,000
-800,000
US$ mn
2011
2012
2013
2014
2015
2016
2017
Assets
Liabilities
Net IIP

Total Wealth (Conventional)

- Only have data to calculate sum of produced capital and NFA from 2011 to 2014
- Some fluctuations but relatively stable overall



MINERAL ACCOUNTS

Mineral and Energy Accounts

Mineral and energy accounts are an important component of natural capital accounting, and are used to calculate:

1. Mineral (and energy) rents – the surplus economic value derived from the exploitation and sale of mineral assets
2. Mineral and energy asset values

Rents (per unit) are used to value assets, so the two are connected

Valuation of Mineral Assets

Key objective:

- Valuation of un-mined mineral assets in the ground

Key inputs:

- Mineral reserves (physical quantities)
- Valuation of un-mined reserves (e.g. per unit)

Valuation of Mineral Assets

Mineral stock valuation depends on the future flow of rent or "income" from the resource

- Similar to a company being valued in terms of the future flow of profits
- Discounted to reach Net Present Value to take account of flows across time

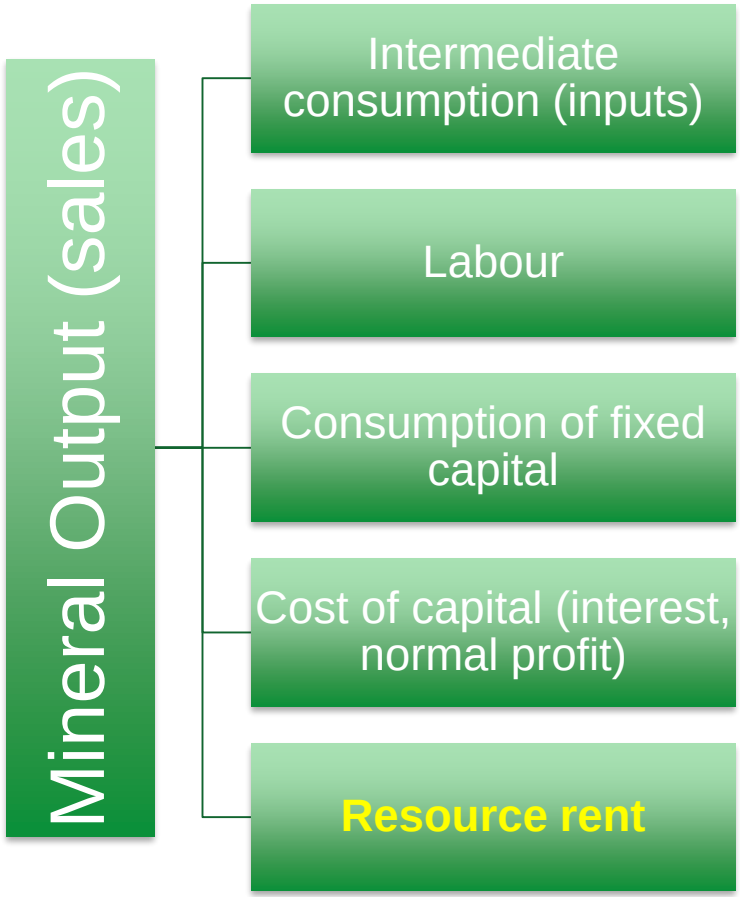
Hence we need:

- Depletion assumptions (rate of exploitation per year)
- Anticipated lifespan of mining
- Discount rate
- Valuation per unit of output (= mineral rent)

Valuation of Mineral Deposits: Calculation of (annual) Mineral Rent

Revenue from sale of mineral (Gross output)
Less: **cost of intermediate consumption**
Intermediate consumption (inputs excluding labour and capital)
Equals: **Value Added (GDP)**
Less: **costs of labour and capital inputs**
Labour costs (wages & salaries)
Equals: **gross operating surplus**
Less: Consumption of fixed (produced) capital (depreciation)
Less: Return to produced capital
Equals: **Resource rent**

Contributions to Value of Mineral Output



- Resource rent is a residual (hence depends on the accuracy of other valuations)
- If a mineral sells for a price that just reflects the costs of production, the surplus (i.e. resource rent) is zero
- Resource rent may be volatile from year-to-year, esp. if price of mineral fluctuates
- Use a moving average to reduce volatility
- Divide by the volume of output to get rent per unit (e.g. per tonne)

Calculating the cost of capital

One of the most difficult issues in mineral accounting is choosing the "cost of capital".

This represents the theoretical "normal" return on capital from economic theory

i.e. the return that is necessary to induce the owners of capital to use in the specified activity

Should include the pure cost of capital and an allowance for risk – which may be considerable in mining

Calculating the cost of capital

Possible benchmarks:

The government bond yield is not appropriate – this represents the risk-free rate of return and cost of funds for government – which may be far from the risk-adjusted cost of capital to a private investor.

Need to try and identify rate of return on that a “typical” mining investor might retire – but cannot always take claimed required return at face value.

In Botswana, we used a benchmark of 15% (in USD) as the required return for a mining investor (equivalent to 20% in BWP terms). This was based on information from mining companies and actual mining feasibility studies.

Valuation of Mineral Assets

Mineral stocks will not/cannot all be sold today, at today's price

Will be mined and sold over a period of time

Must take account of the fact that value will be realised at different points of time in the future

Simple assumptions:

Reserves will be mined at a steady rate until depleted (life of mine = reserve/current production)

Per unit value (rent) will not change (steady prices/costs)

More complex calculations can accommodate:

varying future rates of mining through to depletion

variations in prices/costs/rent

Choose and appropriate discount rate and then:

Discount returns occurring in future and calculate NPV of flow of future returns

Calculation of rents and mineral asset values: data requirements and sources

The calculations need to be done separately for each mineral

Data requirements and sources

Monetary data

Physical data

Sources: Statistics agency; Ministry responsible for mining; Mining companies

Simple valuation of mineral assets

Assumptions:

- Life of mine = *t*
- Constant annual rent per unit of output = *R*
- Constant annual output (units) = *X*
- Discount rate (real) = *d*

Formula for NPV of mineral reserve:

$$NPV = R.X.\left[\frac{(1+d)^t - 1}{d(1+d)^t}\right]$$

World Bank has produced valuations of various mineral assets for Indonesia

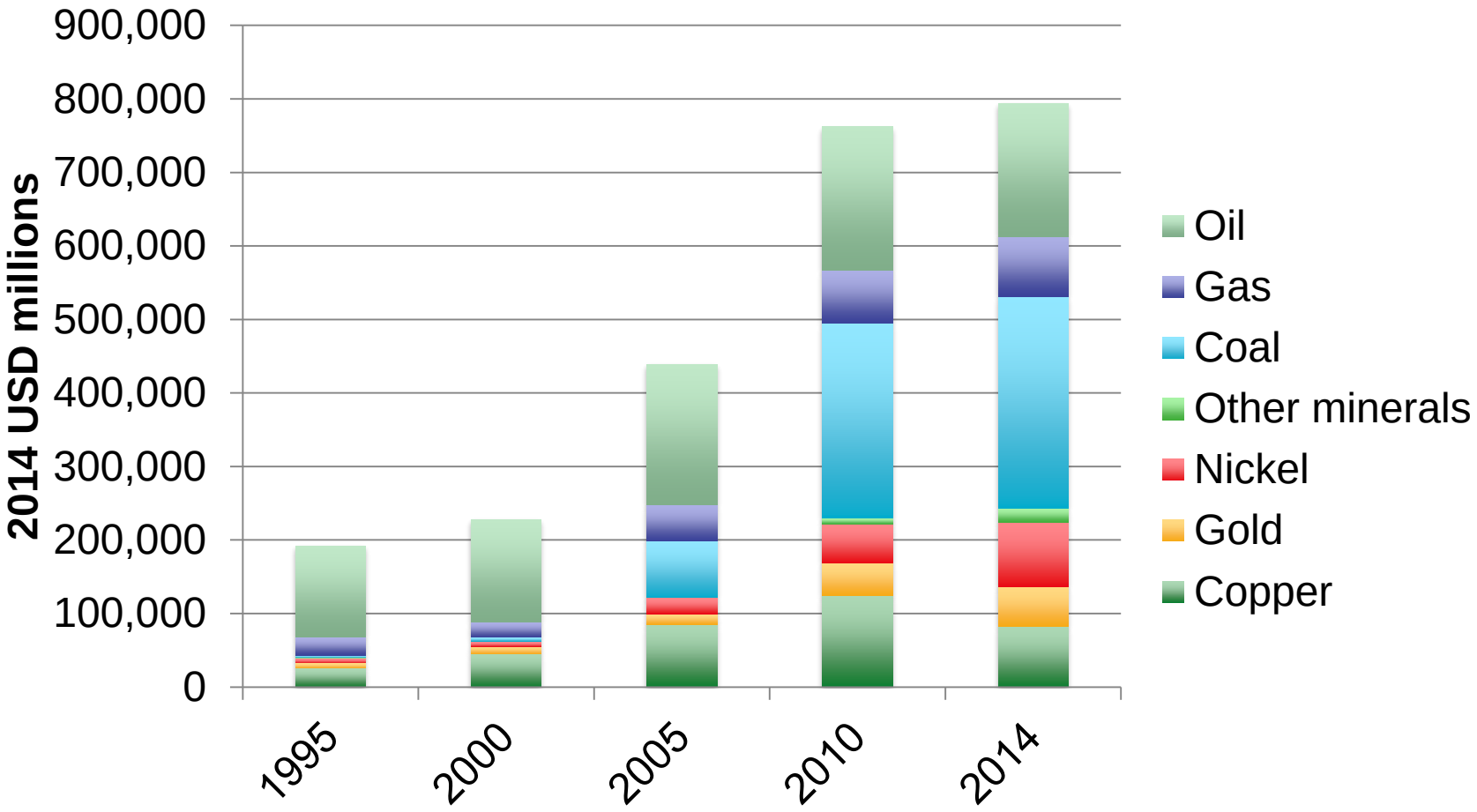
Minerals

- Bauxite
- Copper
- Gold
- Iron ore
- Nickel
- Phosphate
- Silver
- Tin

Energy

- Coal
- Gas
- Oil

World Bank Mineral and Energy Asset Values in Indonesia



EXAMPLE: MINERAL ASSET VALUATION

Mineral Asset Valuation

We do not have sufficient data to prepare mineral accounts, yet

But we can work a hypothetical example using data and assumptions for coal

Data requirements (for coal industry):

Gross output
Intermediate consumption
Value added
Compensation of employees
Consumption of fixed capital
Capital stock
Production (tonnes)
Reserves (tonnes)
Return on capital

We have data on the items in bold (from export data); for the purposes of the exercise, can make assumptions about remaining values

Mineral asset valuation

Assumptions (financial):

Intermediate consumption = 40% of value of GO

Compensation of employees is 15% of value of GO

Fixed investment is 10% of value of GO

Depreciation is 10% of value of fixed capital

Return on capital = 10%

Assumptions (physical)

Opening coal reserves in 2005 = 20,000 billion tonnes

New discoveries

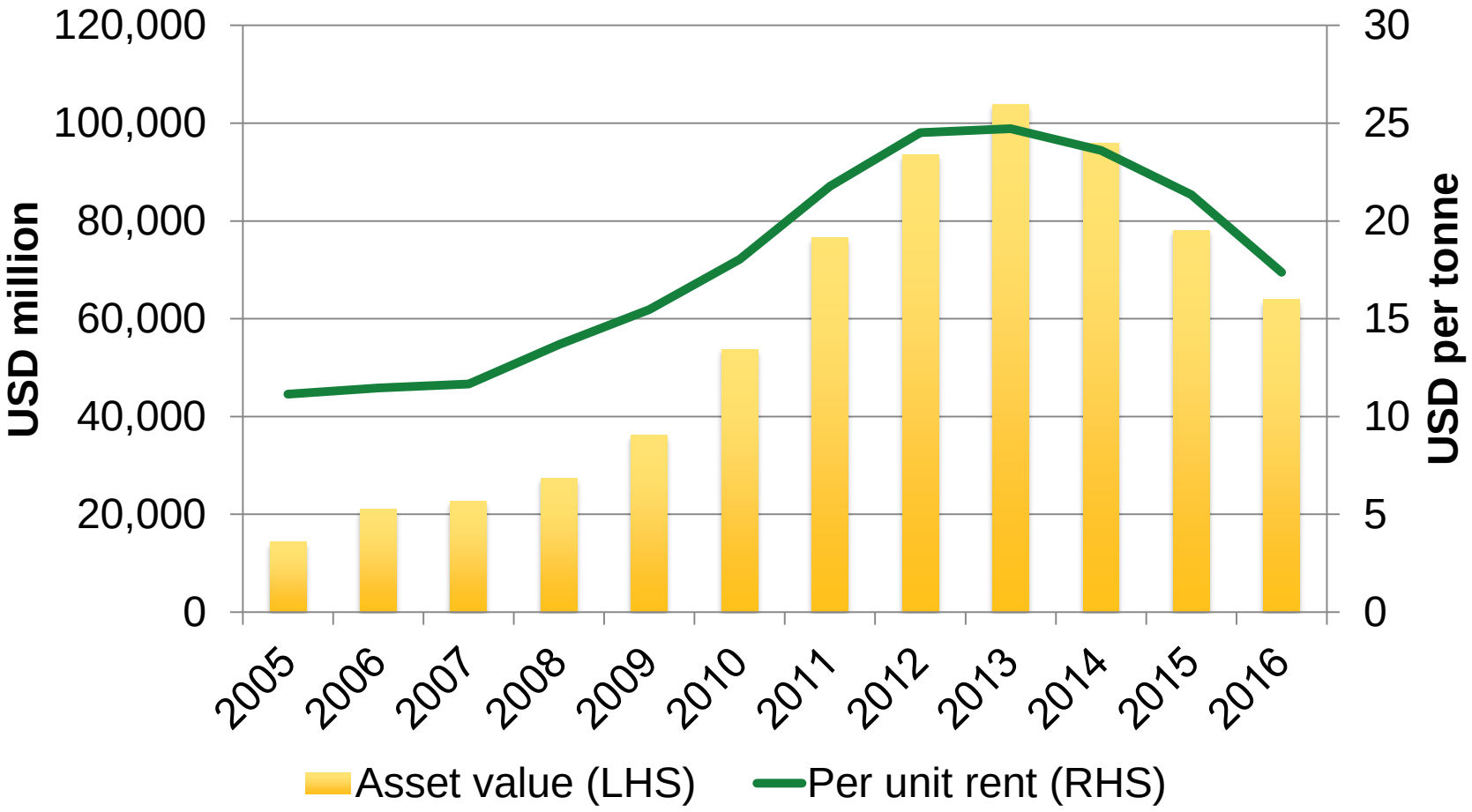
Example of calculation for coal - 2015

	Data item	Value (USD mn)	Notes
1	Gross output	14,511.1	Actual export value
2	Intermediate consumption	5,804.5	40% of GO
3	Value added	8,706.7	[1]-[2]
4	Compensation of employees	2,176.7	15% of GO
5	Gross operating surplus	6,530.0	[3]-[4]
6	Consumption of fixed capital	1,292.6	10% K stock
7	Return on capital	1,308.5	10% of K stock
9	Rent	3,928.9	[5]-[6]-[7]
10	Capital stock	13,084.7	

Example of calculation for coal, 2015

	Data item	Value	Note
11	Physical production (million tonnes)	368.9	
12	Rent per unit of production (USD)	10.7	[9]/[11]
13	Rent (5yma)	17.4	
14	Unmined Reserves (mt)	22,456	
15	Remaining lifespan (years)	60.9	[14]/[11]
16	Valuation of reserves (USD mn)	63,919	NPV of annual rents

Estimates (on the basis of assumptions) – unit rent and value of reserves



INCORPORATING HUMAN CAPITAL INTO THE NATIONAL BALANCE SHEET

Why Human Capital?

Consistency across flow and stock accounts

Extended national accounts (adjusted net savings etc.) included educational expenditures as a form of saving (and hence implicitly as investment)

As a parallel, the extended national balance sheet should also include human capital

More accurate measurement of sustainability

Sustainability implies maintaining capital stock (per capita) from one generation to the next

As countries get richer, human K makes up a larger component of total K

Hence inclusion of human K gives a more accurate measurement of sustainability

Why Human Capital?

Impact Effectiveness

Education typically accounts for a large share of public spending (often the largest)

Need to justify this in terms of impact – given other competing claims on public resources

Human capital has important links:

An important determinant of income levels

A buffer against shocks

Determinant of inequality

Increasingly important as world becomes knowledge-based and globalised

What is Human Capital?

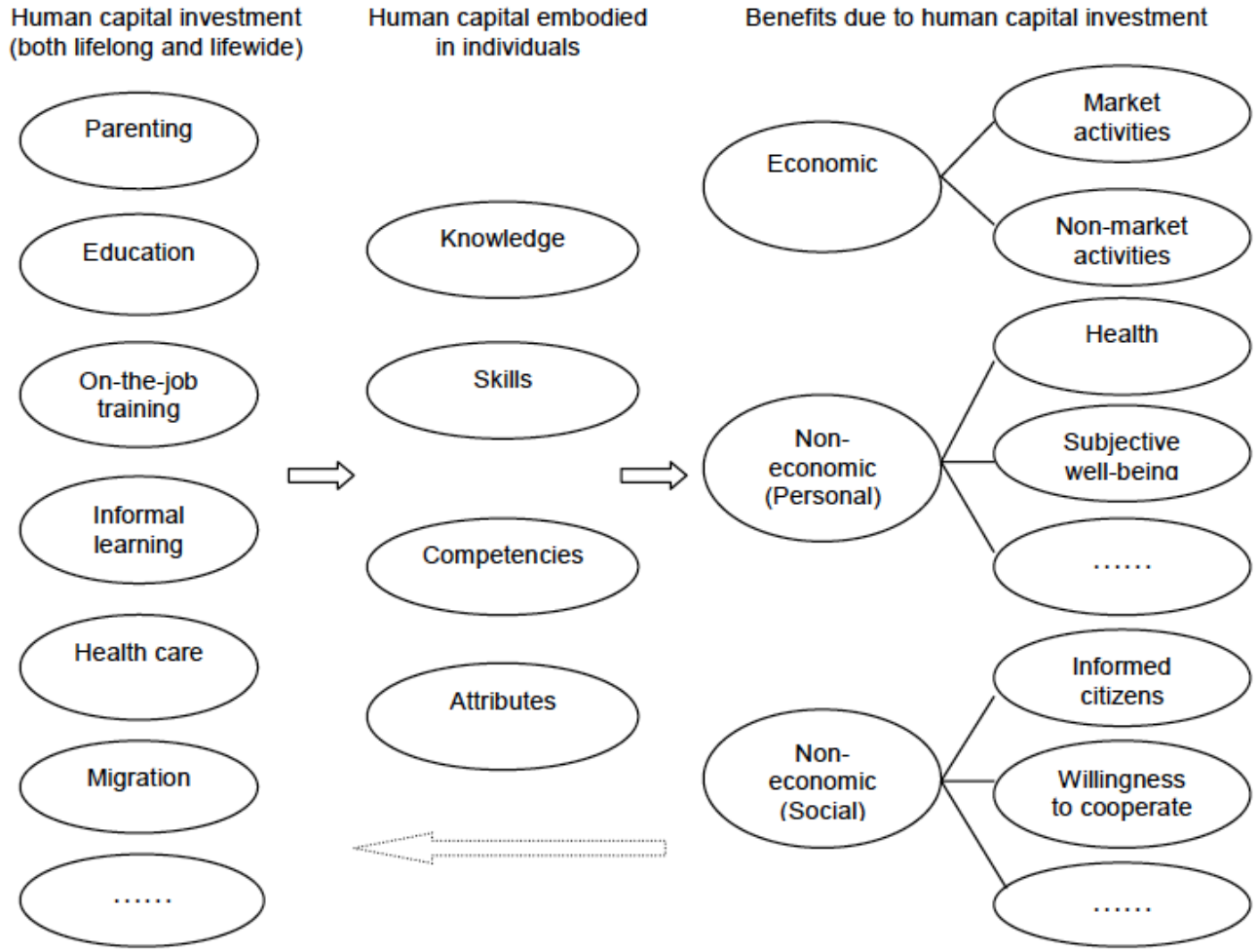
Human capital is complex

Many different ways of building human capital

Many different components

Many different benefits

Human Capital – Formation, Composition & Benefits



Measuring human capital

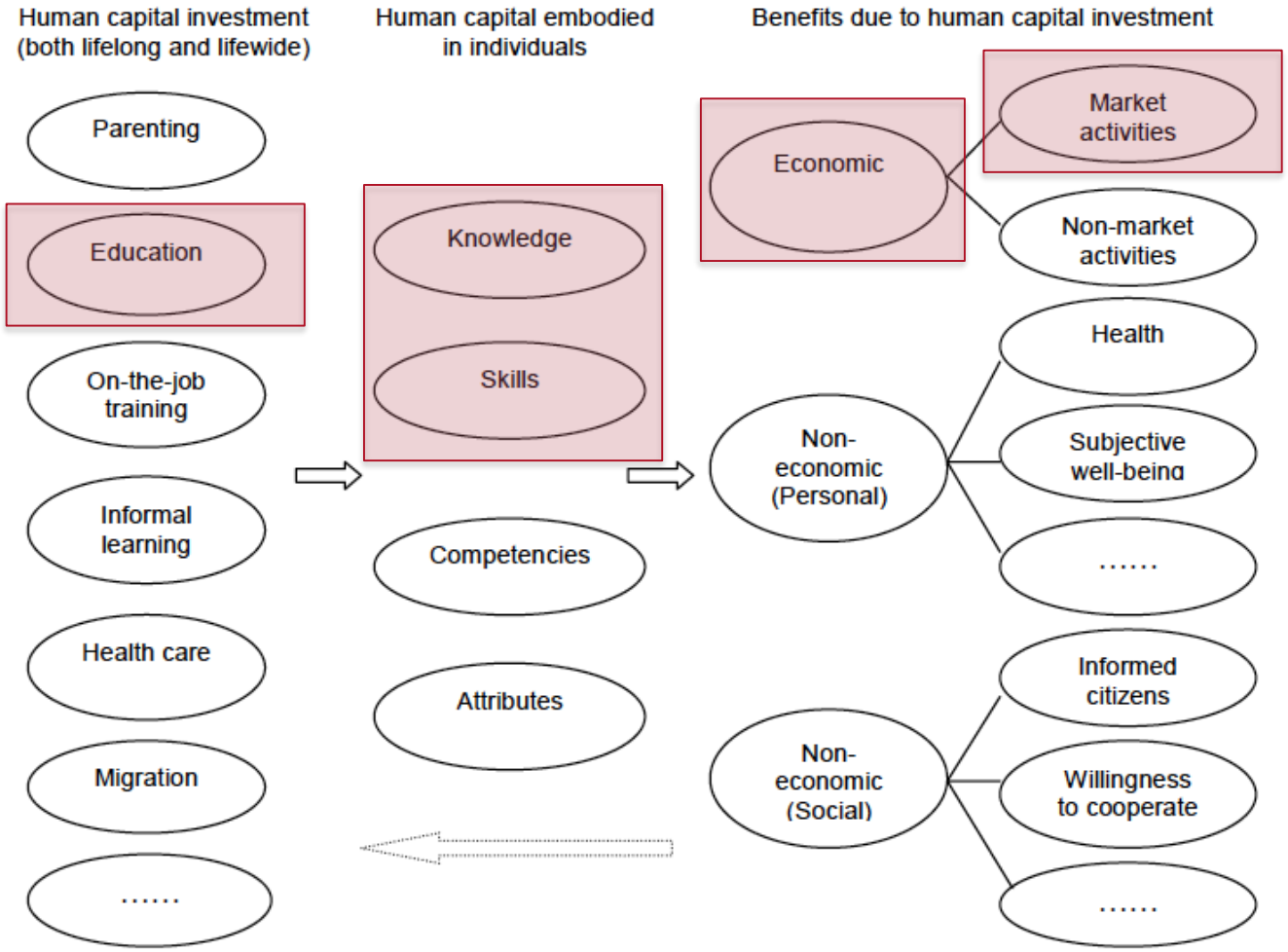
Not easily measured

Monetary: necessary if to be aggregated with other assets to compile balance sheet

Other indicators: more nuanced but not useful as part of a broader measure of capital

Education has benefits for both individual and society

Human Capital – Formation, Composition & Benefits



Methods of monetary measurement

Three approaches

Cost-based approach (inputs)

Income-based approach (outputs)

Indirect: residual-based approach

Generally, a focus on:

Formal education

Returns to the individual (tends to ignore social and non-market benefits)

Cost-based approach (inputs)

In principle, considers costs incurred in producing human capital by:

Individuals, Households, Employers, Governments

Relatively easy to apply:

Needs data on public and private expenditure on formal education

Could in principle be extended to include spending on in-work and adult training

Uses Perpetual Inventory method (similar to produced capital):

Opening stock + new investment – depreciation = closing stock

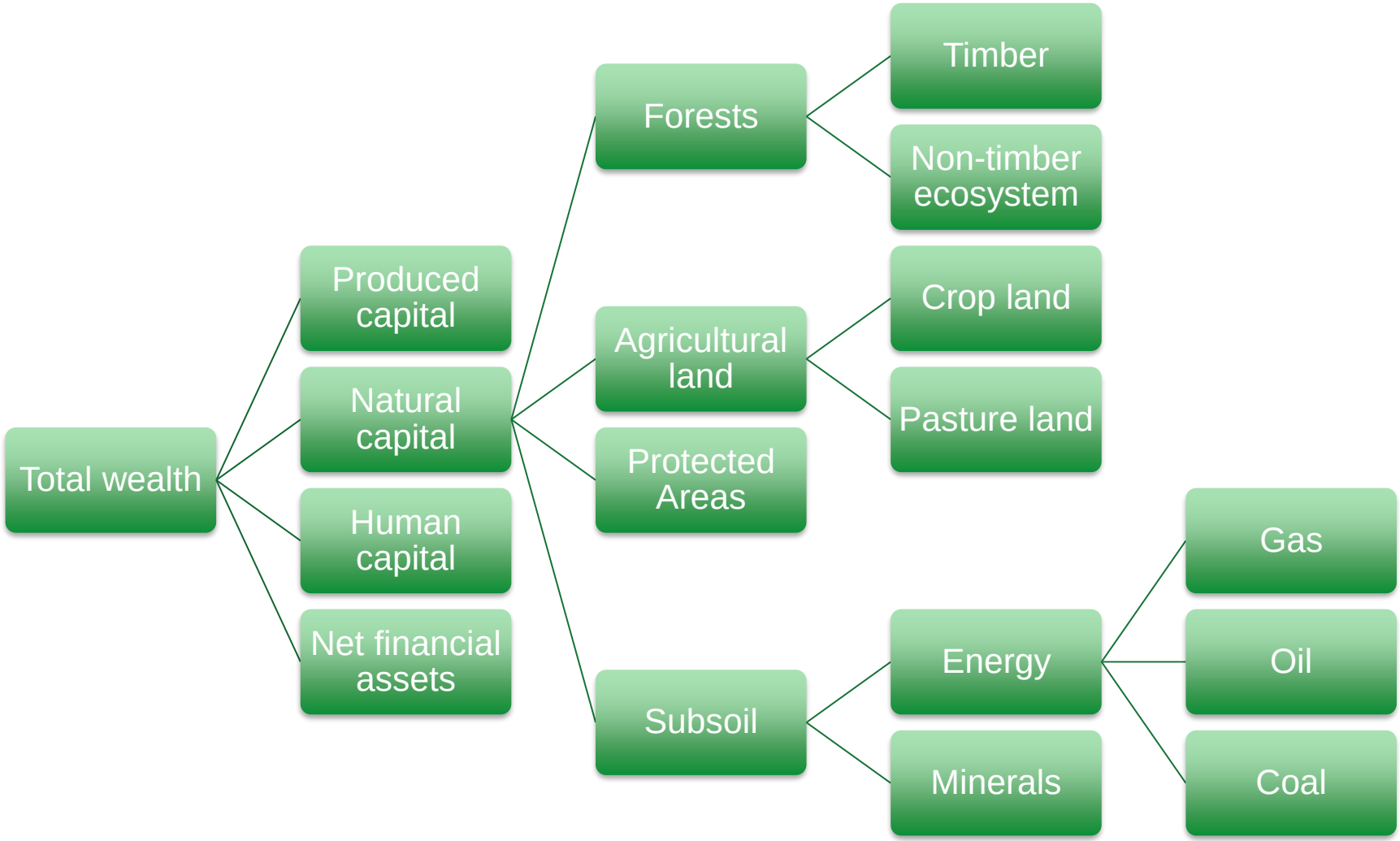
Doesn't include productivity impacts

Income-based approach (outputs)

- Considers the stream of future earnings that human capital investment generates over the lifetime of an individual
- Assumes that income reflects the value of human capital services (i.e. market prices are appropriate)
- Requires assumptions about appropriate discount rate and future income growth
- Requires data on incomes, occupations, qualifications etc. (Labour Force Survey)
- A more complex calculation
- Parallels methodology for valuation of mineral assets
- Includes value of OTJ learning and productivity gains, and tends to give higher values for human capital than input-based measures
- This method is now used by the World Bank in is asset value calculations

CONSTRUCTING COMPREHENSIVE WEALTH ACCOUNTS FOR INDONESIA

World Bank asset classes



World Bank estimates of capital for Indonesia

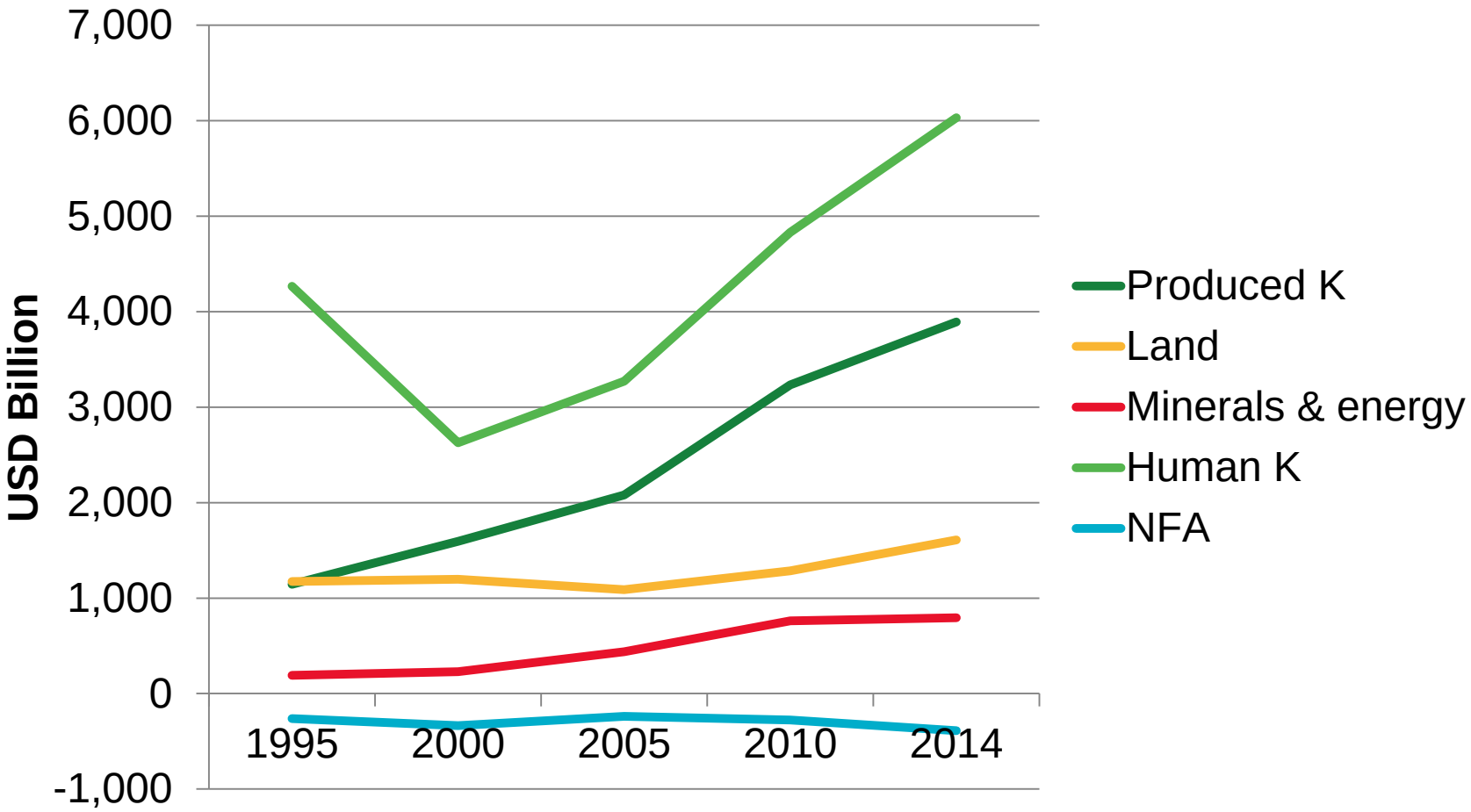
World Bank data for Indonesia on the following types of capital (in USD and USD per capita)

- Produced capital
- Forests – timber
- Forests – non-timber
- Crop land
- Pasture land
- Protected areas
- Mineral assets (8)
- Energy assets (3)
- Human capital

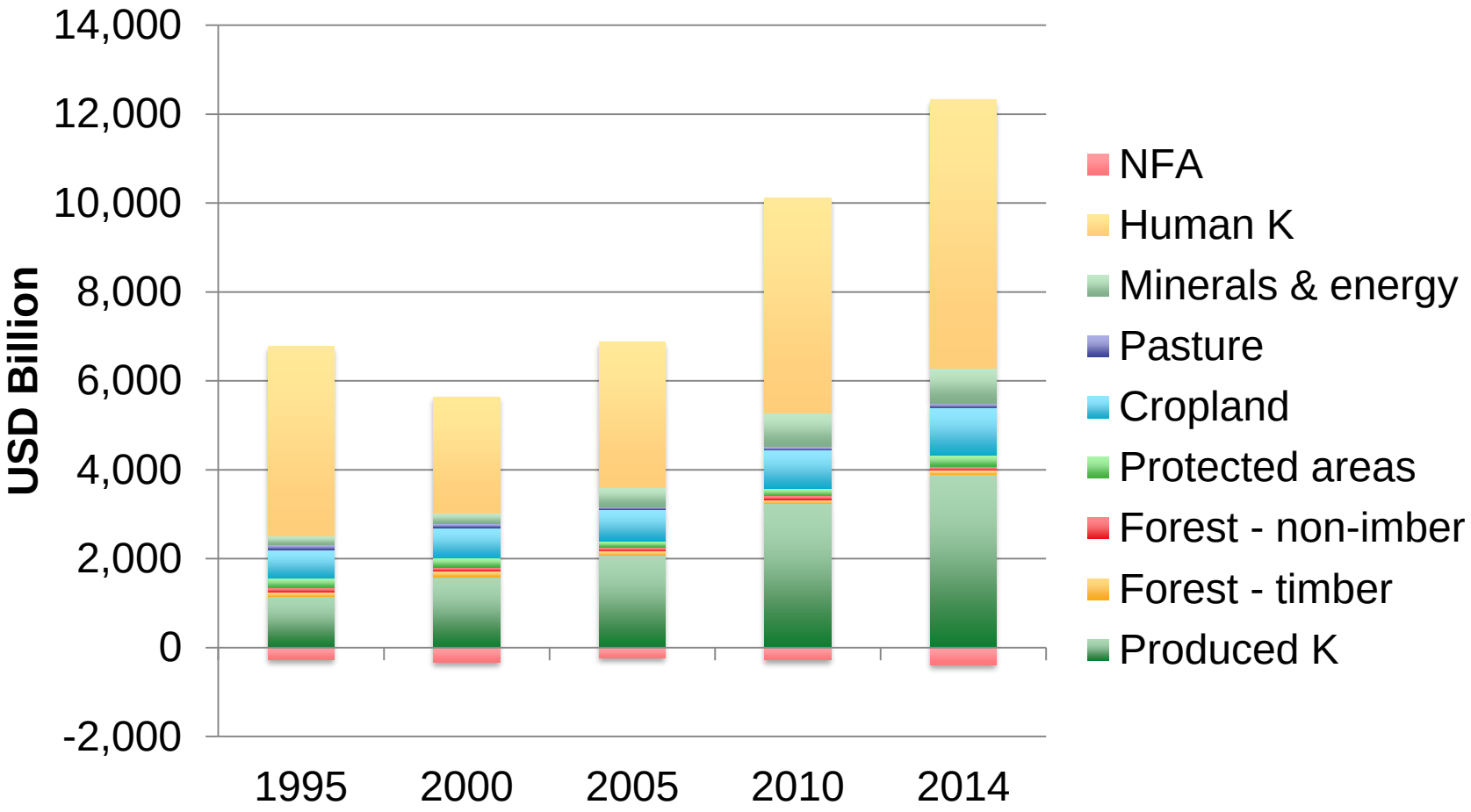
Comments on Selected Asset Classes

Asset class	Comments
Minerals	Bauxite, copper, gold, iron ore, lead, nickel, phosphate, silver, tin, zinc included
Timber	Life of resource reflects both extraction and re-growth
Non-timber ecosystem services	Recreation, hunting, fishing, non-wood forest products, watershed protection
Agricultural land	Production of crops (cereals, fibres, fruits, vegetables, oilseeds, nuts, pulses, roots, spices, sugar, & stimulants) & livestock products (meat, milk, hides etc.)
Protected areas	Opportunity cost (return from agric. land)
Produced capital	Based on PIM for Machinery, equipment, & structures; uplift of 0.24 for urban land
Human capital	Based on database of labour and lifetime incomes, using information on age, gender and years of schooling, including employed and self-employed

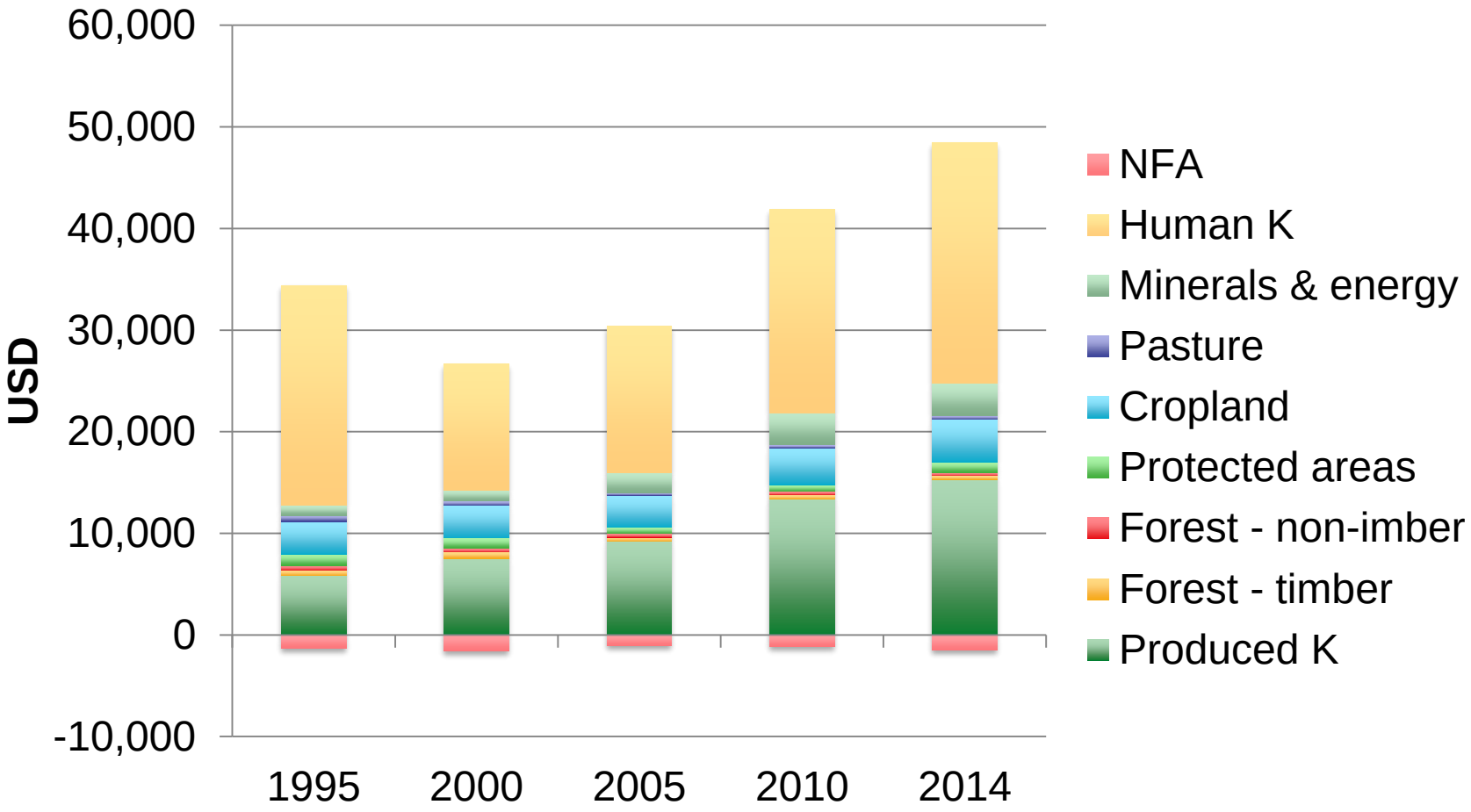
World Bank data series (Produced capital, Land, Human capital, NFA)



Comprehensive wealth - World Bank data (USD billion, constant 2014 prices)



Comprehensive wealth - World Bank data (USD per capita, constant 2014 prices)



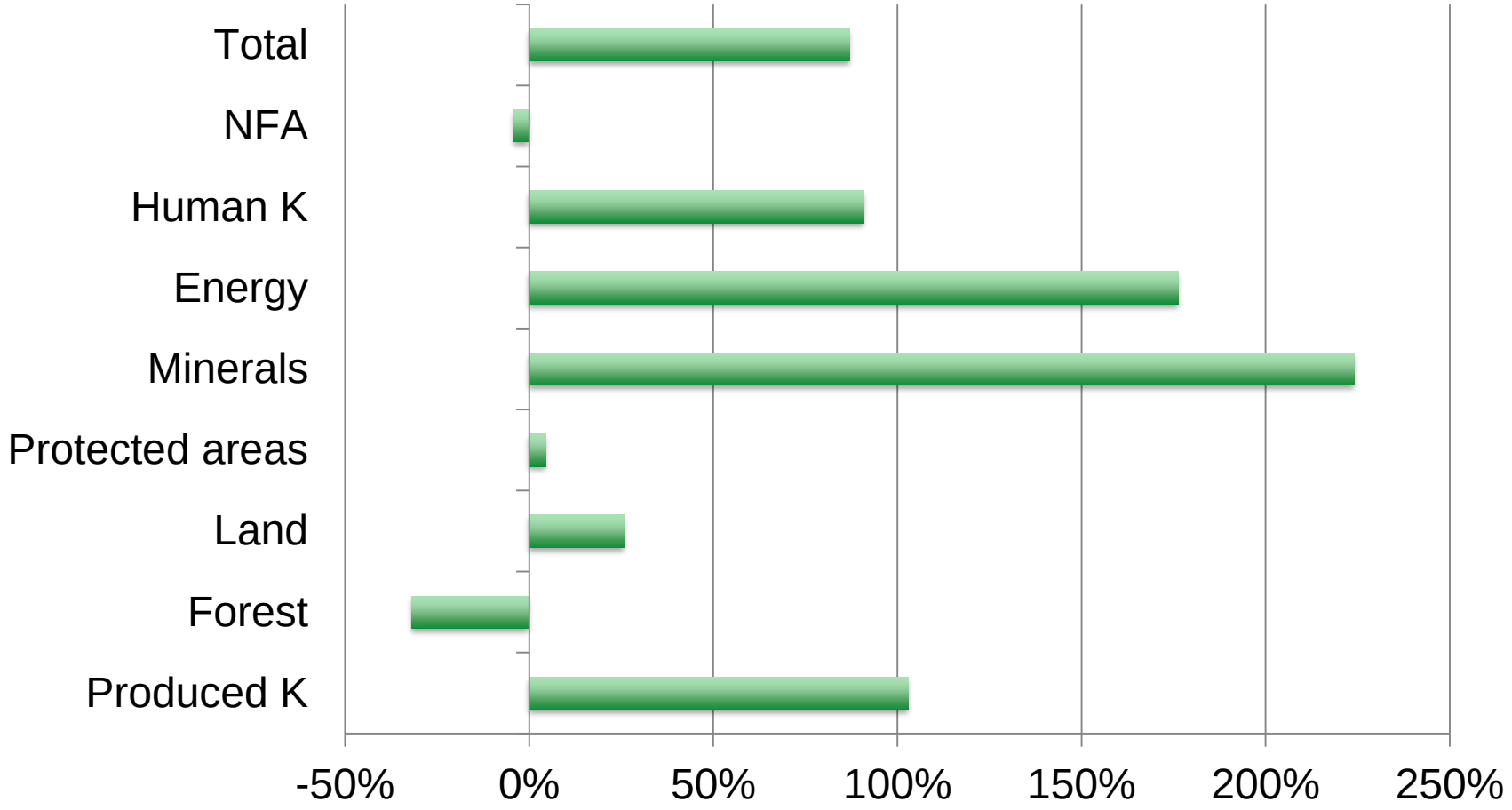
Exercise: Comprehensive Wealth for Indonesia

Produce a graph showing changes in wealth per capita from 2000 to 2014, for the following categories:

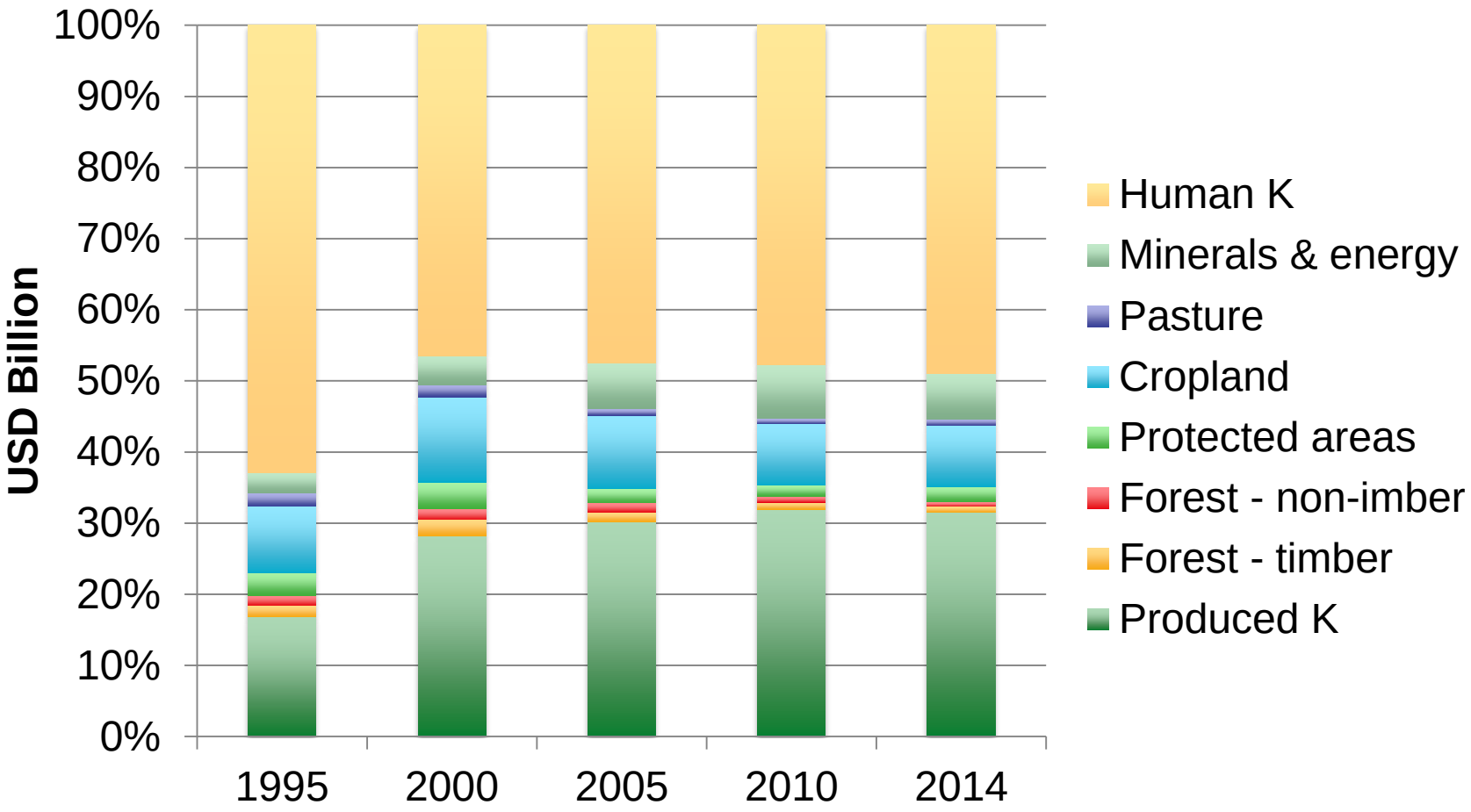
Minerals	Energy
Forests	Land
Human capital	Produced capital
Protected areas	Total wealth

Produce a graph comparing the composition of wealth per capita in 2000 and 2014 for these categories

Growth in assets per capita, 2000-14



Comprehensive wealth - World Bank data (% composition, excl. NFA)



Valuation Methodologies for Selected Asset Classes

In general, the value of an asset is

$$V_t = \sum_{i=t}^{t+T-1} \frac{\overline{R_t}}{(1+r)^{i-t}}$$

where *Rt* is a lagged, five-year moving average of rents in years *t* (the current year) to *t* – 4; *r* is the social discount rate (assumed to be a constant 4 percent), and *T* is the lifetime of the resource.

Rents in the current year are calculated as:

$$R_t = \pi_t q_t$$

where *πt* denotes unit rents, equal to revenues less production costs; and *qt* denoting the quantity of resource extracted. Rents are converted into constant US dollars at market rates using country-specific GDP deflators before averaging to obtain *Rt*.

The present value of rents from energy and mineral resources is estimated under the restrictive assumption that rents remain constant in future years.