I-WAVES
Training on Macroeconomic Indicators
Session 3a: Building Comprehensive Wealth Accounts in Indonesia
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

- 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

<table>
<thead>
<tr>
<th>Asset class</th>
<th>Comments / Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced capital</td>
<td>• Not available from national sources [?]</td>
</tr>
<tr>
<td></td>
<td>• Estimates from various international sources</td>
</tr>
<tr>
<td>(Net) Financial assets</td>
<td>• Assets held abroad by Indonesian residents (govt., firms, individuals)</td>
</tr>
<tr>
<td></td>
<td>• Mainly official foreign exchange reserves and external pension fund assets</td>
</tr>
<tr>
<td></td>
<td>• Net of liabilities to non-residents</td>
</tr>
<tr>
<td></td>
<td>• Mainly inward FDI and govt. borrowing abroad</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>Produced capital assets</th>
<th>Plus: Financial Assets</th>
<th>Equals: Total Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less: Financial Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equals: Net Worth</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 \textit{investment} (+), \textit{consumption} of capital (-), and \textit{disposals} (-), i.e.

\[ K_1 = K_0 + \text{Inv}_1 - K_{\text{cons}_1} - K_{\text{disp}_1} \]

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

<table>
<thead>
<tr>
<th>Type of Asset</th>
<th>OECD</th>
<th>Australia</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential dwellings</td>
<td>50-75</td>
<td>40-90</td>
<td>50</td>
</tr>
<tr>
<td>Industrial buildings</td>
<td>40-60</td>
<td>50-65</td>
<td>50</td>
</tr>
<tr>
<td>Other construction</td>
<td>35</td>
<td>10-100</td>
<td>30-80</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>10-25</td>
<td>15-30</td>
<td>8</td>
</tr>
<tr>
<td>Machinery</td>
<td>15-30</td>
<td>15-30</td>
<td>8-16</td>
</tr>
<tr>
<td>Computers</td>
<td>5-15</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>10-40</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

*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
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)

Relative to GNI, capital stock has grown only marginally.

- **PPP**
- **Private**
- **Govt**
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
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 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

<table>
<thead>
<tr>
<th>Revenue from sale of mineral (Gross output)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Less: <strong>cost of intermediate consumption</strong></td>
<td></td>
</tr>
<tr>
<td>Intermediate consumption (inputs excluding labour and capital)</td>
<td></td>
</tr>
<tr>
<td>Equals: <strong>Value Added (GDP)</strong></td>
<td></td>
</tr>
<tr>
<td>Less: <strong>costs of labour and capital inputs</strong></td>
<td></td>
</tr>
<tr>
<td>Labour costs (wages &amp; salaries)</td>
<td></td>
</tr>
<tr>
<td>Equals: <strong>gross operating surplus</strong></td>
<td></td>
</tr>
<tr>
<td>Less: Consumption of fixed (produced) capital (depreciation)</td>
<td></td>
</tr>
<tr>
<td>Less: Return to produced capital</td>
<td></td>
</tr>
<tr>
<td>Equals: <strong>Resource rent</strong></td>
<td></td>
</tr>
</tbody>
</table>
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:

$$NPV = R.X. \frac{(1+d)^t}{d(1+d)^t} \frac{1}{d}$$
World Bank has produced valuations of various mineral assets for Indonesia

<table>
<thead>
<tr>
<th>Minerals</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bauxite</td>
<td>Coal</td>
</tr>
<tr>
<td>Copper</td>
<td>Gas</td>
</tr>
<tr>
<td>Gold</td>
<td>Oil</td>
</tr>
<tr>
<td>Iron ore</td>
<td></td>
</tr>
<tr>
<td>Nickel</td>
<td></td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td></td>
</tr>
<tr>
<td>Tin</td>
<td></td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Data item</th>
<th>Value (USD mn)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1      Gross output</td>
<td>14,511.1</td>
<td>Actual export value</td>
</tr>
<tr>
<td>2      Intermediate consumption</td>
<td>5,804.5</td>
<td>40% of GO</td>
</tr>
<tr>
<td>3      Value added</td>
<td>8,706.7</td>
<td>[1]-[2]</td>
</tr>
<tr>
<td>4      Compensation of employees</td>
<td>2,176.7</td>
<td>15% of GO</td>
</tr>
<tr>
<td>5      Gross operating surplus</td>
<td>6,530.0</td>
<td>[3]-[4]</td>
</tr>
<tr>
<td>6      Consumption of fixed capital</td>
<td>1,292.6</td>
<td>10% K stock</td>
</tr>
<tr>
<td>7      Return on capital</td>
<td>1,308.5</td>
<td>10% of K stock</td>
</tr>
<tr>
<td>9      Rent</td>
<td>3,928.9</td>
<td>[5]-[6]-[7]</td>
</tr>
<tr>
<td>10     Capital stock</td>
<td>13,084.7</td>
<td></td>
</tr>
</tbody>
</table>
## Example of calculation for coal, 2015

<table>
<thead>
<tr>
<th>Data item</th>
<th>Value</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical production (million tonnes)</td>
<td>368.9</td>
<td></td>
</tr>
<tr>
<td>Rent per unit of production (USD)</td>
<td>10.7</td>
<td>[9]/[11]</td>
</tr>
<tr>
<td>Rent (5yma)</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>Unmined Reserves (mt)</td>
<td>22,456</td>
<td></td>
</tr>
<tr>
<td>Remaining lifespan (years)</td>
<td>60.9</td>
<td>[14]/[11]</td>
</tr>
<tr>
<td>Valuation of reserves (USD mn)</td>
<td>63,919</td>
<td>NPV of annual rents</td>
</tr>
</tbody>
</table>
Estimates (on the basis of assumptions) – unit rent and value of reserves

![Bar chart showing asset value (LHS) and per unit rent (RHS) from 2005 to 2016. The asset value peaks in 2013 and then decreases, while the per unit rent increases from 2005 to 2013 and then decreases.](chart.png)
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

Human capital investment (both lifelong and lifewide) → Human capital embodied in individuals → Benefits due to human capital investment

- Parenting
- Education
- On-the-job training
- Informal learning
- Health care
- Migration
- ...

- Knowledge
- Skills
- Competencies
- Attributes

- Economic
- Non-economic (Personal)
- Non-economic (Social)

- Market activities
- Non-market activities
- Health
- Subjective well-being
- Non-economic (Personal)
- Non-economic (Social)
- Informed citizens
- Willingness to cooperate
- ...
- ...

Human Capital © 2014
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

Human capital investment (both lifelong and lifewide)
- Parenting
- Education
- On-the-job training
- Informal learning
- Health care
- Migration
- ...

Human capital embodied in individuals
- Knowledge
- Skills
- Competencies
- Attributes
- Non-economic (Personal)
- Non-economic (Social)

Benefits due to human capital investment
- Market activities
- Economic
- Non-market activities
- Health
- Subjective well-being
- Informed citizens
- Willingness to cooperate
- …
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 its asset value calculations.
CONSTRUCTING COMPREHENSIVE WEALTH ACCOUNTS FOR INDONESIA
World Bank asset classes

- Total wealth
  - Produced capital
  - Natural capital
  - Human capital
  - Net financial assets
  - Agricultural land
    - Forests
    - Non-timber ecosystem
  - Protected Areas
    - Timber
    - Crop land
    - Pasture land
  - Subsoil
    - Energy
    - Minerals
  - Coal
  - Oil
  - Gas
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

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

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

where \( R_t \) 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 \( \pi_t \) denotes unit rents, equal to revenues less production costs; and \( q_t \) 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 \( R_t \).

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