Mineral Accounting, National Wealth and Adjusted Net Savings Calculations in Botswana

8th April 2015

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Botswana

- Landlocked country located in Southern Africa
- Large (560,000 km^2) but with small population (2m), hence sparsely populated; mostly desert
- Important mining sector: the world's largest producer of diamonds, also base metals (copper & nickel), gold, large coal deposits, and soda ash
- Major areas reserved as national parks, with important ecosystems (wetlands, desert) and wildlife populations
- Substantial population of livestock; cattle rearing the main activity in rural areas
- Upper middle income country (GDP/ capita USD7,700)

System of Environmental-Economic Accounting (SEEA)

- Framework for understanding the interaction of environment and the economy
- Describes stocks and changes in stocks of environmental assets
- Complementary to economic national accounts (GDP, capital stock-produced assets, savings, investment etc.)
- Particular focus on trends in the availability and use of natural resources
- Includes both renewable and non-renewable assets

Examples of renewable and non-renewable environmental assets

Renewable	Non-renewable
Timber	Minerals
Fisheries	Fuels (energy)
Water	Water
	Soil

Natural Capital

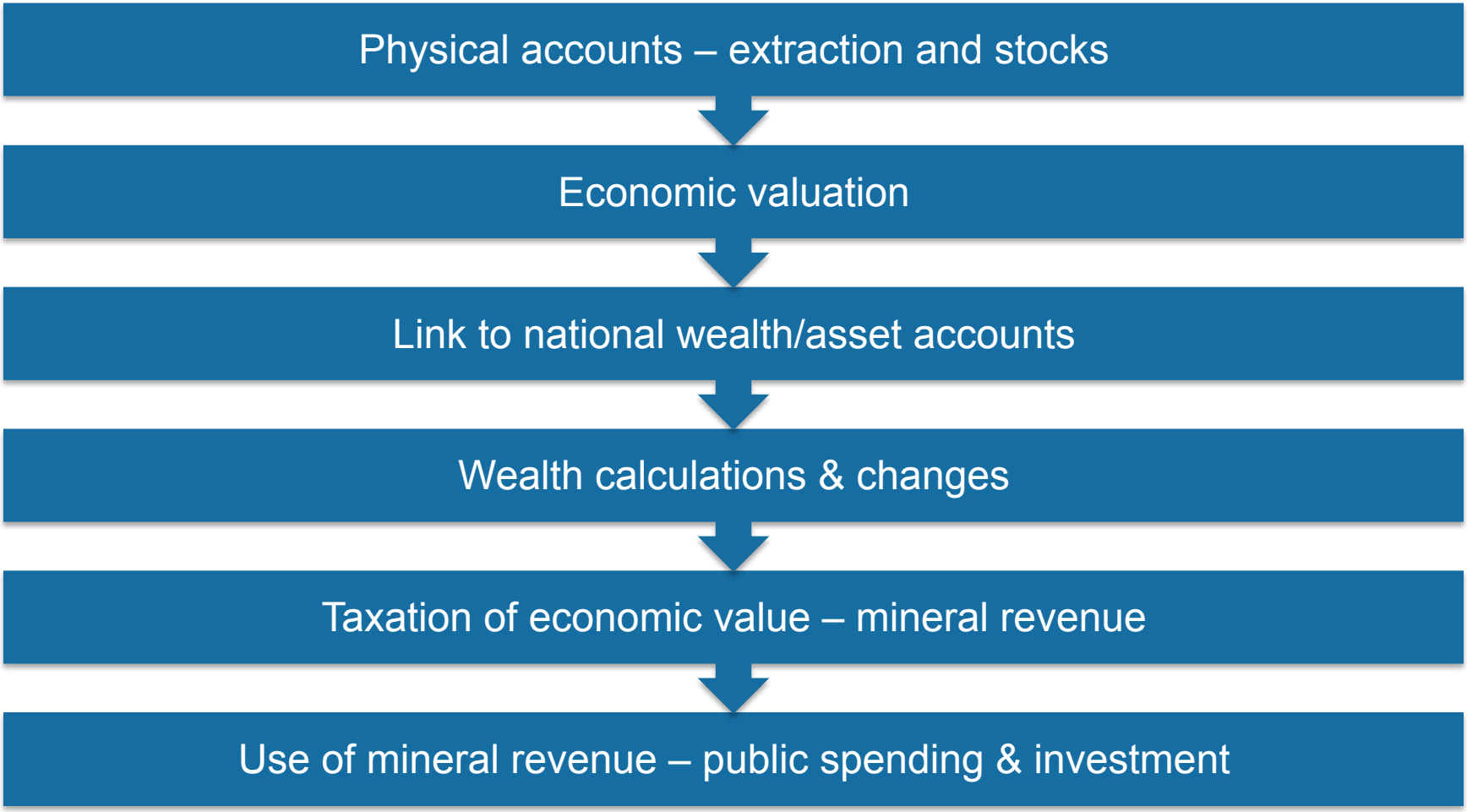
- Many components to natural capital in Botswana
- To date, natural capital accounting has focused on:
  - Minerals
  - Water

Type	Details
Minerals	Diamonds
	Copper-nickel
	Coal
	Gold
	Soda ash
Land	Pasture
	Arable
	Protected areas (national parks)
Water	Rivers, dams, aquifers
Animals	Cattle
	Wildlife

Mineral Accounts - Objectives

1. **Tracking changes in the value of national mineral assets**
   - A component of the national balance sheet
2. **An input to the calculation of Adjusted National Savings (ANS)**
   - Incorporating resource depletion into the national accounts
3. **Assessing whether mineral exploitation is leading to asset depletion**
   - Is resource depletion being matched by re-investment?
4. **Tracking the various types of income earned from the exploitation of mineral assets**
   - who earns income? what is done with the income?
5. **How effective is fiscal policy with regard to mineral exploitation?**
   - Taxation of mineral rents
   - Use of revenues from mineral taxation

Stages of Mineral Accounts



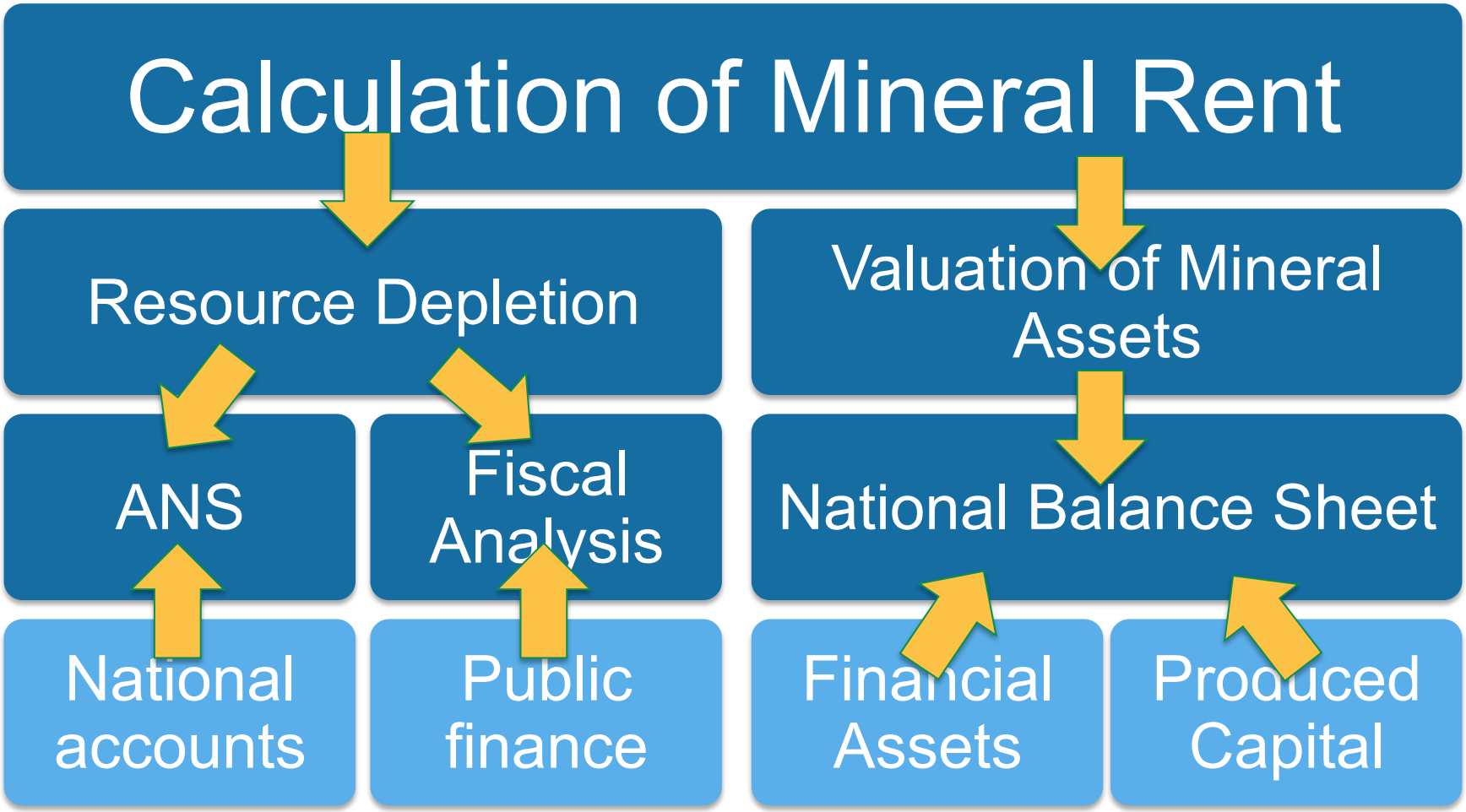
MINERAL RENT – THE PRINCIPLES

Mineral Rents

The concept of mineral rents is central to mineral accounts, the valuation of mineral assets & depletion

- Represents the surplus revenue derived from the sale of minerals over and above the costs of production (including costs of capital)
- Used to value “un-mined” minerals in the ground
- Optimal mining fiscal regime should aim to tax mineral rents as highly as possible

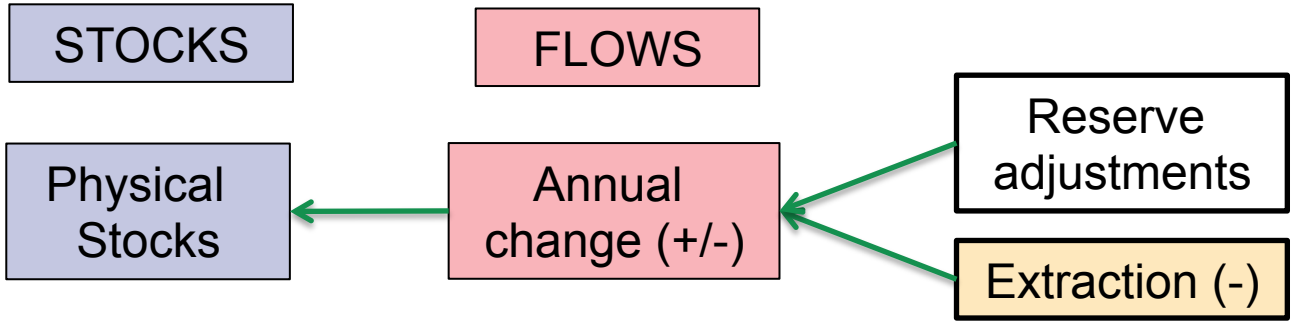
Mineral Accounting: the Process



Mineral Accounts - Components

1. **Physical Accounts**
   - The physical quantities of mineral assets held in the ground (measured in tonnes, barrels, carats etc.)
   - Cannot be aggregated across minerals
2. **Monetary accounts**
   - Based on the physical accounts, but with the addition of a monetary valuation
   - Can be aggregated across minerals
   - Can be integrated into national accounts
3. **Resource rent calculations**
   - Required for the valuation of physical assets to produce monetary accounts

Mineral Accounts - Components



Minerals – Physical Accounts

Item	Comment
Opening stock	
Additions to stock (+)	
Discoveries	
Upwards re-appraisals	Depending on geological information, technology, resource prices
Reclassifications	Depending on legal/regulatory changes
Total additions to stock	
Reductions in stock (-)	
Extractions	
Downwards reappraisals	
Reclassifications	
Catastrophic losses	e.g. mine flooding, oil-well fires, disasters
Total reductions	
Closing stock of mineral resources	

Valuation of physical mineral stocks

Market price

Derived from sales of “in situ” mineral resources

But, few transactions, hence not readily available

Indirect approach

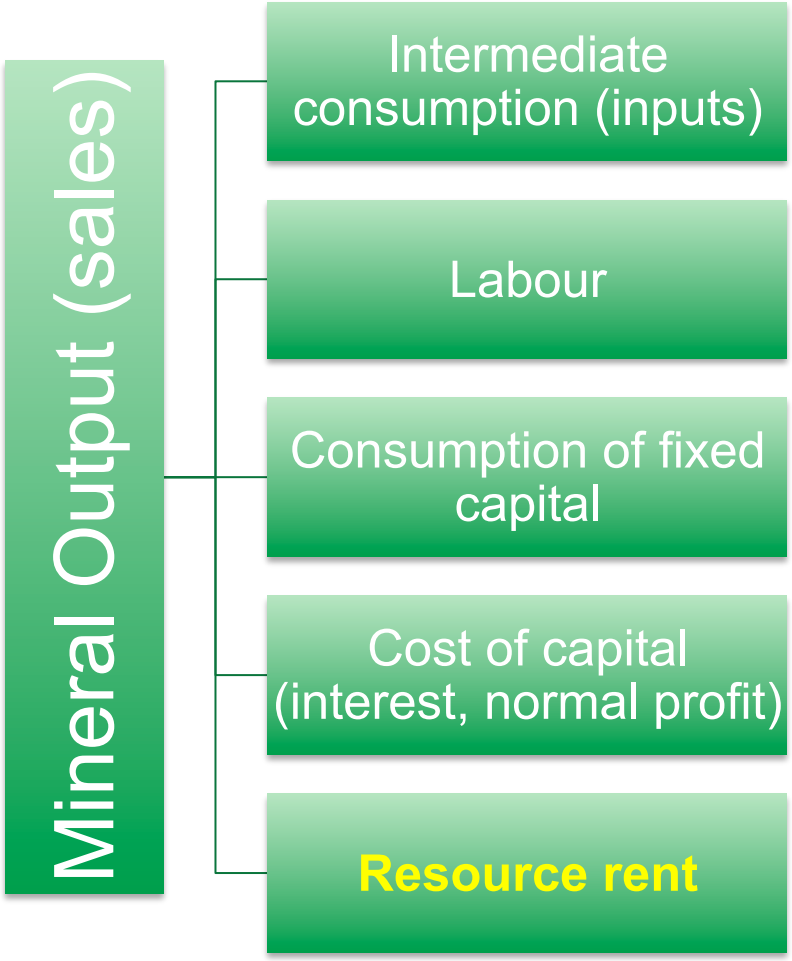
A mineral deposit yields a regular flow of produced minerals

Calculate Net Present Value (NPV) of that future flow of minerals

Need information on:

- **Anticipated future production**
- **Value of the mineral - determined by Resource Rent**

Contributions to Value of Mineral Output

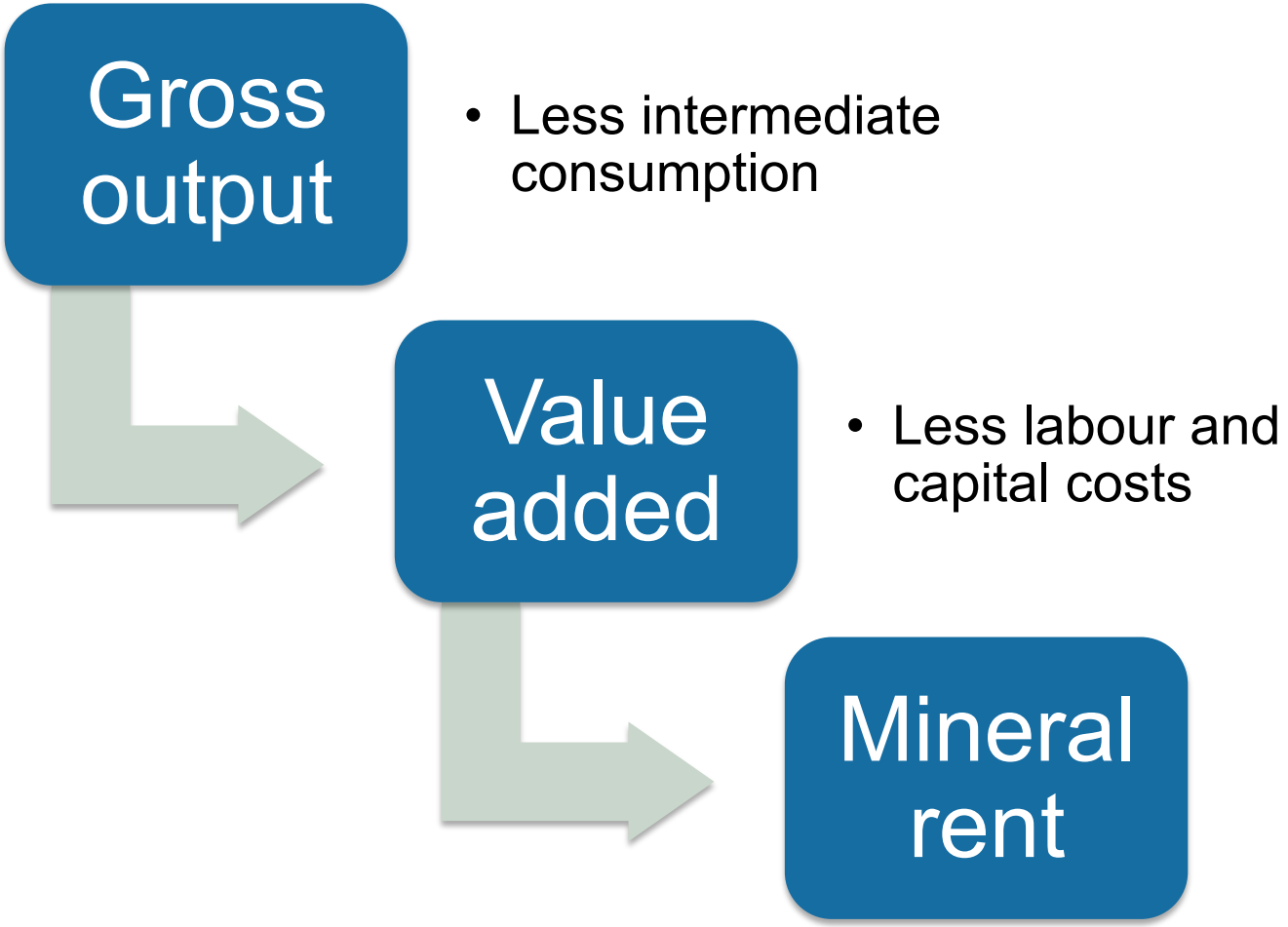


- Resource rent is a residual (hence depends on the accuracy of other valuations)
- If a mineral sells for a price that just reflects the costs of production, the surplus (i.e. resource rent) is zero
- Resource rent may be volatile from year-to-year, esp. if price of mineral fluctuates
- Use a moving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

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**

Flow of rent calculations - 1



Flow of rent calculations - 2

Mineral rent

÷ Extraction

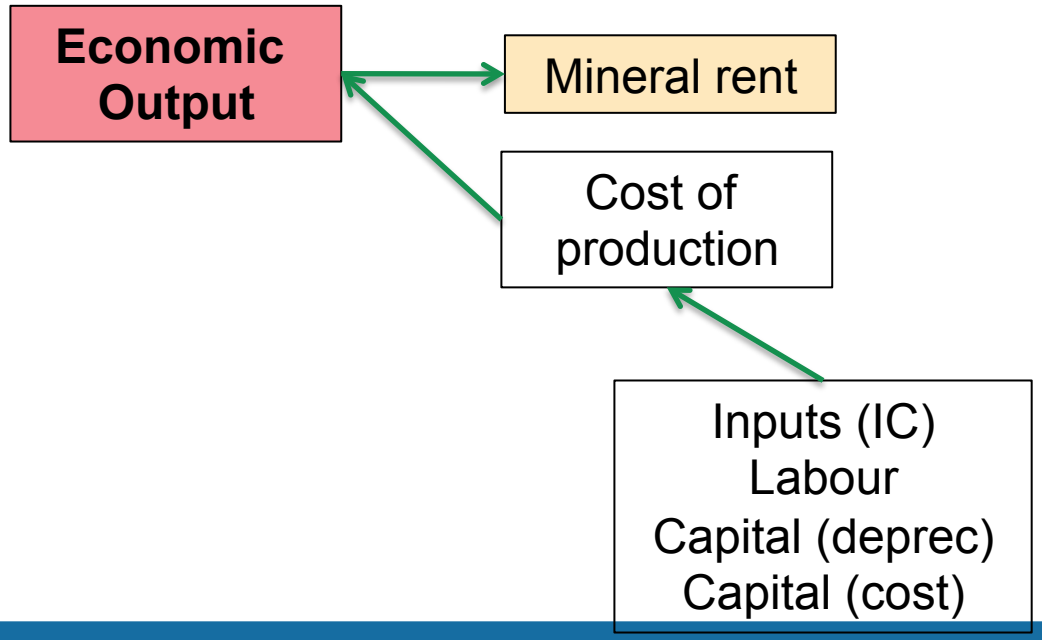
Per unit Rent

NB the value of mineral resource rent (per unit) is not constant, and may vary from year to year as mineral prices and costs of production change

Mineral Accounts - Components

STOCKS

FLOWS



Valuation of (Un-mined) Mineral Assets

We now have

Information on mineral stocks (un-mined reserves in ground)

A valuation of per-unit mineral rent

Hence we can put a value on mineral assets

However, it is not as straightforward as simply multiplying the volume of the resource stock by the per unit value

Why not?

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:

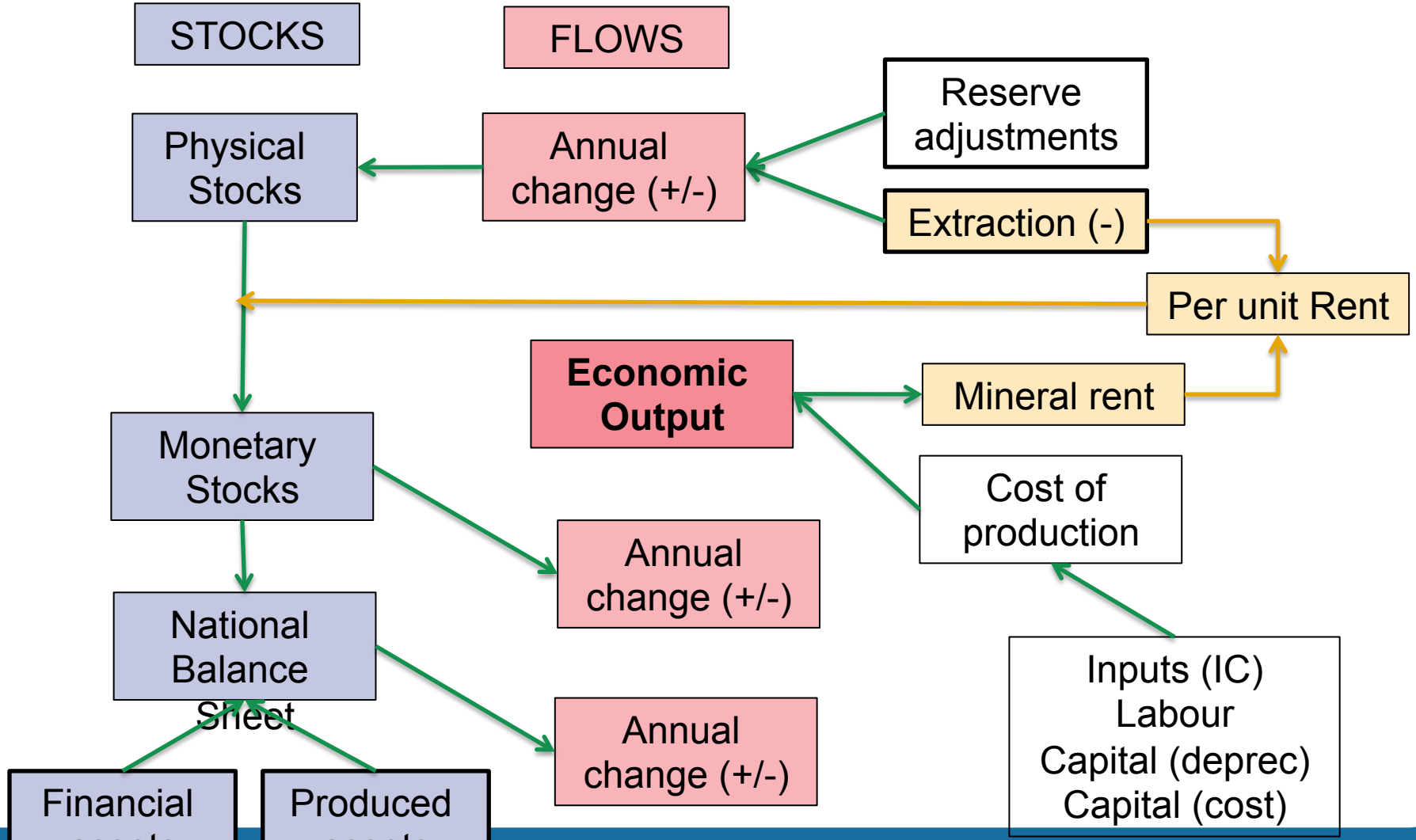
Reserves will be mined at a steady rate until depleted (life of mine = reserve/current production)

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

Hence:

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

Mineral Accounts - Components



MINERAL RENT – THE PRACTICE

Mineral Accounts - Data Requirements & Assumptions

Physical Accounts

Reserves (in the ground)

Production (extraction of minerals)

New discoveries, other adjustments etc.

Usually obtained from mining companies, Government depts responsible for mines

Monetary Accounts

Gross output

Value added

Labour costs

Consumption of fixed capital (depreciation)

Capital stock (fixed assets)

Usually obtained from Statistics Bureau, National Accounts

PHYSICAL ACCOUNTS

Calculation of Diamond Rent 1979-2013

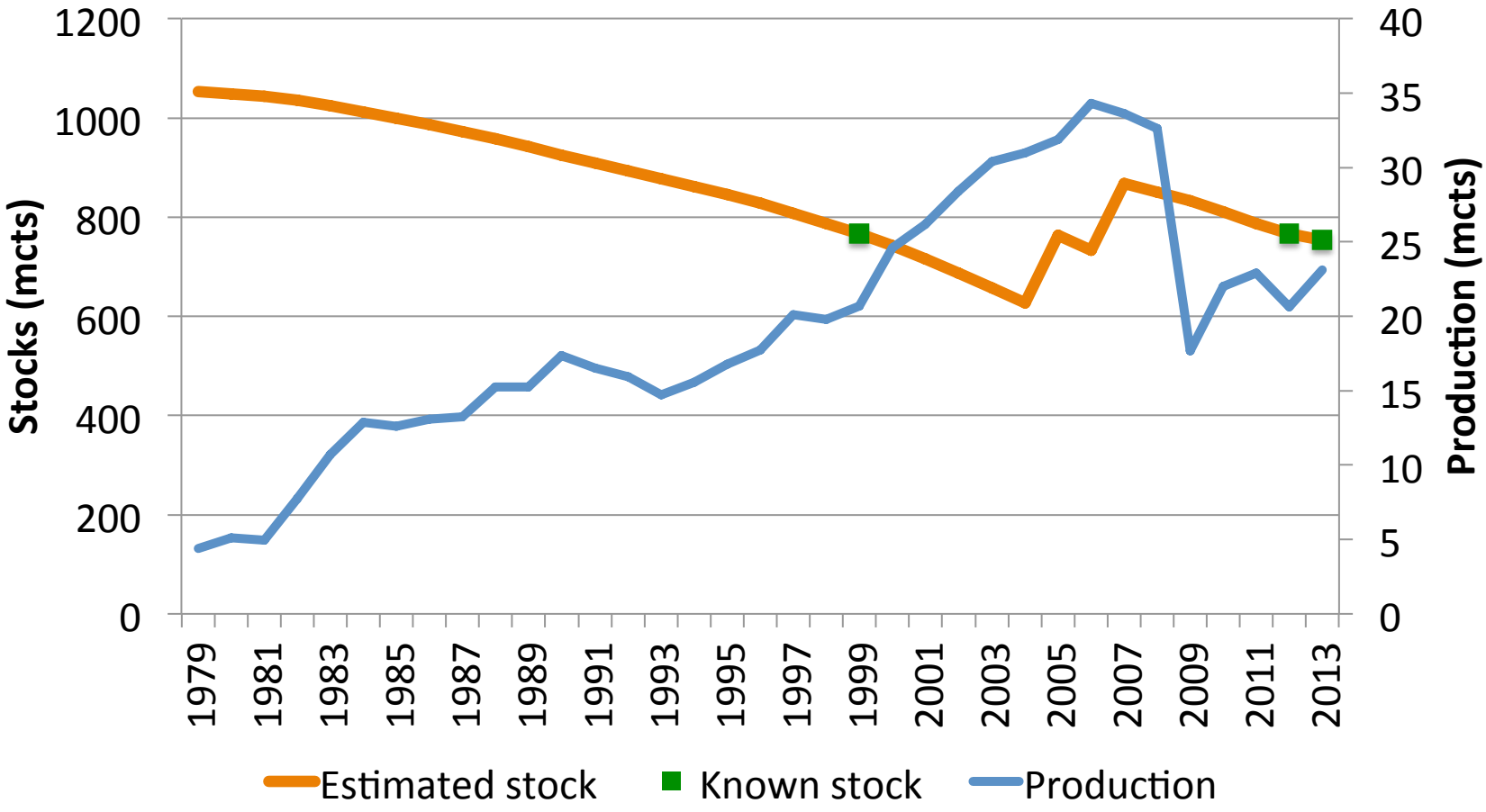
Physical accounts – requirements – 2 of:

- End of year stocks
- Annual production
- Annual reserve adjustments/discoveries

In practice, data availability was limited; we had:

- Annual diamond production
- End of year stocks only for 1999, 2012, 2013
- Little information on new discoveries
- No information on reserve adjustments
  - **i.e., not enough information**
  - **Had to make estimates of discoveries and reserve adjustments, based on reported information on new mines and extended production at existing mines**

Diamond reserves and production



RENT CALCULATION

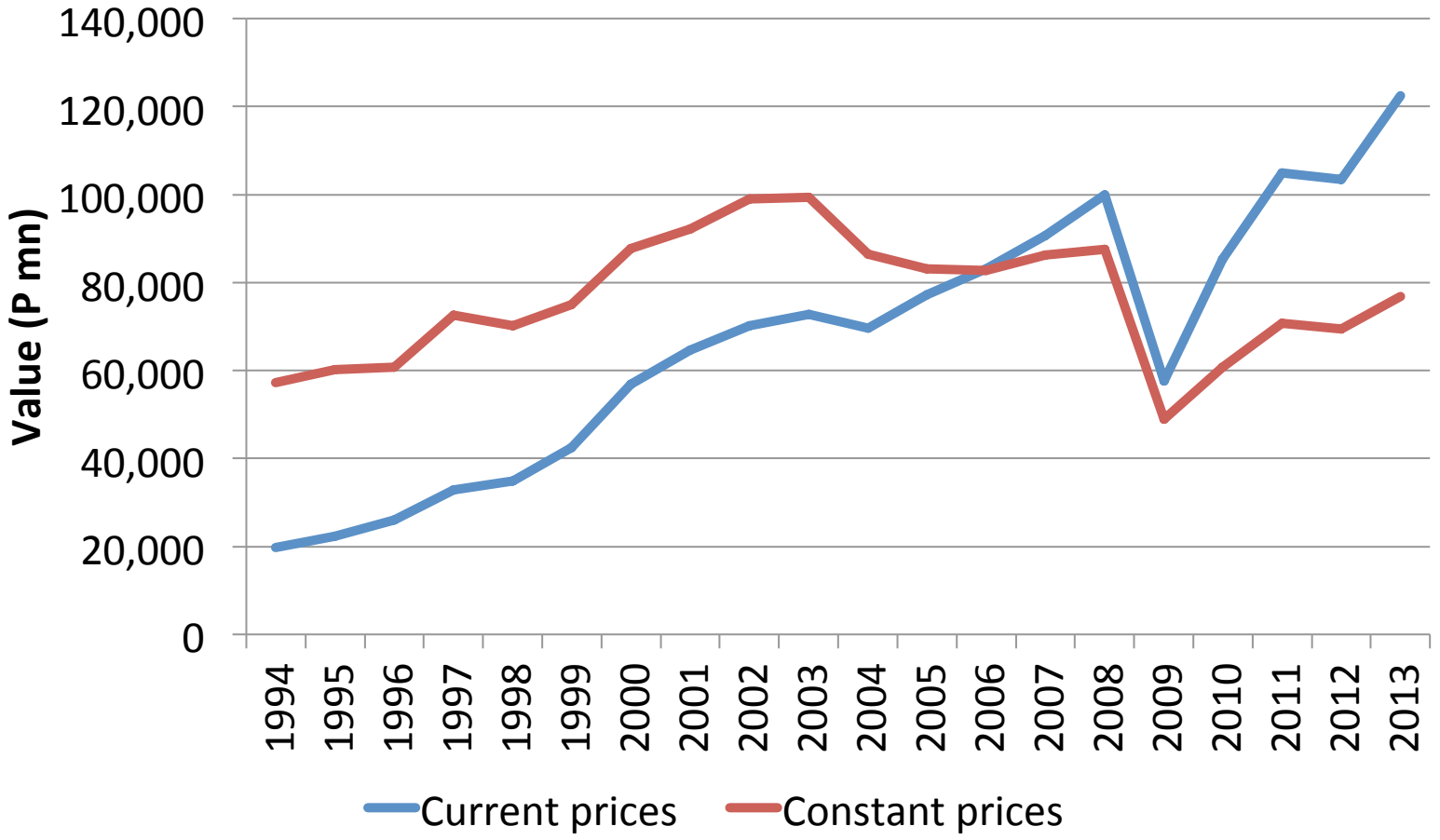
Example of diamond rent calculation - 2010

Variable	Source	Value (P mn)
Gross output	StB (NA)	23,349
- Intermediate consumption	StB (NA)	4,147
= Value added	StB (NA)	19,202
- Wages	StB (NA)	1,492
= Operating surplus	StB (NA)	17,710
- Consumption of fixed capital	StB (NA)	1,214
- Return on capital	Calculated	1,292
Capital stock	*StB (NA)*	*6,461*
Return on capital (nominal)	*Assumed*	*20%*
= Total rent	Calculated	15,204

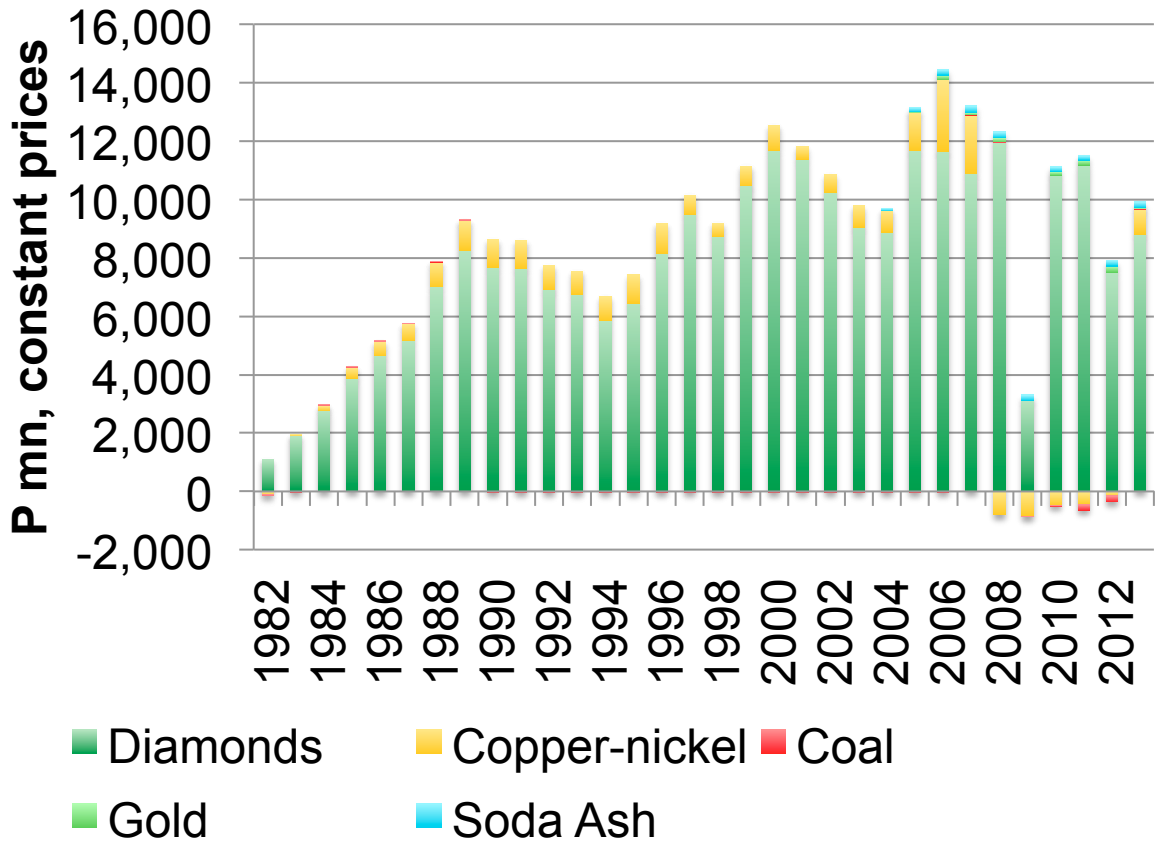
Example of diamond rent calculation - 2010

Variable	Source	Value
Total rent	Calculated	15,204
Extraction (mcts)	DoM	22.0
Per unit rent (P/ct)	Calculated	691
Per unit rent 5yma (P/ct)	Calculated	400
Reserves (mcts)	Calculated	811
Est. life of mine (years)	Calculated	37
Value of reserves (NPV rent) (P mn)	Calculated	85,275
Discount rate (real)	Assumption	10%

Valuation of Diamond Reserves 1994-2013



Resource rent – by mineral (in real terms)



- Overall resource rent dominated by diamonds
- Rent can be negative, if no scarcity value, or if costs of production are very high

Mineral Accounts – rents generated by mineral, annual avg. 2009-2013

Mineral	Rent (P million)	% of total
Diamonds	12,132	99.6%
Copper-nickel	-243	-2.0%
Coal	-128	-1.1%
Gold	166	1.4%
Soda Ash	255	2.1%
TOTAL	12,182	

VALUATION OF MINERAL ASSETS

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)

Hence:

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

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

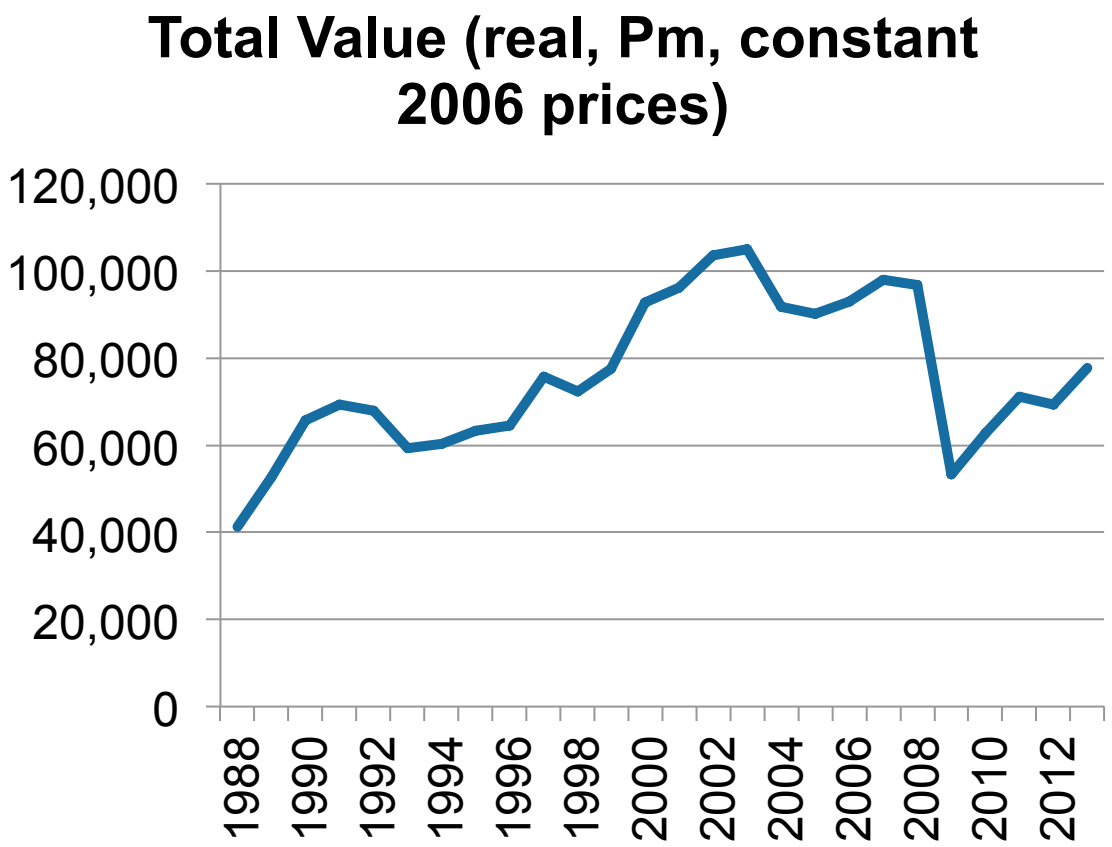
Formula for NPV of mineral reserve:

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

Valuation of Botswana's mineral assets, 2013

Mineral	Reserves (units)	Valuation (P/ unit)	Life of mine (years)	Total value
Diamonds	754.1 mcts	554.2	33	120,861
Copper-nickel	1.2 mt	-8001.1	17	0
Coal	3,340 mt	-128.1	2,233	0
Gold	14,129 kg	111,158	12	902
Soda ash	5.9 mt	1,080	26	1,945
				123,707

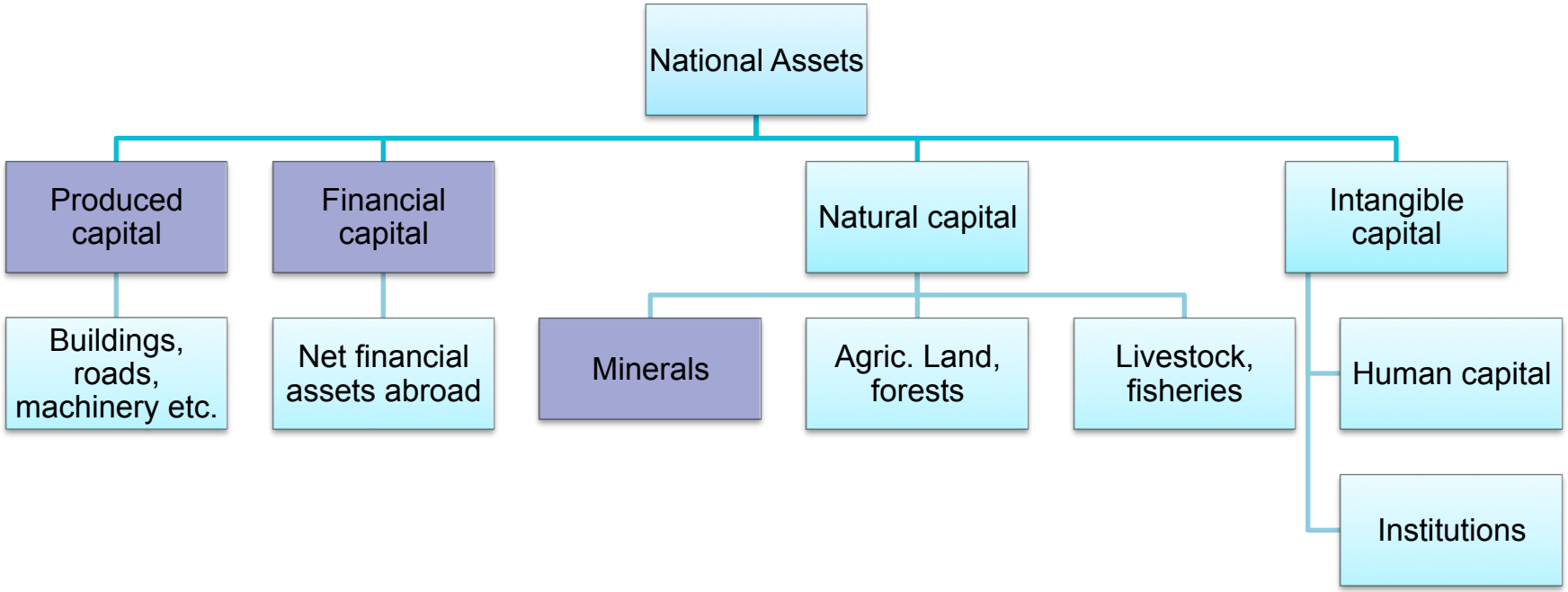
What is the trend in mineral assets?



- Value of (unmined) mineral assets grew over the years as prices rose and more deposits were discovered
- Peaked in the early 2000s and has since declined due to depletion, rising production costs and lower prices

NATIONAL BALANCE SHEET

National Balance Sheet



The present exercise focuses on Produced Capital, Financial Assets and the Minerals component of Natural Capital

Using information on key assets on the national balance sheet, we can trace the level, composition of and changes in national assets over time, and assess sustainability

Description of Asset Classes

Asset class	Comments / Data
Produced capital	• Prepared specifically for the WAVES project • Distinguishes between public (govt.) assets and private sector assets (firms and households)
Mineral assets (non-produced capital)	• Prepared under mineral accounting component of WAVES project • Value of (unexploited) deposits major minerals (diamonds, copper-nickel, coal, soda ash, gold)

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

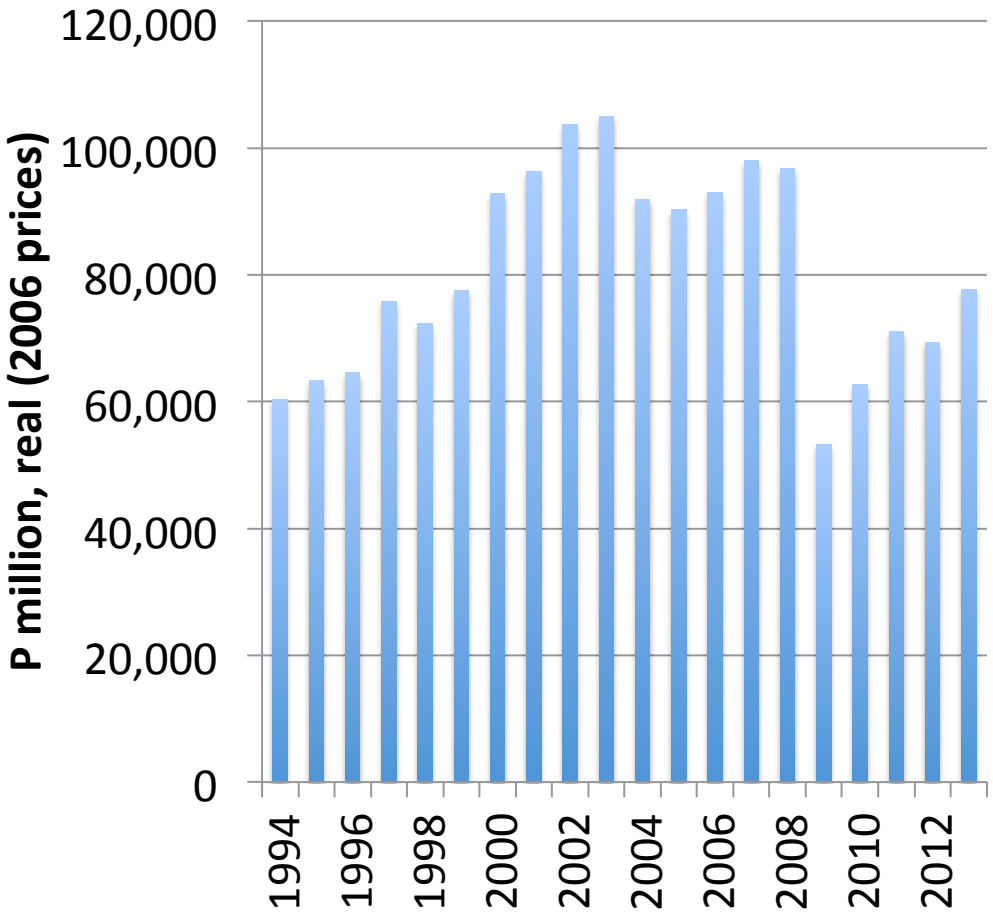
National Balance Sheet

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

We will consider:

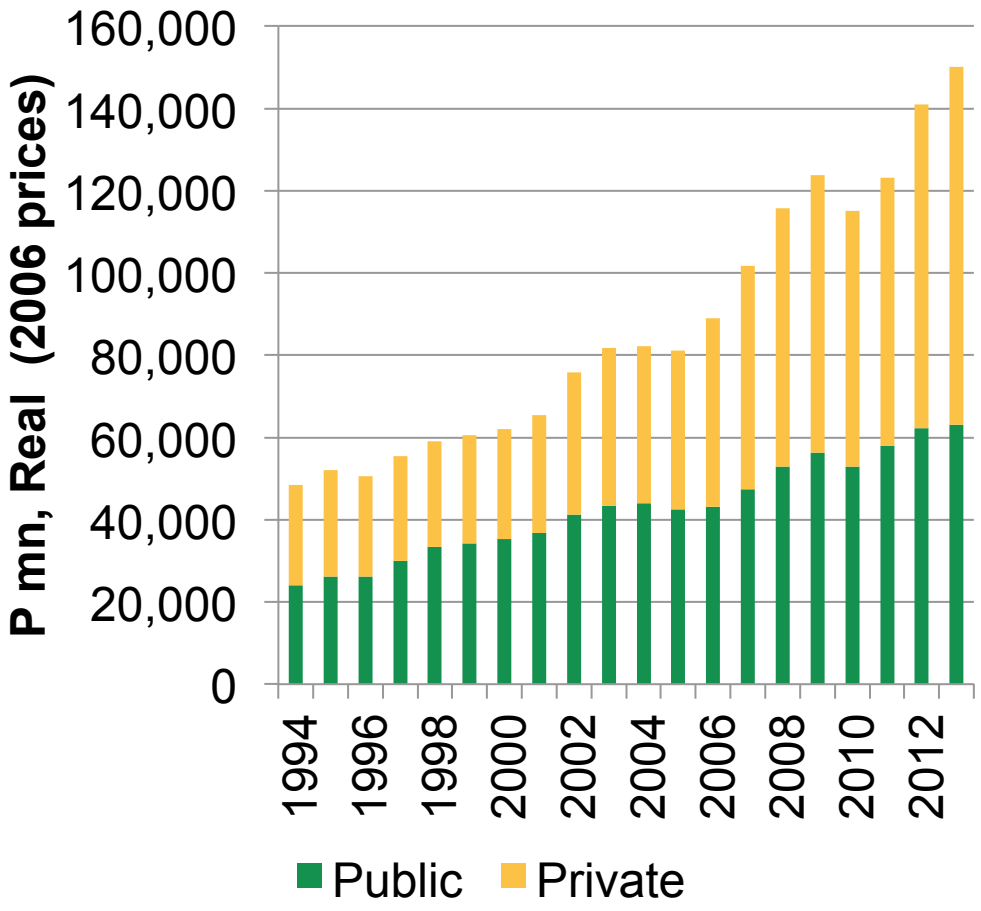
- The composition of total net worth (division between types of assets)
- Trends in total and individual assets (in real terms and relative to GDP)
- Changes in total assets

Real Assets – Mineral assets



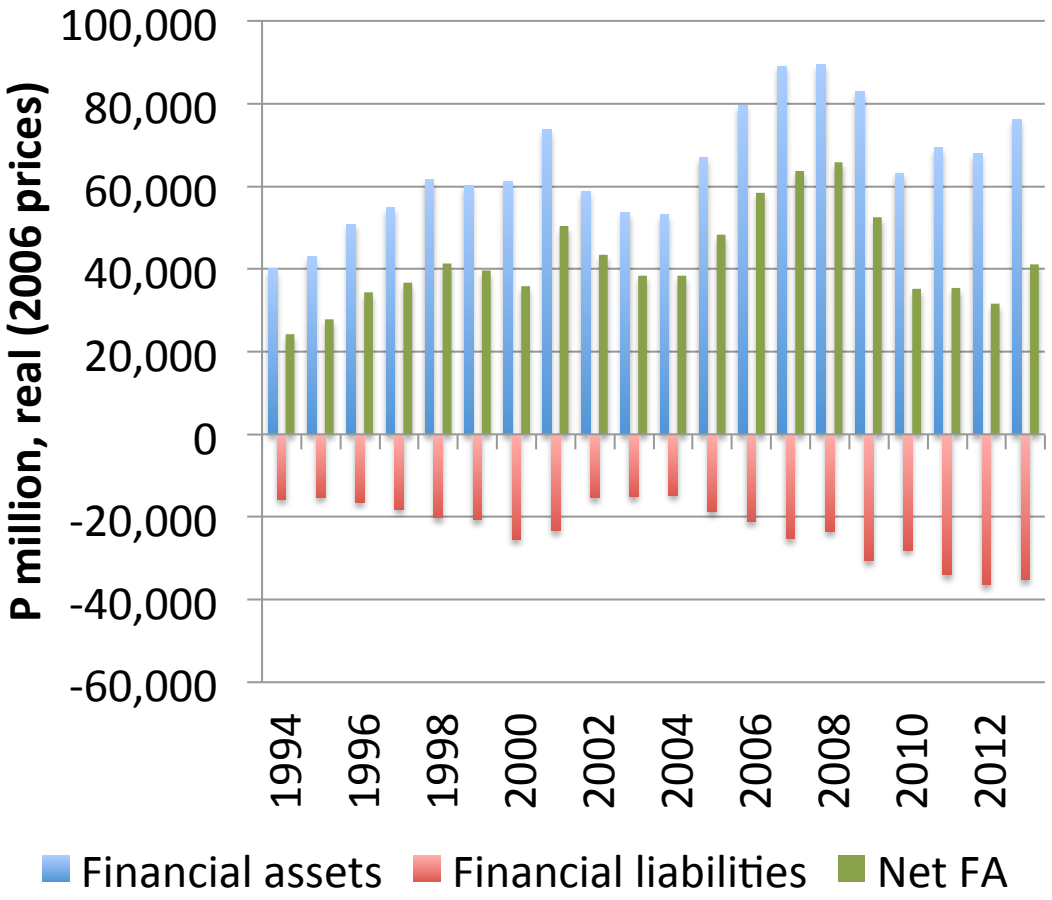
- Mineral assets peaked in early 2000s, sharp drop with GFC, partial recovery since
- But no higher in 2013 than in 1999

Real assets – Produced Capital



- Steady upward trend in produced assets, now with private sector assets now the largest share

Financial Assets

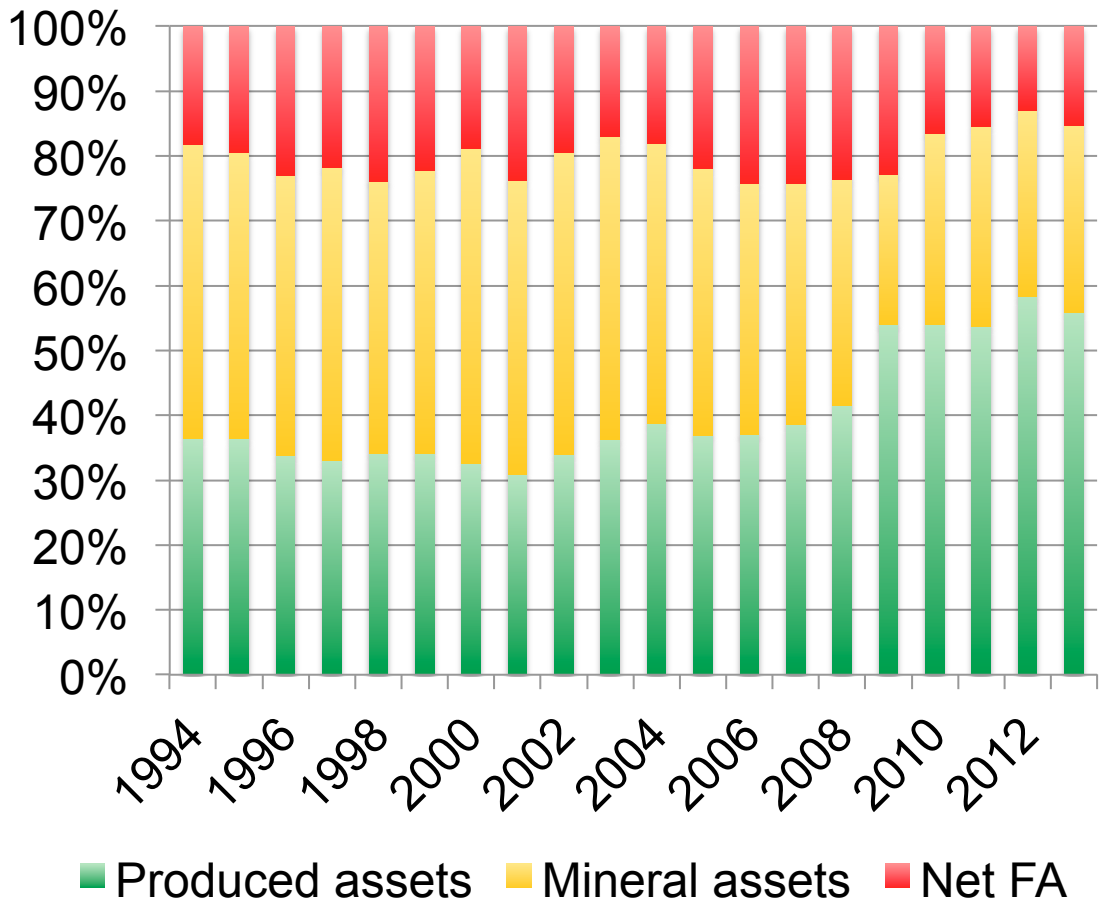


- NFA – sharp decline after GFC due to both lower assets and greater liabilities
- No higher in real terms in 2013 than 15 years earlier

Stock of National Assets, 2013

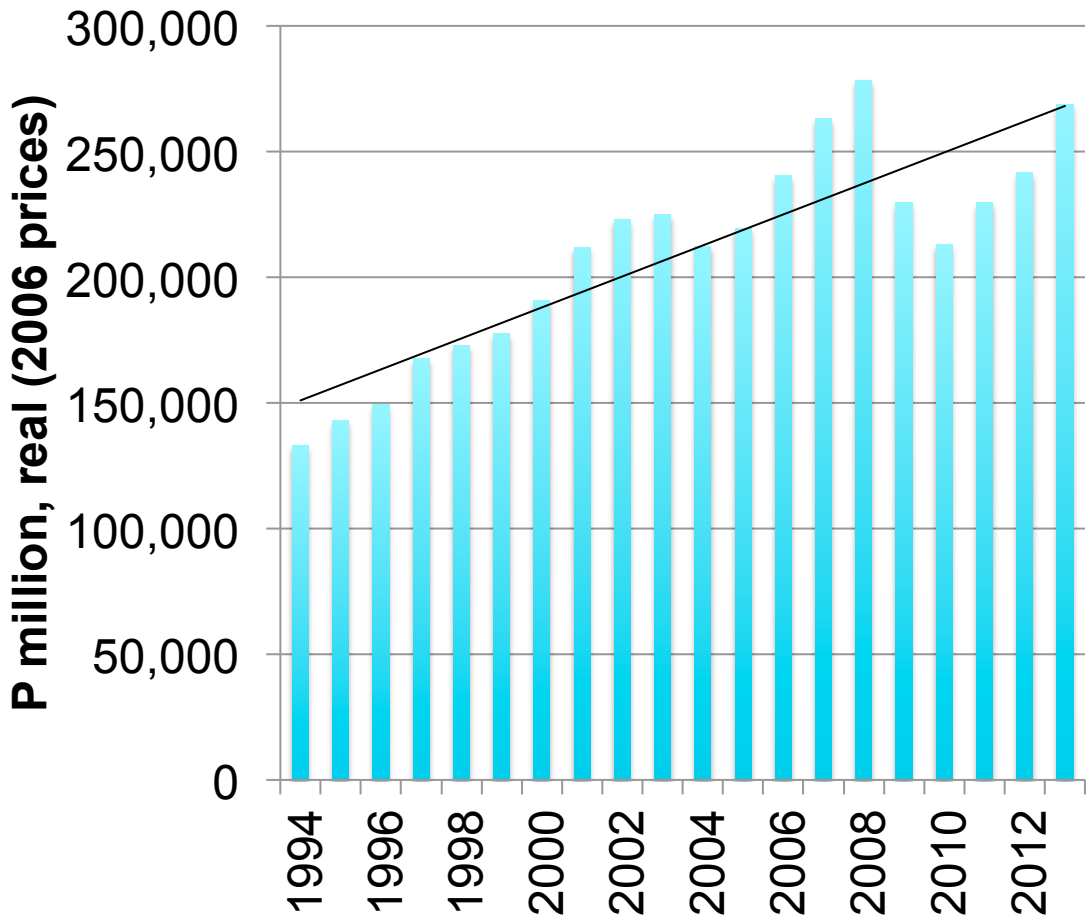
Asset type	Value, 2013 (P mn)
Produced capital	239,011
Public	*100,367*
Private	*121,071*
Residential buildings	*17,573*
Mineral deposits	123,707
Financial assets	121,350
Total assets	484,069
Financial liabilities	55,933
Net financial assets	65,417
Net worth	428,135

Composition of Net Worth



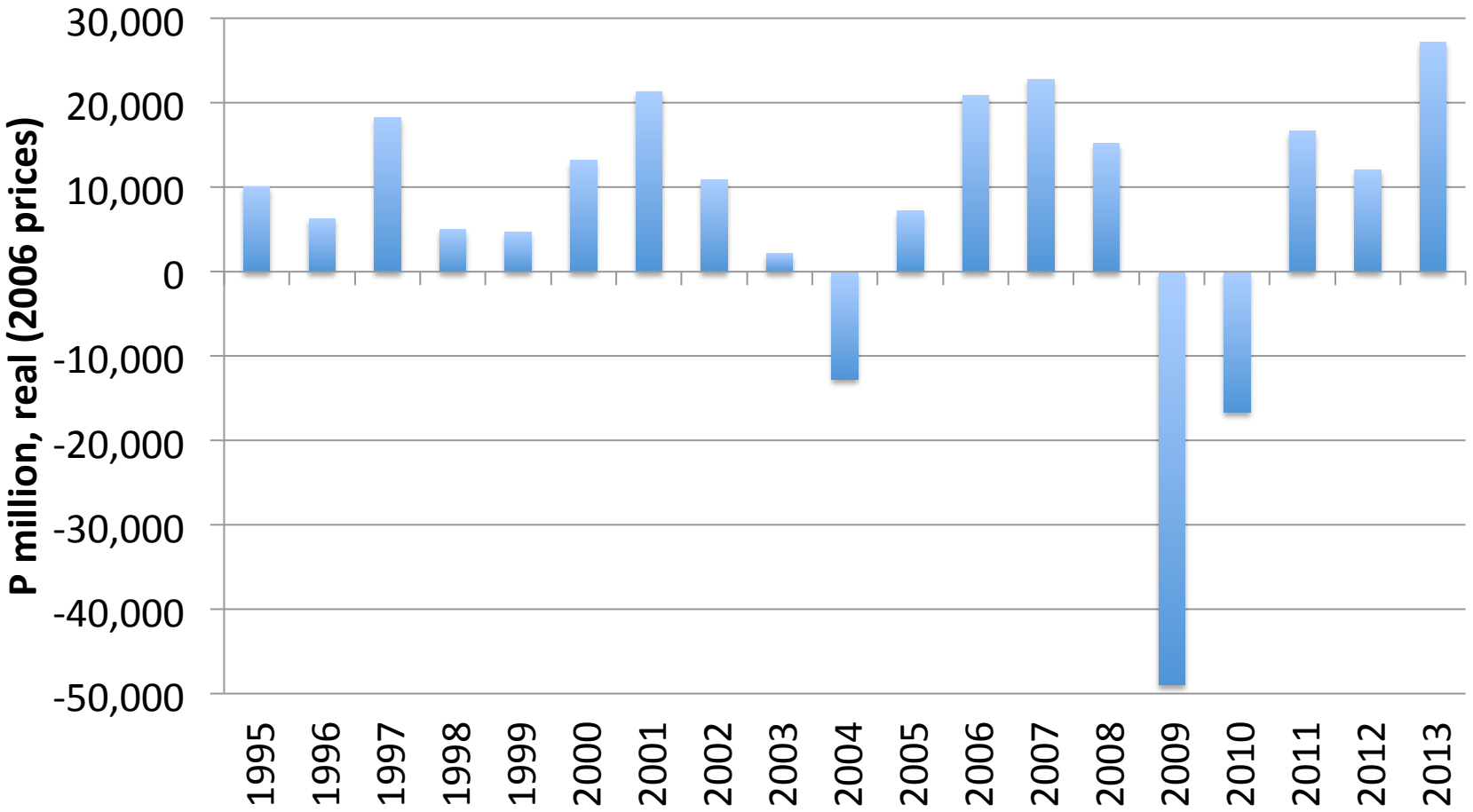
- Mineral assets used to make up the largest share of national assets
- Now smaller than produced assets
- Share of NFA also declining
- Shift away from mineral assets to be expected as mineral economy develops
- As mineral resources are depleted, they should be offset by other productive assets

National balance sheet trends (net worth, real)

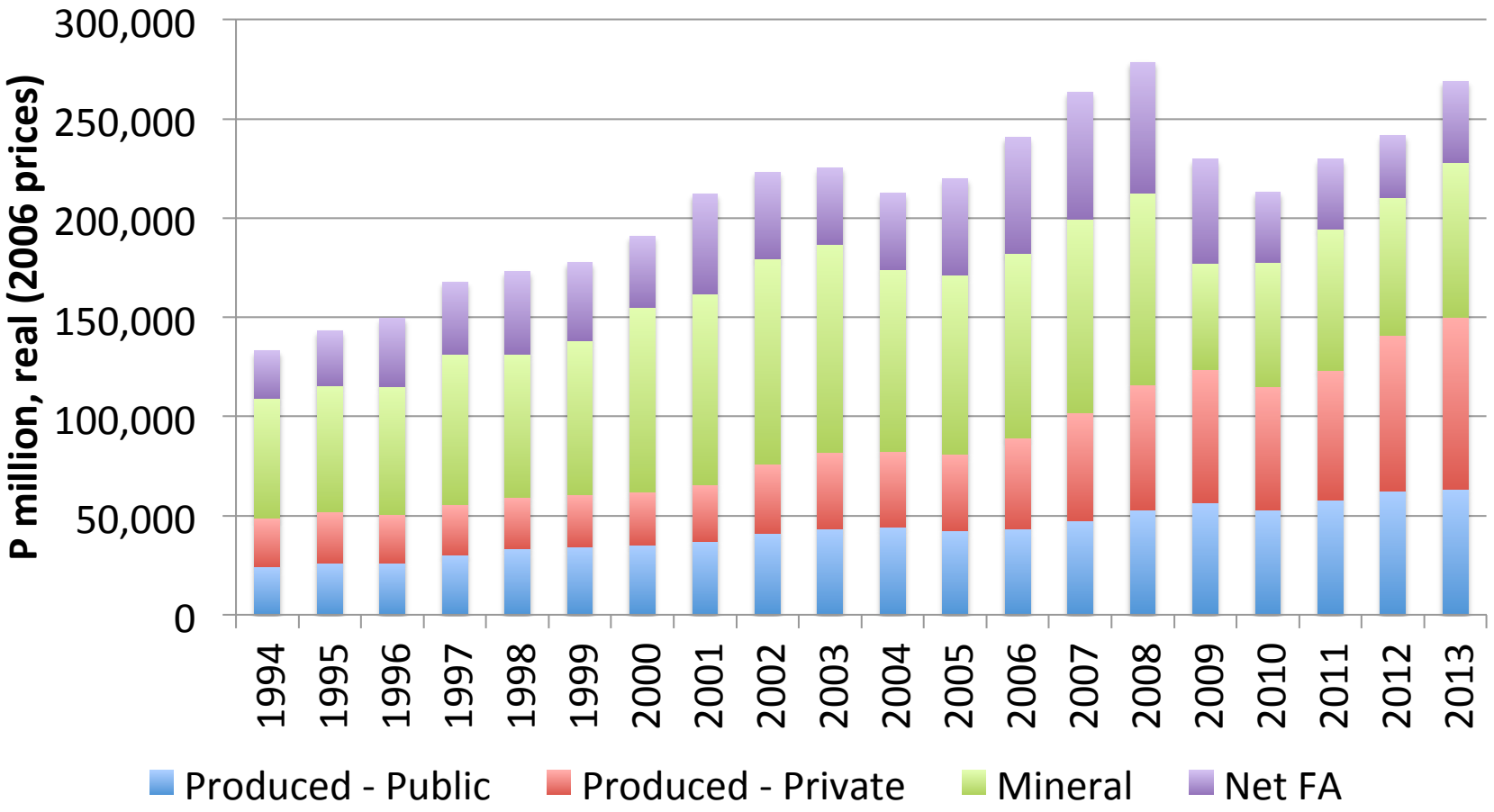


- An upward trend, but a sharp decline after the GFC

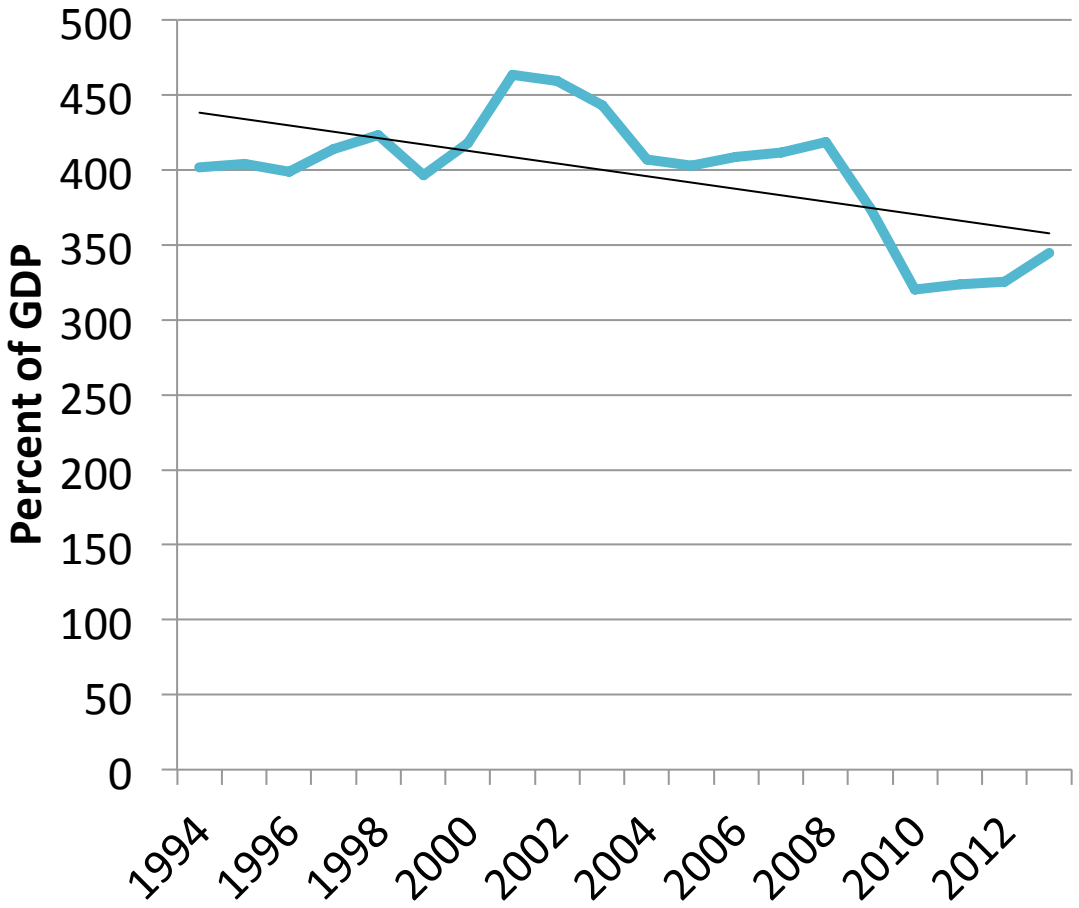
Change in total assets (real)



Real Asset Trends – All

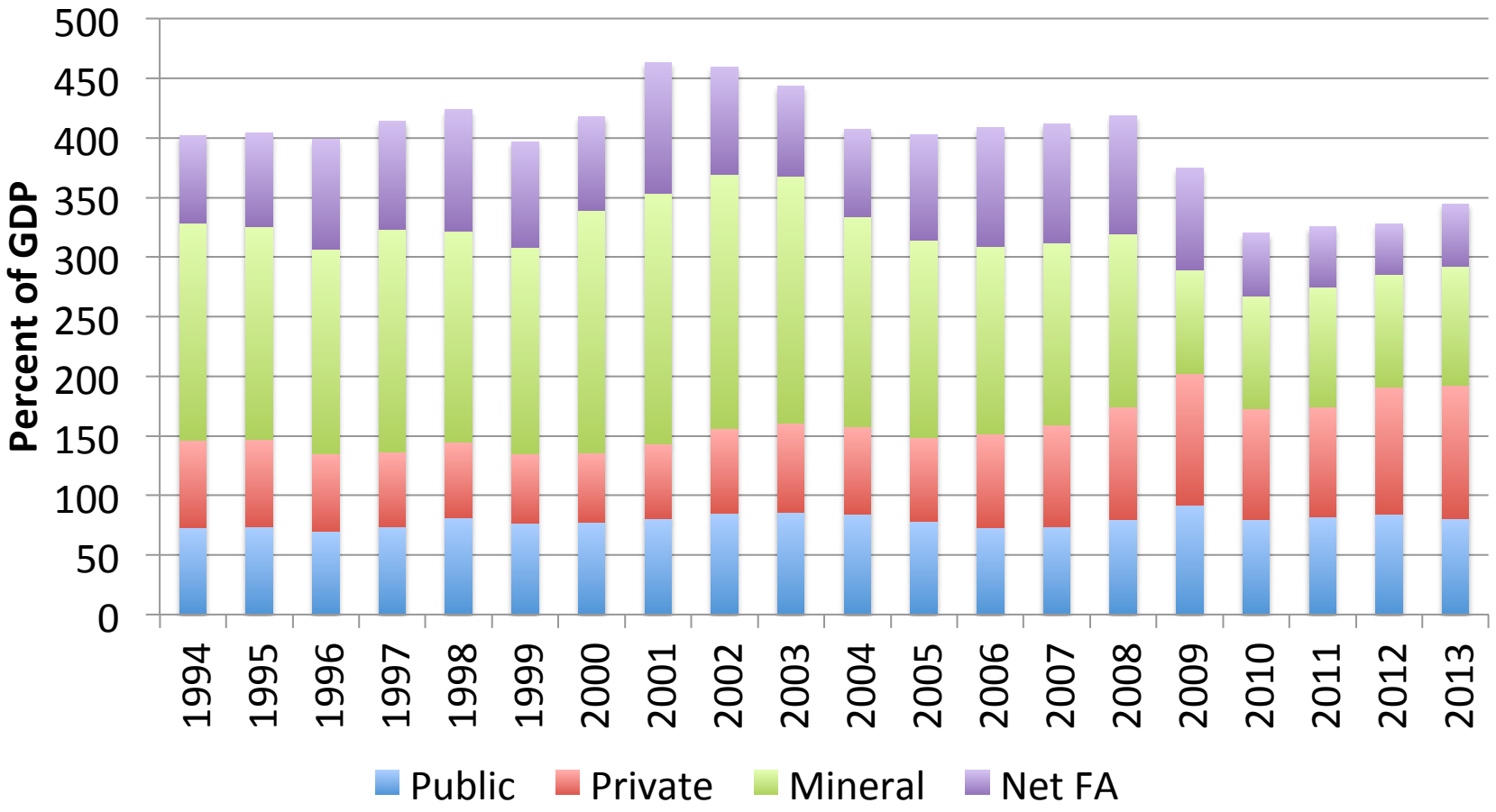


National Wealth – in relation to GDP

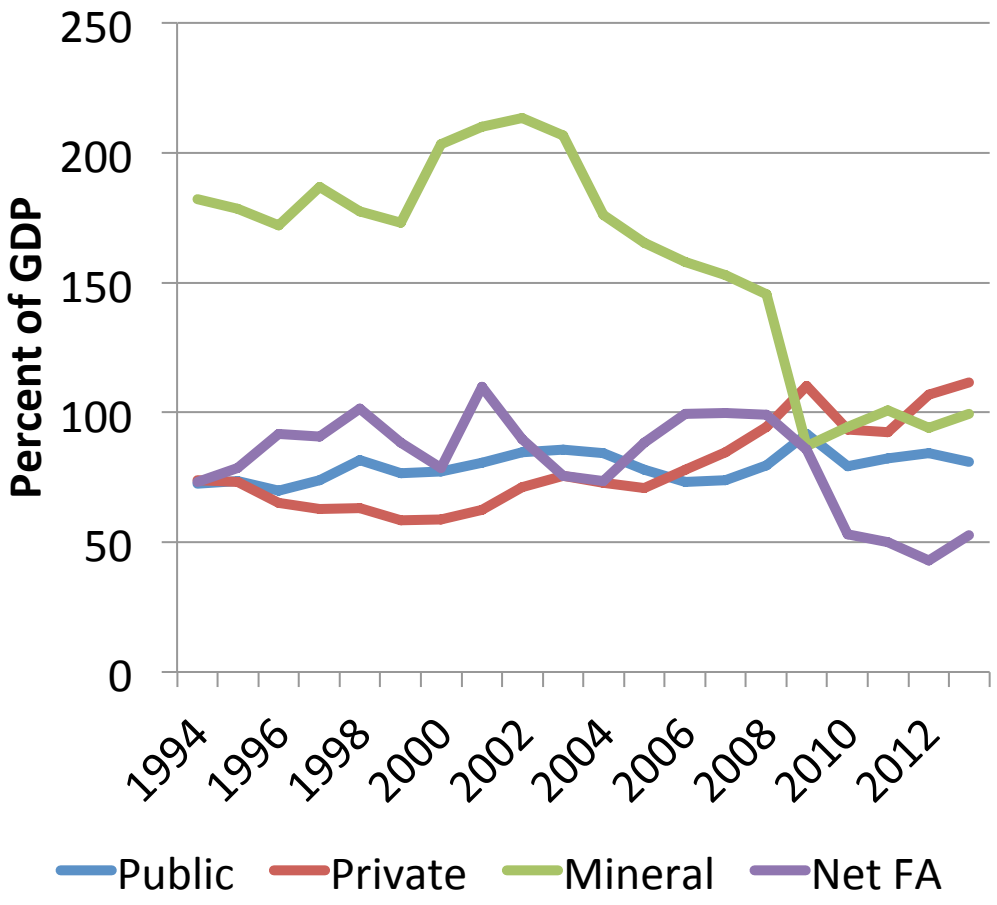


- National assets have been rising in real terms, but have not risen as fast as GDP
- Hence national assets have fallen in relation to GDP

National wealth by asset class

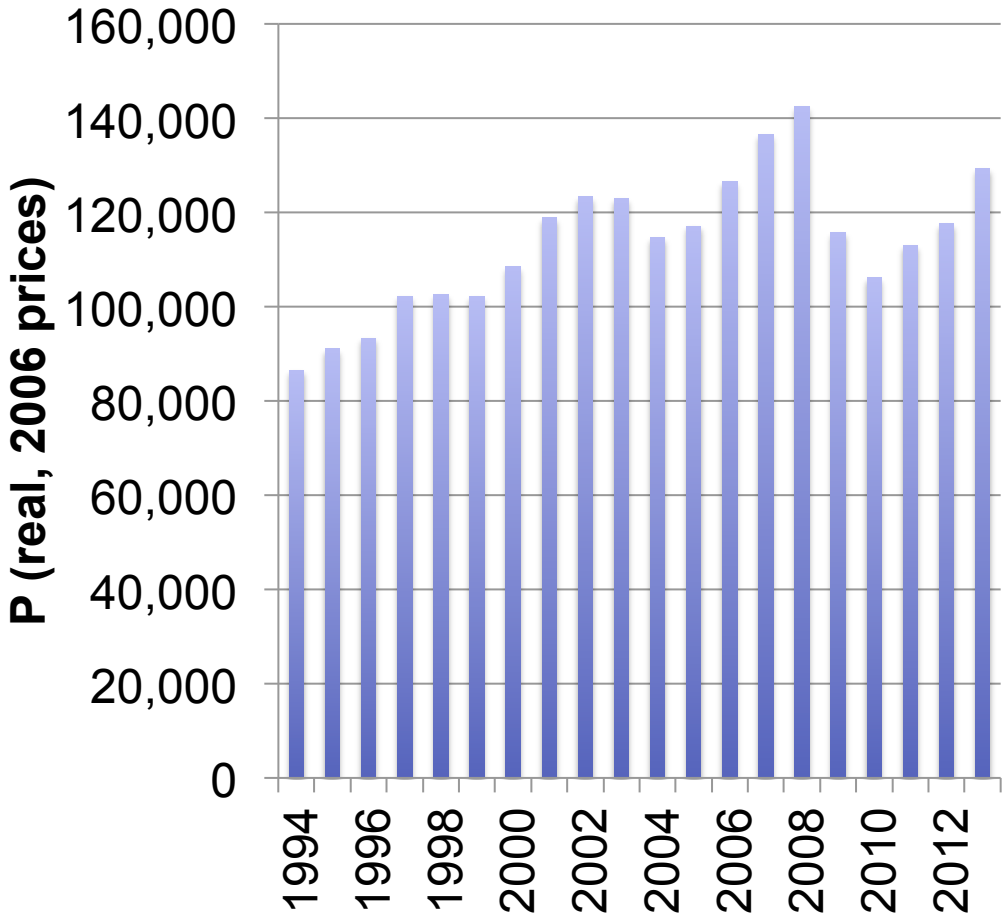


National wealth by asset type



- Main driver of lower national assets has been declining mineral assets
- Net financial assets have also fallen
- Produced assets (private) has risen fastest
- But not enough to offset decline in other asset classes

Real national net worth per capita



- Steady increase in real net worth per capita to 2008, but now below peak

Concluding Comments

- Some success in transforming mineral assets into other assets (mainly produced capital, less so financial assets)
- GFC was a major shock to national wealth, not just GDP
- National wealth has not kept up with GDP growth
- Could indicate lower future growth – unless productivity (of asset use) is increasing
- Supports argument for saving more of mineral revenues (e.g. proposed new fund for future generations).

ADJUSTED NET SAVINGS

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

Gross National Savings

- Deduct: consumption of fixed capital

Net National Savings

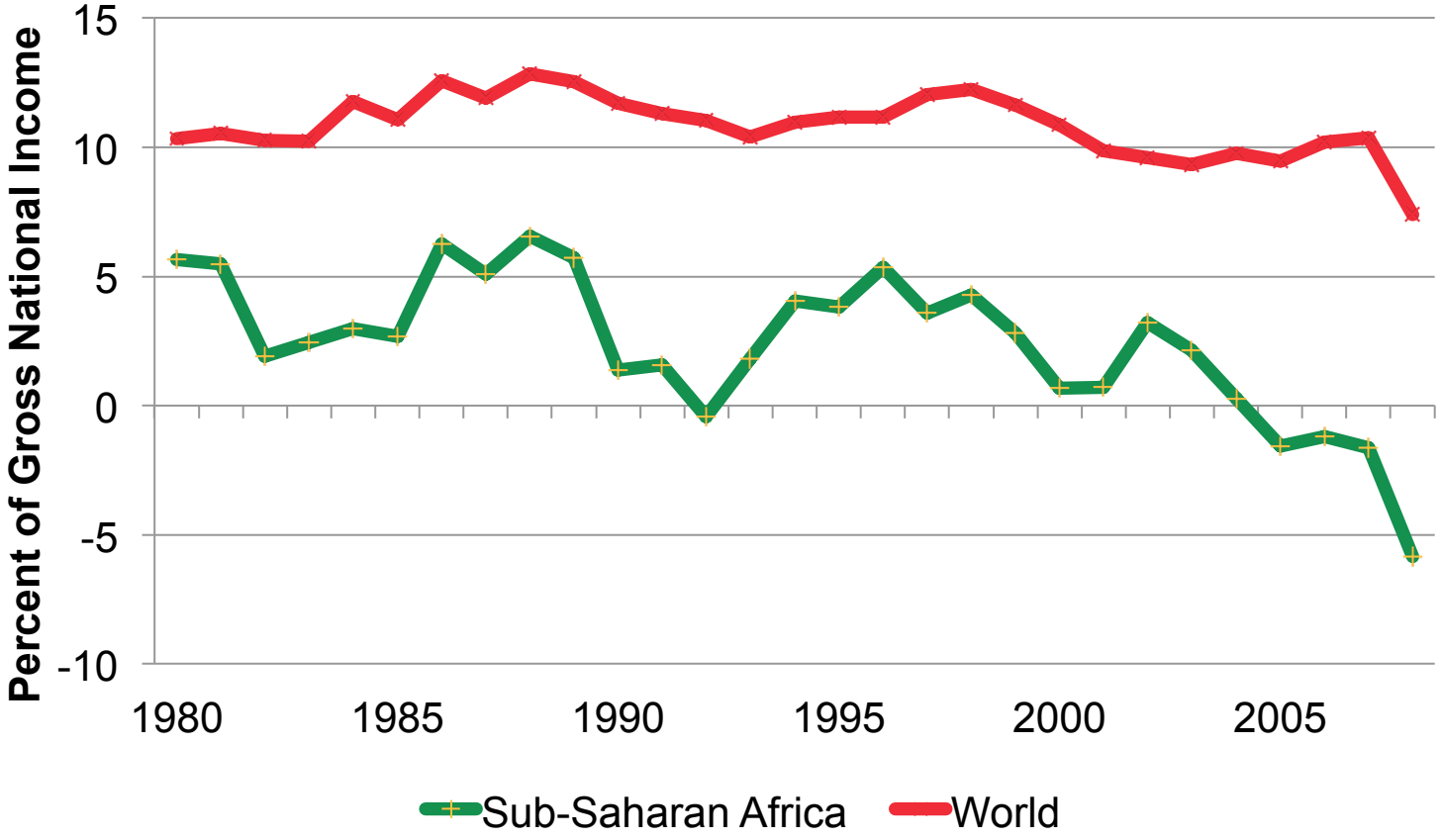
- Add: expenditure on education (investment in human K)
- Deduct: natural resource depletion (minerals, energy, forests etc.)
- Deduct: pollution damage

Genuine National Savings (adjusted net savings)

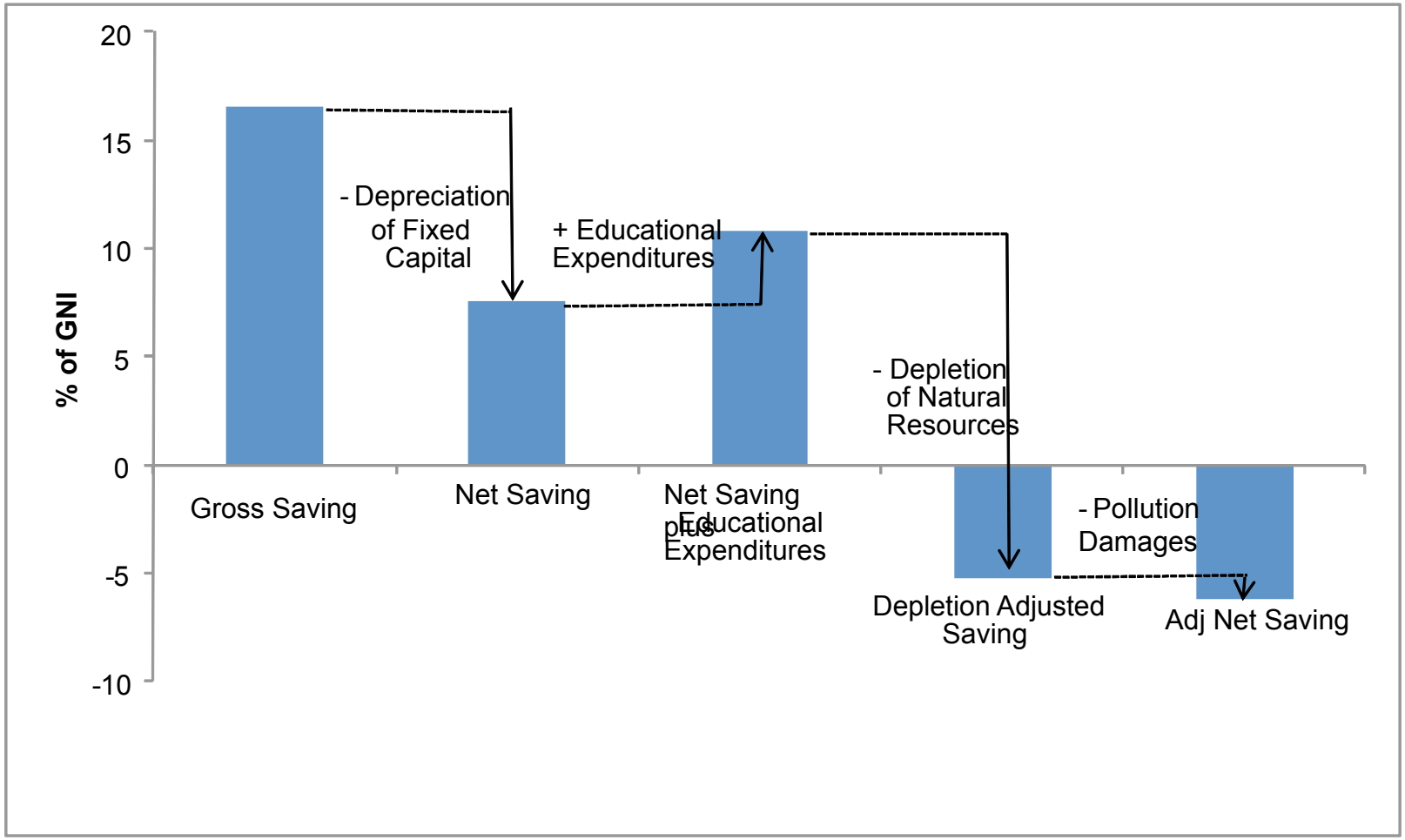
- Monitoring changes in wealth each year

Sub-Saharan Africa generally has had low ANS – due to mineral depletion and lack of investment

Adjusted Net Saving for Sub-Saharan Africa and the World, 1980-2008



Adjusted Net Saving: Sub-Saharan Africa, 2008



Calculation of Genuine National Savings (Adjusted net savings) – Botswana practice

Gross National Savings

- Deduct: consumption of fixed capital

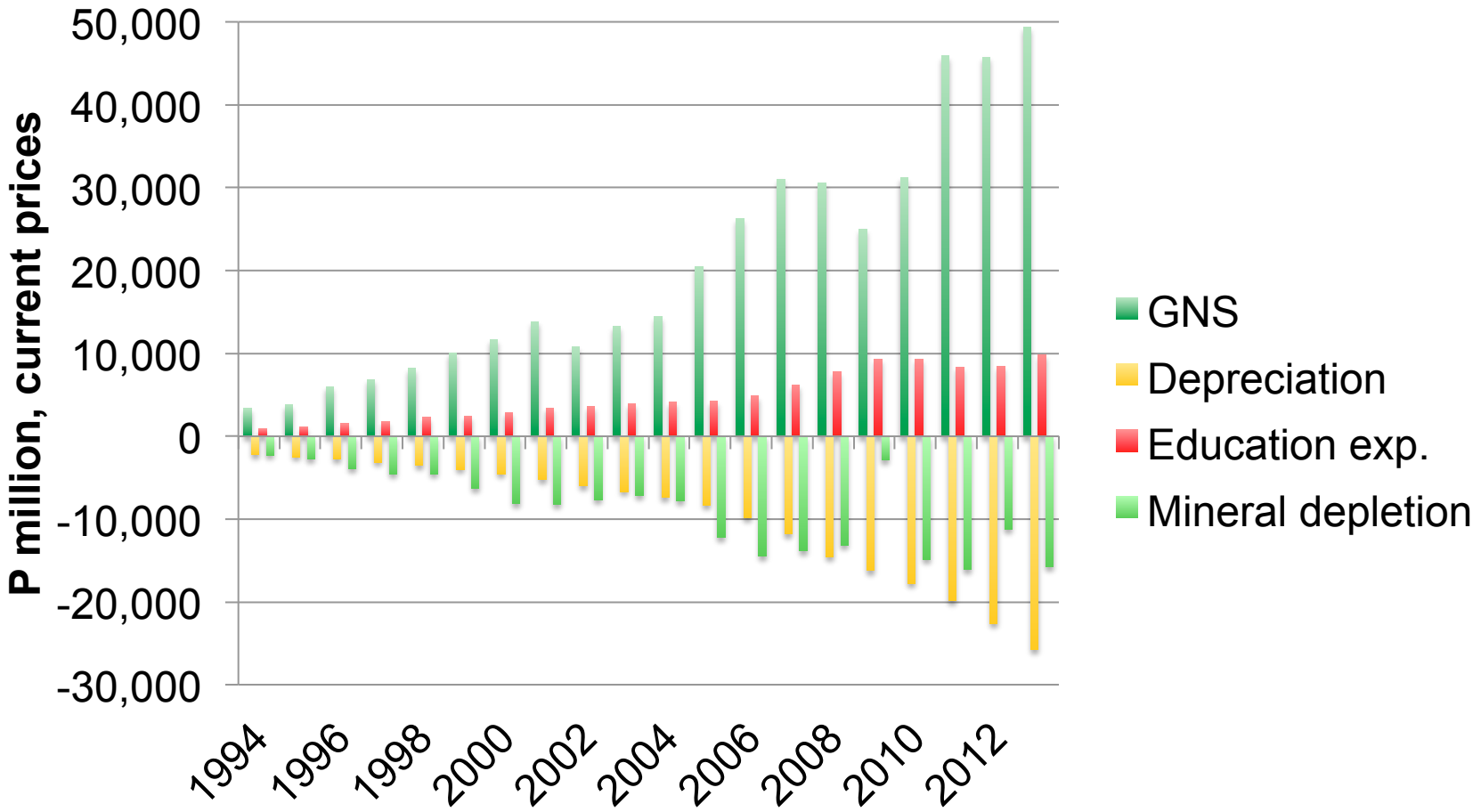
Net National Savings

- Add: expenditure on education (investment in human K)
- Deduct: natural resource depletion (minerals)

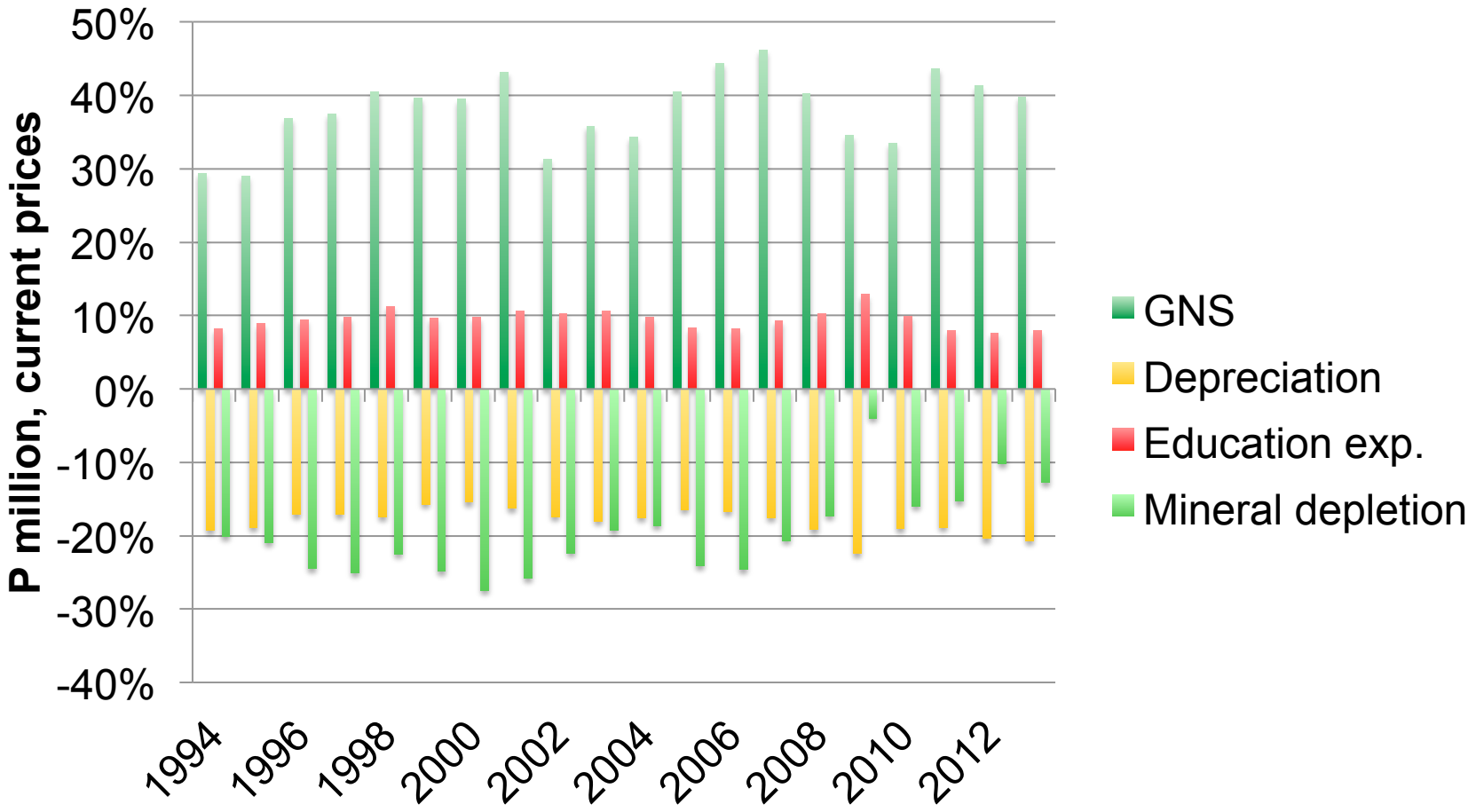
Genuine National Savings (adjusted net savings)

- Monitoring changes in wealth each year

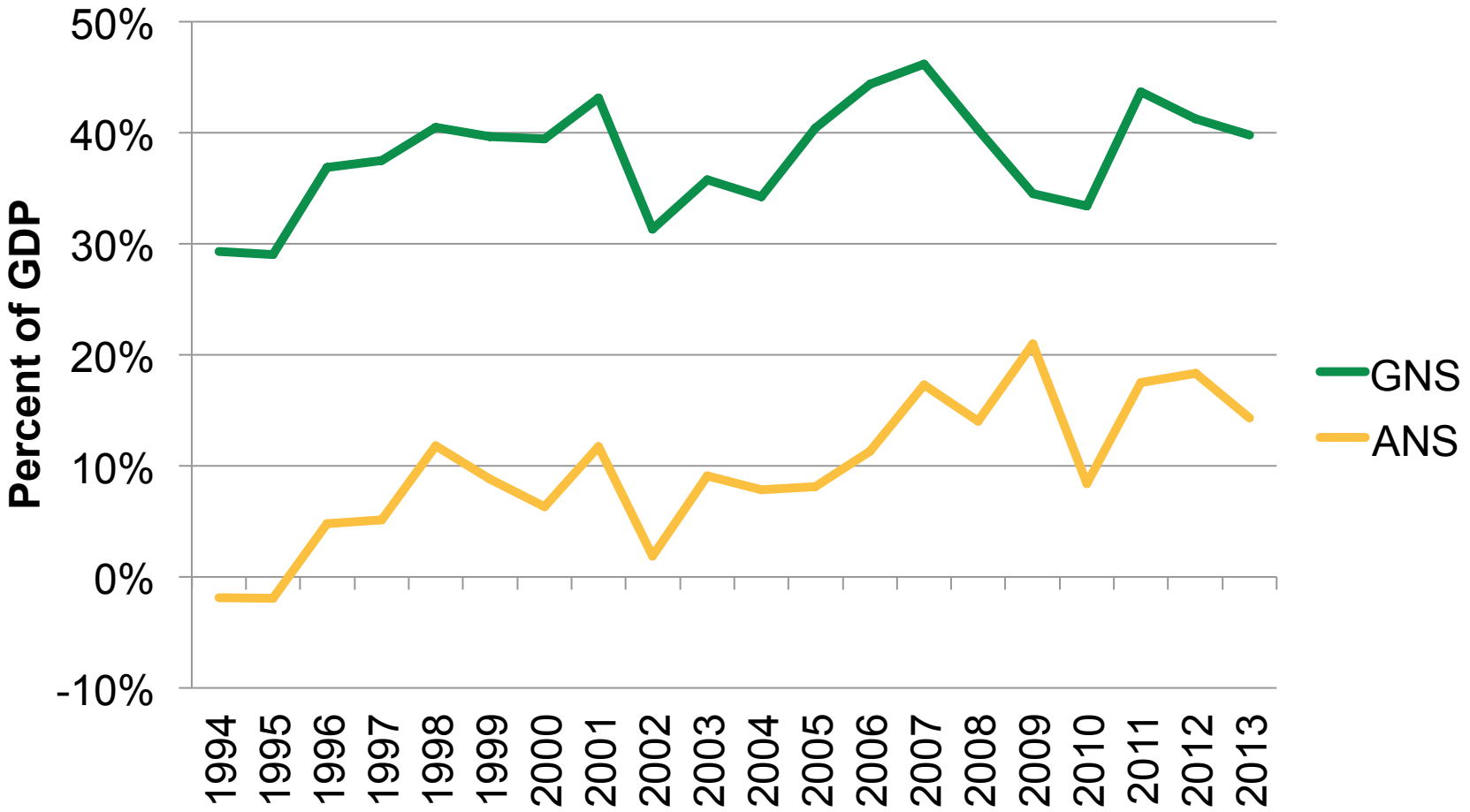
Adjusted net savings - components



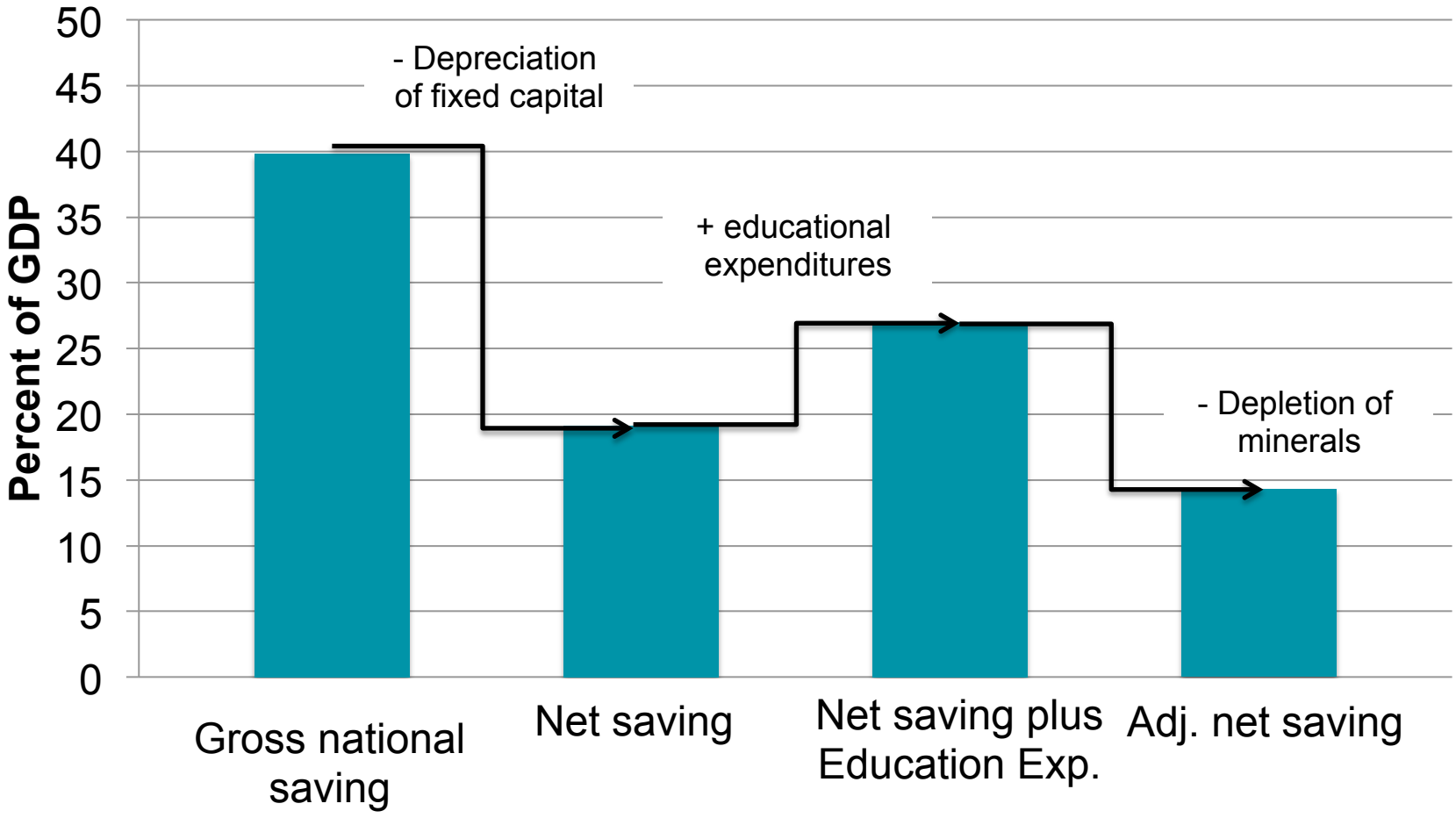
Adjusted net savings - components



Gross National and Adjusted Net Savings



Adjusted net savings, 2013



Adjusted net savings: conclusions

- ANS is significantly lower than GNS, due mainly to consumption of fixed capital (depreciation) in recent years, and depletion of minerals in earlier years
- Investment in human capital has made an important contribution to boosting ANS
- Overall, ANS has remained positive, indicating that assets have been accumulated rather than depleted

THANK YOU!

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