Accounting for resource use

Souvik Bhattacharjya
Fellow
Resources, Regulation and Global Security Division
TERI

What is sustainability?

- Simple definition.. "*the ability to sustain*" or, "*the capacity to endure*" …"*equilibrium relation between human activities and their physical surroundings*"
- With population growth, increased economic activities, demand for better quality of life, (& so on), the pressure on nature's finite resources are increasing rapidly.
- Pose severe economic problems, social inequality and environmental degradation
- No easy solutions as these issues are interlinked.

The three pillars of sustainability

Employing existing resources optimally so that a responsible and beneficial balance can be achieved over the longer term.

Ability of a social system, such as a country, to function at a defined level of social well being indefinitely.

Human activity uses nature's resources at a rate at which they can be replenished naturally.

Basic interpretation of sustainable development

- The concept of 'sustainable development' within it contains 3 ***key*** concepts i.e. equity, needs , limitations

EQUITY	*Intergenerational equity* (fairness of justice), *growth with distributional aspects* (dominated 1970s); elimination of poverty and inequity
NEEDS	Meeting human needs and aspirations for a better life
LIMITATIONS	Limitations posed due to technologies, institutional arrangements as they are under control of social and individual decisions; capacities of environment to support life

Strong vs. weak sustainability

❑ The debate fundamentally originates from the fact that what do we wish to preserve and pass on to future generations. But how do we do it?

Weak sustainability

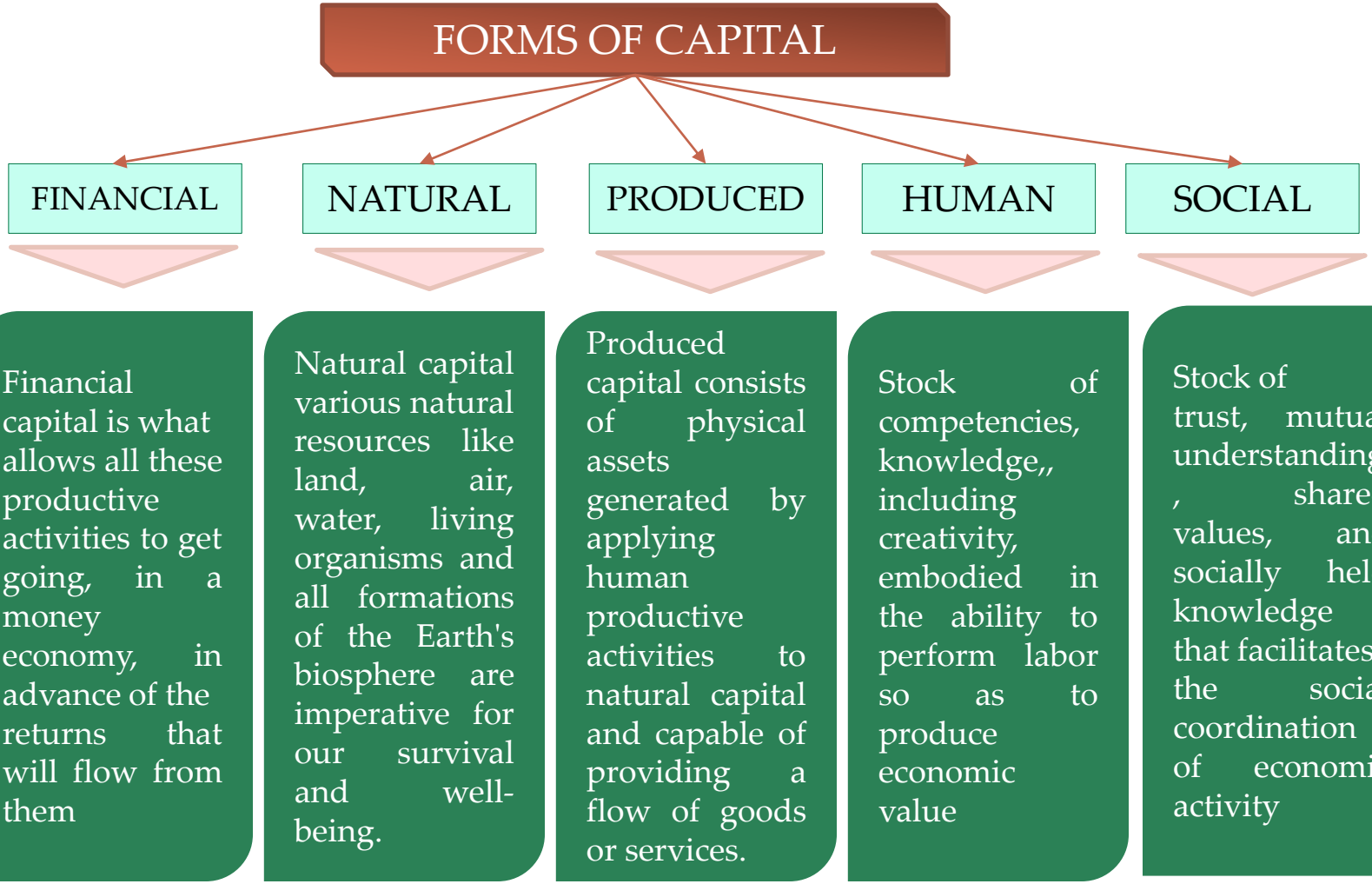
- Quantification in economic terms (economists approach)
- Natural capital overtime converted to other forms of capital
- **But**: Can crowd out people's other forms of values e.g environmental value
- The classic case of Nauru (resource curse)

Strong sustainability

- Quantification in biophysical terms (ecologists approach)
- Minimum amounts of different types of capital be maintained
- Acknowledgement of environmental integrity, ack. Intrinsic value & rights
- Examples may include compensatory a forestation

❑ Choice of which to choose is dependent on scientific, ethical, prudential, and obvious political choice

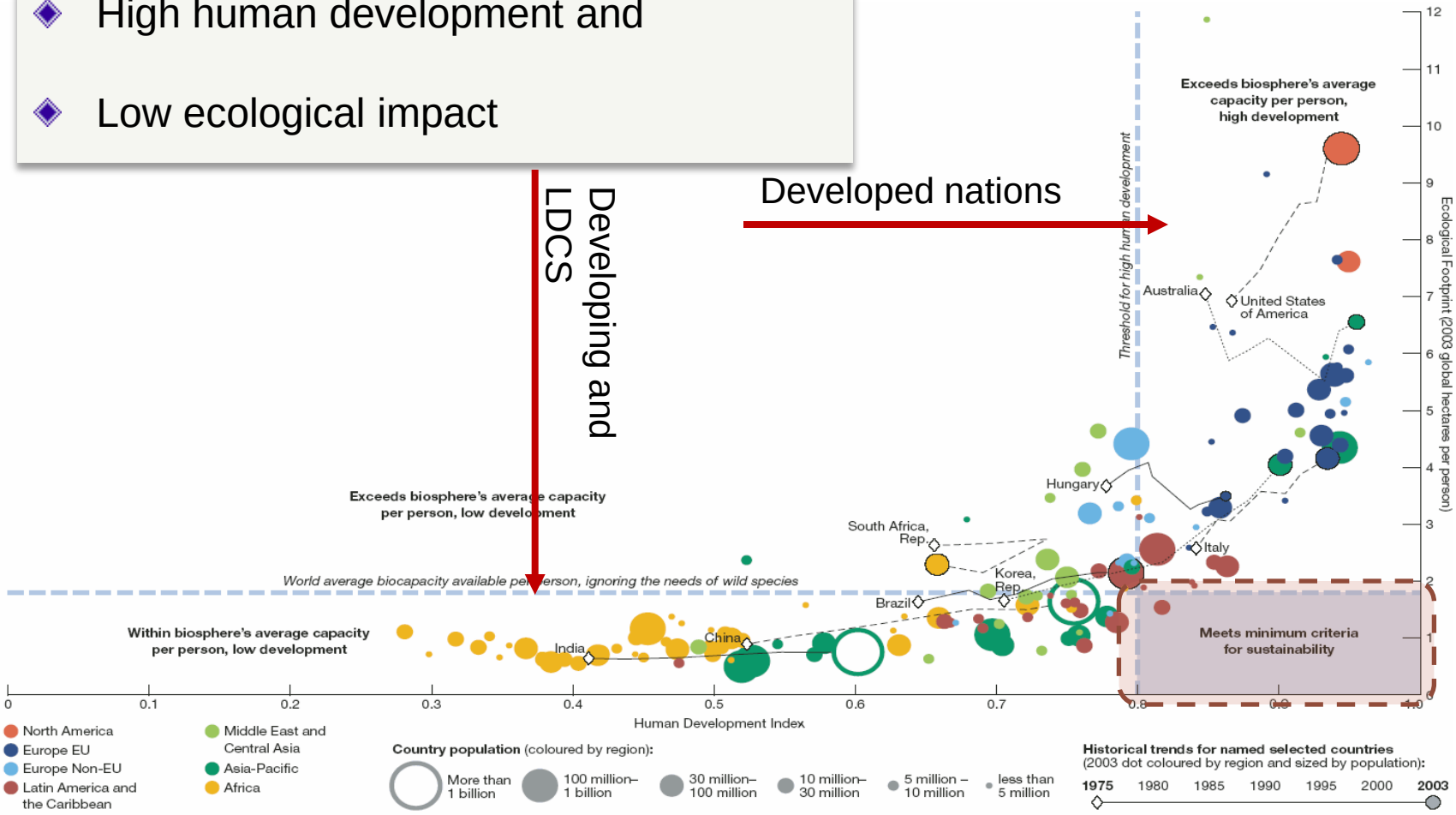
Forms of capital



Our future based in SD

Meet the dual goals of sustainability–

- High human development and
- Low ecological impact

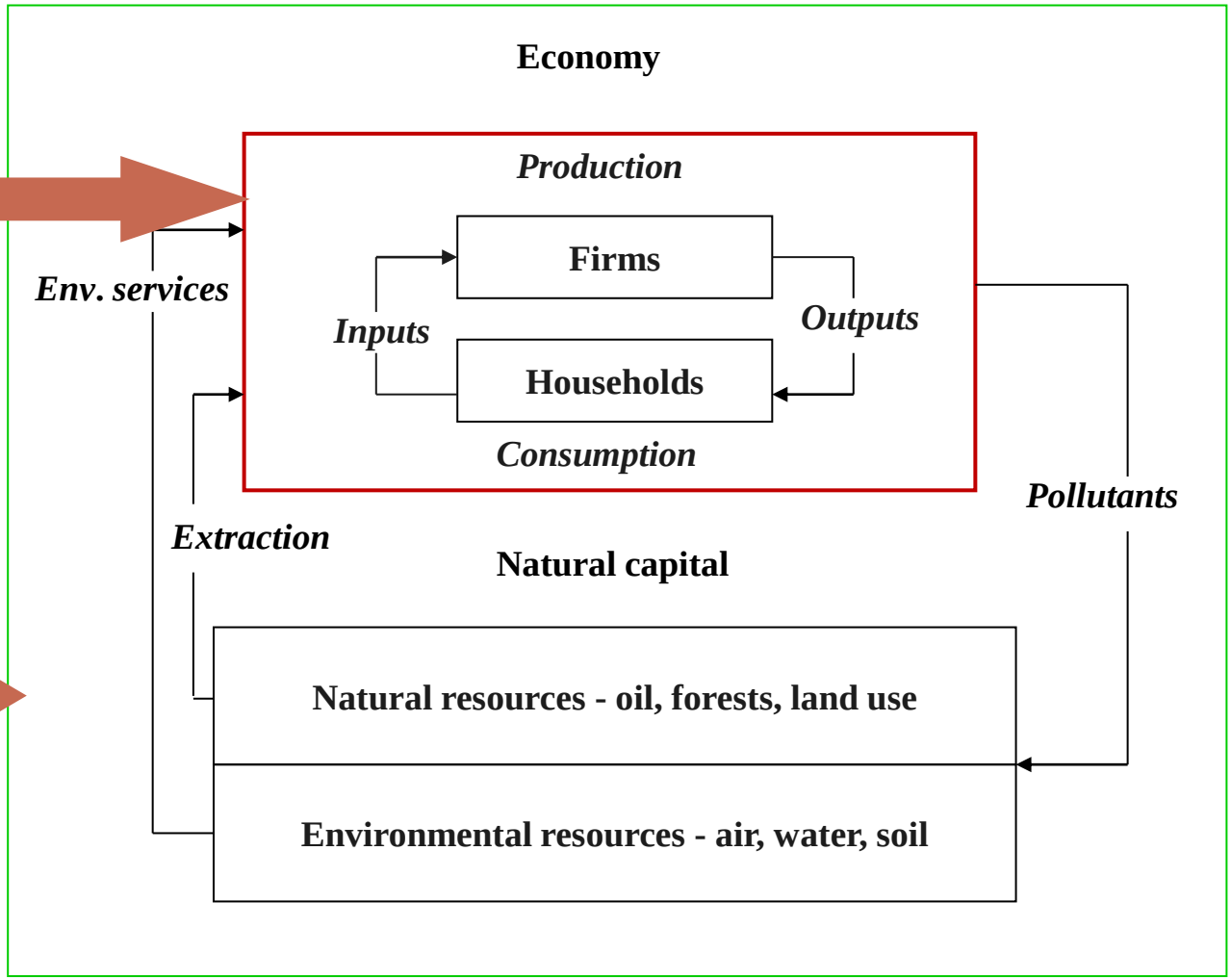


Source: UNDP (2009)

Economy-environment interlinkages

Current income accounting process

Adjusted income accounting should incorporate both



Are our national accounts sustainable?

- National accounts - set of systematic statistical statements that reflect the value of total final o/p produced in various economic sectors, along with details of distribution of factor incomes among various groups and final expenditure of the economy
- Key economic indicators: gross domestic product (GDP), vs gross national product (GNP), income growth rates, investments and savings, trade balance, etc.

Issues:

- Doesn't reflect scarcity of natural resource, degradation of environmental quality in terms of pollution, impact on human health, reduced productivity
- Absence of appropriate adjustment for depreciation of natural capital

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- So … we need a measure that can provide economy's wealth and the distribution, (and not GDP growth),

Sustainable national income accounting

- **Preparation of physical accounts**
  - natural resource depletion / reserve base recovery (minerals, forests etc.)
  - environmental degradation / improvement (air, water etc.)

- **Preparation of monetary accounts**
  - valuing physical accounts to the extent possible (using various techniques) (very challenging)

- **Adjustment of national income / wealth aggregates**
  - making necessary adjustment to the national income accounts

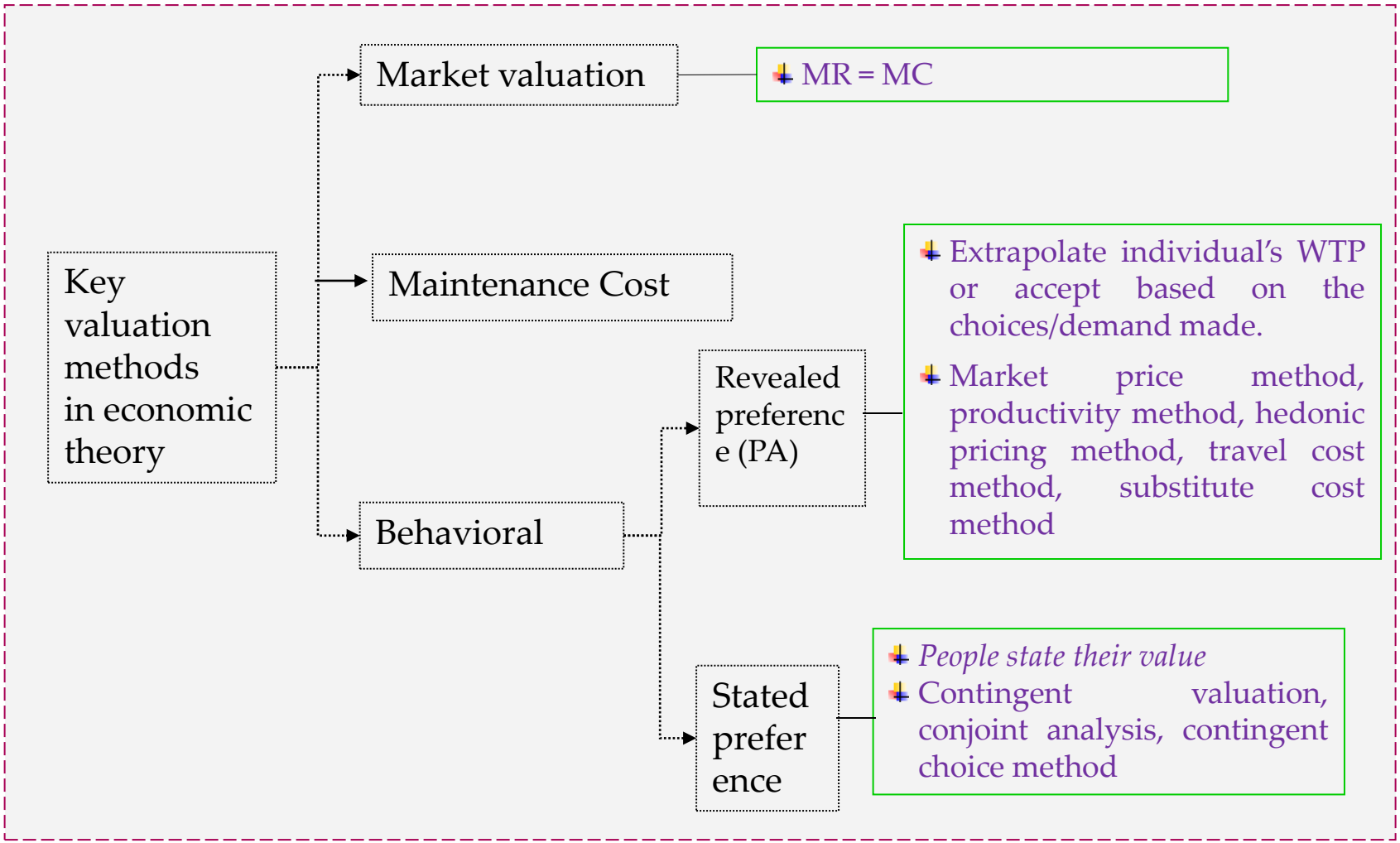
Physical accounts

- **Resource depletion/ reserve base recovery/resource addition (e.g. forest)**

Opening stock
+ quantity changes (use/reserve discovery/other reasons)
= Closing stock

- **Environmental degradation/improvement, increase/decrease emission, increase/decrease in discharge of effluents**

Monetary accounts



Market based valuation techniques

Market price method:

- Uses market price method of goods and services bought and sold in the markets.
- Demand function from the buyer and supply function from the seller.
- To determine a producer and consumer surplus, a demand function must be estimated and then the standard market price must be subtracted from the level demanded.
- Consumers are willing to pay more, and producers are willing to accept more.
- Equilibrium is reached when both the consumers and producers are able to maximize their surpluses.

Limitation

- Only takes into account use-values and marketed goods or services that have an actual price
- It does not consider services such as the value of freely available resources (e.g. water, soil, etc) and does not typically work well on a large scale.

Revealed Preference (1/2)

Hedonic pricing method:

- The hedonic pricing method is used to *estimate the value of environmental amenities* that affect prices of marketed goods.

- The method is based on the assumption that people value the characteristics of a good, or the services it provides, rather than the good itself. *Prices reflect the value of a set of characteristics, including environmental characteristics, that people consider important when purchasing the good*.

- The first step is to collect data on (e.g. residential property sales) in the region for a specific time period

VS

- Statistically estimate a function that relates property values to the property characteristics, including the distance to open space & resulting function measures the portion of the property price that is attributable to each characteristic.

- Thus, the researcher can estimate the value of preserving open space by looking at how the value of the average home changes when the amount of open space nearby changes. .

Revealed Preference (2/2)

Travel cost method:

- Used to *estimate the value of recreational benefits* generated by ecosystems. It assumes that the value of the site or its recreational services is reflected in how much people are willing to pay to get there.

- Basic premise - *time and travel cost expenses that people incur to visit a site represent the "price" of access to the site*. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that people make at different travel costs.

- *To apply the travel cost method, the following information needs to be collected:*
- Number of visits from each origin zone (usually defined by zipcode) (weighting)
- Demographic information about people from each zone
- Round-trip mileage from each zone
- Travel costs per mile
- Value of time spent traveling, or the opportunity cost of travel time

Stated preference

Contingent valuation:

- Contingent valuation is a survey-based economic technique for the valuation of non-market resources, such as environmental preservation, environmental services, impact of contamination, etc.
- CVM is extremely flexible and can be used to value most environmental assets/resources and services.
- Typically the survey asks how much money people would be willing to pay (or willing to accept) to maintain the existence of (or be compensated for the loss of) an environmental feature, such as biodiversity. *(Open ended questions should be avoided)*
- Relevant statistical/econometric tools are used to estimate the sensitivity of willingness-to-pay and relevant explanatory variables.
- The cost numbers in the question have to be given based on references of some relevant/indicative market prices.
- However it may not yield accurate results due to biases that may be introduced in the survey or through respondents behaviour.

Accounting for unsustainable mineral extraction: Madhya Pradesh and West Bengal

Depletion – physical accounts

- Closing stock = Opening stock + reserve accretion – production
  - Period: 2000-2003
  - Opening stock - proved “reserves”
  - Non-coking and coking coal
  - Coal: 85% of the value of minerals produced in MP, & 98% in WB

Monetary accounts

- Economic depreciation and the value of changes in stock of exhaustible natural resource dealt with (i) Net present value method (ii) User cost method (iii) Net price method
- **NPV method**: Based on oppr. cost principle, where resources would be extracted/used if discounted net returns > discounted returns from alt. investment.
- **Net price method**: Based on 'Hotelling' rent i.e. in a perfectively competitive market net price of a resource rise @ rate of interest of alternative investment, offsetting discount rate.
- **User cost:** makes a distinction between the "true income" and the "gross receipts" generated by an asset; defines true income as the amount of income that would be sustained indefinitely regardless of the actual finite lifetime of the asset by suitably investing a portion of the gross receipts generated which can be the depletion cost, otherwise referred to as the user cost

Estimating NPV of resource rent

$$RV = RR\sum_{K=1}^{n}\frac{1}{(1+r)^{k}} = RR\left[\frac{(1+r)^{n}-1}{r(1+r)^{n}}\right]$$

where

- RV: Value of the resource;
- RR: Resource Rent;
- n: life of the deposit in years. Can be expressed as S/E where S is the stock of the resource in physical terms and E, the annual rate of extraction, assumed to remain constant; and
- r: rate of discount

Resource rent estimation

Step1: Gross Operating Surplus (GOS)

GOS = Value of coal – Intermediate consumption – Compensation to employees

Step2: Net Operating Surplus (NOS)

NOS = GOS – Consumption of Fixed Capital

Step3: Return on the value of produced assets (RPA)

RPA: rate (or oppr. cost of investment)*Value of coal

Step4: Resource rent (RR)

RR = NOS - RPA

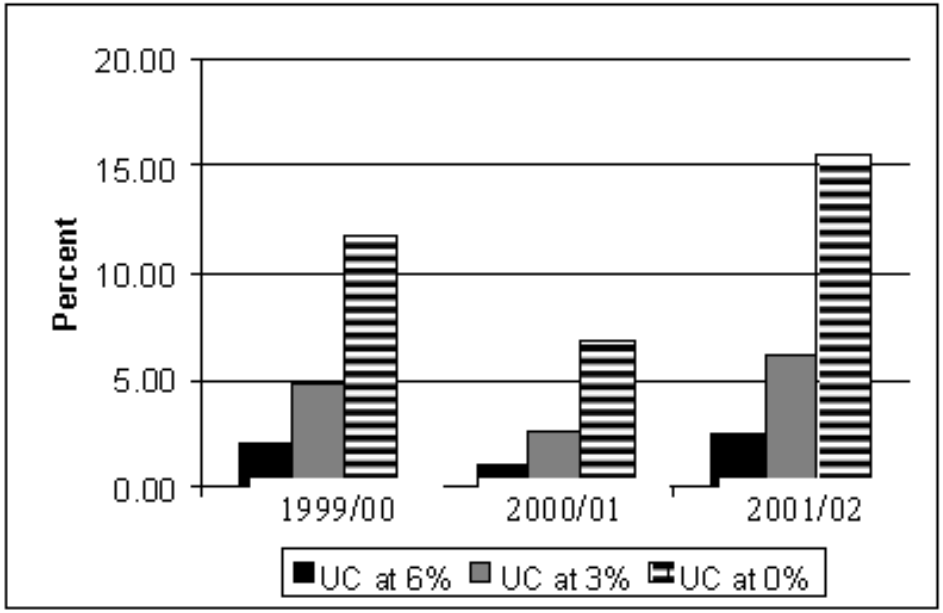
Data sources and assumptions

Gross Operating Surplus (GOS)	Consumption of fixed capital (CFC)	Return to produced assets	Others
Gross value of coal output Minerals Yearbook, IBM; State Statistical Bureau.	**Option 1-** as % of value of output- CSO **Option 2-** Estimated using all India CFC data for the mining sector - CSO	**Value of produced capital** Estimated using all India data on Net Fixed Capital Stock for the mining sector - CSO	**Life of minerals** Based on reserves and production reported in the Coal Directory of India
Intermediate consumption **Option 1-** as % of value of output CSO **Option 2-** Estimated from company wise data on intermediate consumption (weighted using company wise shares in total state production)- includes energy purchase, insurance, R&M of buildings, P&M etc., transport charges etc.		**Rate of return**: 3%	**Rate of discount** for NPV – sensitivity analysis at 3% and 6% **Constant price series-** Based on all India mining sector deflator
Compensation of employees Estimated from company wise data on intermediate consumption (weighted)			

Adjustment based on the user cost approach

• True income, Y, is the part of net revenue that could be consumed annually in perpetuity if the remainder of net revenue were invested in renewable capital.

• The annual true income, Yt , is only a fraction of the net price, NP, in each period and can be shown to be equal to $Yt = NP*(1 - e^{-rT})$. The remaining part of the net price , $NP*e^{-rT}$, is the depletion cost which would have to be invested in each period, t, if development is to be sustainable.



Issues in accounting and valuation

- Availability of data
- Disagreement over the appropriate unit of measurement
- Disagreement on the rate of discount
- Problems of aggregation
- Issues of double counting e.g. defensive expenditure
- Choice of method and comparability of results