

# Introduction to Environmental Economics (IKT3620)

**Economic growth, Environment and Sustainable  
Development**

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# GNP & GDP

- **GDP:** An estimated value of the total worth of a country's production and services, within its boundary, by its nationals and foreigners, calculated over the course on one year
  - $GDP = C + I + G + E - Im$
- **GNP:** An estimated value of the total worth of production and services, by citizens of a country, on its land or on foreign land, calculated over the course on one year
  - $GNP = GDP + NR$  (Net income inflow from assets abroad or Net Income Receipts) -  $NP$  (Net payment outflow to foreign assets)

# GNP

GNP has been widely criticized as a measure of well-being.

- The effects of the economy on the environment are not well measured by GNP
  - Oil spill: A lot of money spent on cleaning up → GNP can rise even if citizens are in a worse situation
- Changes in natural resource stock do not show up in GNP
  - Farming → if there is soil erosion, productive stocks of soil can be severely affected
- GNP does not tell how fairly the economic pie is divided up
  - GNP per capita can be rising but at the same time income inequalities can worsen.

# Why do economies grow?

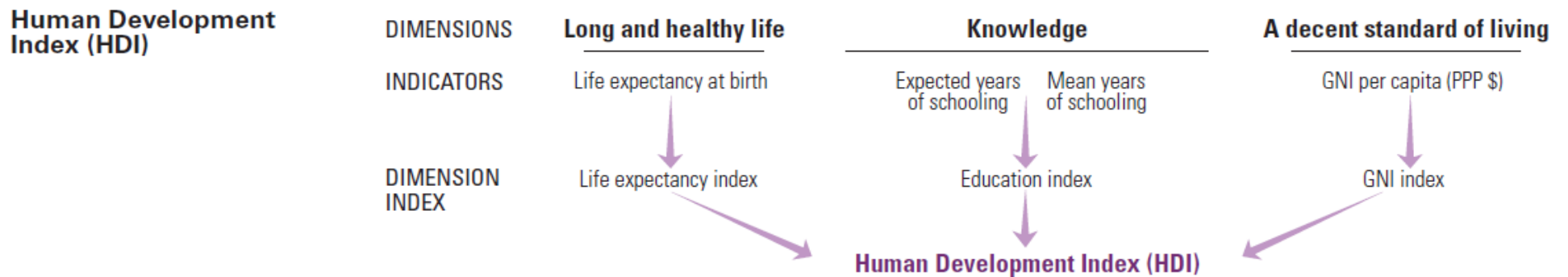
- Economies grow because of
  - Increasing resources
    - K,L,Land,En,Res
  - Productivity growth
    - Average productivity of agricultural land in terms of yields per m<sup>2</sup> have increased over time
    - Human capital
      - Education
      - LbD→despite no changes in the machinery, workers increased their output by 2% each year simply by becoming more experienced in the job (Sweden, 1800s)
    - Mining
    - Capital

# Growth vs. Development

- Growth and Development are not usually the same
  - Development has a broader definition
- Development necessitates a bunch of other indicators that would be improving over time
  - GNP/capita
  - Reduction in income inequality
  - Improvement in infant mortality
  - Reductions in morbidity (illness) and mortality (death) rates among adults as well as children
  - Improvement in a range of environmental indicators

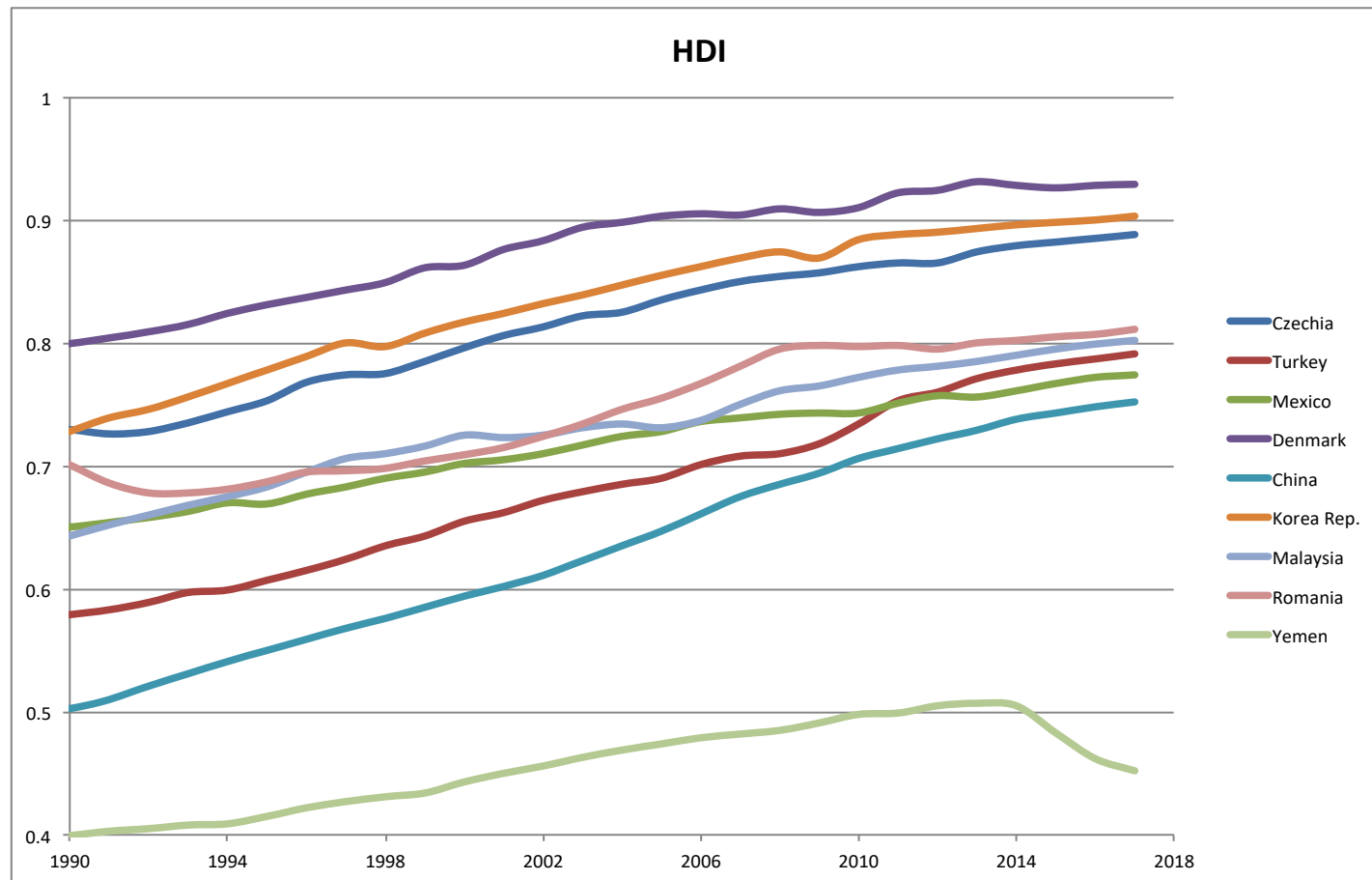
# Growth vs. Development

- The human development Index (HDI) was introduced by the United Nations (UN) in 1990 and is published annually
  - A set of three indicators was chosen to represent aspects of development for a nation
    - Life expectancy
    - Education level
    - GNI (previously known as GNP)



# Growth vs. Development

Human Development Index (HDI)



# Growth vs. Development

Rank on HDI	Country	HDI score	GDP per capita in PPP
1	Norway	0.97	53,433
2	Australia	0.97	34,923
3	Iceland	0.96	35,742
4	Canada	0.96	35,812
5	Ireland	0.96	44,613
157	Uganda	0.51	1,059
158	Nigeria	0.51	1,969
159	Togo	0.49	788
160	Malawi	0.49	761
161	Benin	0.49	1,312

Source: Human Development Report (2009).

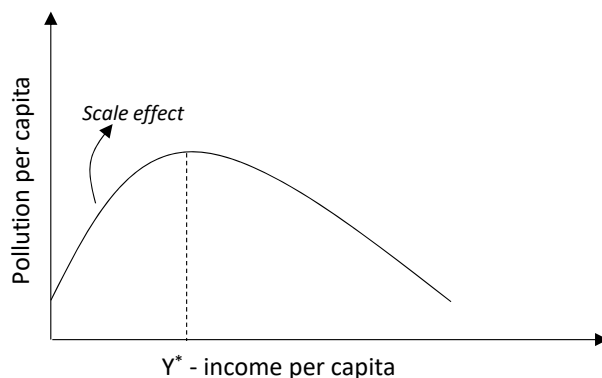


# Growth vs. Development

- STRONG CORRELATION BETWEEN THE TWO
  - Income is a major determinant of the other measures of well-being in HDI
  - Both HDI and GNP measures omit any direct account of environmental degradation

# Growth and the Environment: The Environmental Kuznets Curve

- Can economies grow their way out of environmental problems?
- What are the links between economic growth and environmental quality?
- The '**limits to growth**' school argued strongly that the relationship between growth and env. is negative
  - Economic growth is by definition bad for the env.
  - It leads to more resource use and more pollution
- Environmental Kuznets Curve (EKC) hypothesis suggests otherwise
  - The EKC hypothesis states that as per capita incomes grow, environmental impacts rise, hit a maximum, and then decline.



## Why emissions/pollution can fall?

- Increasing demand for env quality
- Tech improvements over time make production cleaner while economies of scale in pollution abatement can also kick in
- Increasing scarcity of 'environmental quality' drives up the relative price of environment
  - Yet, because of the non-market nature of env means that this can fail
  - Or when pollution increases, marginal damage goes up increasing the incentive for pollution reduction

# The economics of sustainable development: Definitions

- Developed nations started to be more aware of the environmental issues due to industrialization and economic growth.
- 1984: The Brundtland Commission - BC (more formally, the World Commission on Environment and Development, WCED).

**Gro Harlem Brundtland**



# The economics of sustainable development: Definitions

- The Brundtland Commission's mandate was to:
  - re-examine the critical issues of environment and development and to formulate innovative, concrete, and realistic action proposals to deal with them;
  - strengthen international cooperation on environment and development and to assess and propose new forms of cooperation that can break out of existing patterns and influence policies and events in the direction of needed change; and
  - raise the level of understanding and commitment to action on the part of individuals, voluntary organizations, businesses, institutes, and governments.
  - “The Commission focused its attention in the areas of population, food security, the loss of species and genetic resources, energy, industry, and human settlements - realizing that all of these are connected and cannot be treated in isolation one from another”

# The economics of sustainable development: Definitions

- UN's Brundtland commission → Our Common Future (1987)
- Conclusion:
  - 1. Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

# The economics of sustainable development: Definitions

- 2. Thus the goals of economic and social development must be defined in terms of sustainability in all countries - developed or developing, market-oriented or centrally planned. Interpretations will vary, but must share certain general features and must flow from a consensus on the basic concept of sustainable development and on a broad strategic framework for achieving it.
- 3. Development involves a progressive transformation of economy and society. A development path that is sustainable in a physical sense could theoretically be pursued even in a rigid social and political setting. But physical sustainability cannot be secured unless development policies pay attention to such considerations as changes in access to resources and in the distribution of costs and benefits. Even the narrow notion of physical sustainability implies a concern for social equity between generations, a concern that must logically be extended to equity within each generation.

# The economics of sustainable development: Definitions

- Dec, 1987: Brundtland commission dissolved officially after releasing the report.
- OCF influenced the Earth Summit in Rio de Janeiro, Brazil (1992), the UN Conference on Environment and Development, Johannesburg, South Africa (2002)...
- The report crafted the most prevalent (yaygın) definition of sustainability

# The economics of sustainable development: Definitions

- There are other definitions
- A common feature of many definitions is that SD is primarily concerned with fairness over time.
- Therefore, SD is principally an equity issue rather than an efficiency issue



# The economics of sustainable development: Definitions

- Economists' views:
  - Outcome approach:
    - Outcome approach states that the utility of the present generation is maximized subject to the condition that utility of the future generation is not less than that of the present generation.
  - Opportunity approach
    - it must be ensured that this generation leaves the next generation a stock of capital no less than what is available today.
      - '*Weak sustainability*' of this approach says that equality of total amount of man-made capital, human capital and natural capital between the present and future generations ensures sustainable development.
      - '*Strong sustainability*' version claims that each of the capital goods is to be preserved for the future generations rejecting the possibilities of substitutability.

# The economics of sustainable development: Definitions

- Four forms of capital can be distinguished:
  1. Produced capital,  $K_p$ 
    - Machinery, roads, bridges, phone networks, satellites, and so on.
    - May be used up in the production of consumption goods and services
    - Depreciation that needs to be offset with new investment, else  $K_p$  will decline
  2. Human capital,  $K_h$ 
    - Includes all skills and knowledge embodied within people
  3. Social capital,  $K_s$ 
    - Social networks that facilitate mutually beneficial collective action
      - Co-operative groups that manage common-access resources can agree to implement rules for utilizing such resources for mutual, long-term benefits (e.g.; coastal fisheries, grazing lands).
      - Quality of a country's institutions: the degree of corruption, political openness, or the quality of justice.

# The economics of sustainable development: Definitions

4. Natural capital,  $K_n$ 
  - Comprises all gifts of nature
    - Renewable and non-renewable energy and material resources
    - Clean air and water
    - Nutrient and carbon cycles
    - Biodiversity
  - Natural capital can clearly be depreciated when for example
    - A non-renewable resource such as oil is used up
    - When a species dies out
    - When global stock of atmospheric carbon increases
  - Investment in  $K_n$ 
    - Forest replanting
    - Cutting emissions of GHGs
    - Restocking of fisheries
- '*Strong sustainability*:'  $K_n$  cannot be substituted for by increases in other forms of capital

# The economics of sustainable development: Definitions

- Economic work on SD typically proceeds from the assumption that the natural capital stock can be aggregated in monetary units
- This way we can add the value of forest stocks to the value of agricultural land to the value of oil reserves...
- Things get more complicated with stock of biodiversity, carbon sinks...
- Conceptually, we can think of shadow prices existing for all forms of natural capital, which can be used to add together different elements of this stock
  - Such shadow prices would indicate how much better off society would be if the stock of any capital asset was increased by one unit.

# The economics of sustainable development: Definitions

- Relative importance of different form of capital to a country's overall health

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	<b>Natural capital share (%)</b>	<b>Produced capital share (%)</b>	<b>Intangible capital share (%)</b>
Low-income countries	26	16	59
Middle-income countries	13	19	68
High-income countries	2	17	80
World	4	18	78

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*Note:* 'Intangible' includes human and social capital.

*Source:* World Bank (2006).

# The economics of sustainable development: Definitions

- **Hartwick's rule:** Defines the amount of investment in produced capital (buildings, roads, knowledge stocks, etc.) that is needed to exactly offset declining stocks of non-renewable resources.
  - Hartwick's rule – often abbreviated as "invest resource rents" (difference between P and MC)– requires that a nation invest all rent earned from exhaustible resources currently extracted, where "rent" is defined along paths that maximize returns to owners of the resource stock. The rule extends to the case of many types of capital goods, including a vector of stocks of natural capital.
- The difference between total investment in some kinds of capital and total disinvestment in other types of capital → **Genuine savings** (last slide)
- A positive value for a nation's genuine savings has been linked to the possibility of long-run economic sustainability.

# Measuring Sustainability

- At the Earth summit in Rio in 1992, the nations agreed to produce annual statistics on the sustainability of their economics
- SD is such a broad concept that one measure is unlikely to tell us all about sustainability of the economic-environmental system.
- It may therefore be better to talk of indicators of “System performance”
- We will discuss two:
  - GREEN NET NATIONAL PRODUCT
  - GENUINE SAVINGS

# GREEN NET NATIONAL PRODUCT (GNNP)

- The national accounts omit many of the inputs that the environment provides
  - b/c these inputs are unpriced by the market
- When a country depleted its natural capital, this is typically ignored in the national accounts; **but depreciation of man-made capital is allowed for**
- Calculating GNNP involves correcting for these omissions, and for other changes that impact well-being; e.g., POLLUTION
  - $GNNP = NNP - (p_1 - mc_1)\Delta NR - (p_2 - mc_2)\Delta R - v(\Delta S)$
  - $\Delta NR = Q_{NR} - N_{NR}$  and  $\Delta R = Q_R - G_R$
- If GNNP is rising over time, then development can be judged to be sustainable.



# GREEN NET NATIONAL PRODUCT

- There are challenges with determining the correct prices and marginal costs
- Well-known problems of property rights mean that using market prices to undertake green adjustments will not deliver the desired outcomes

# Genuine savings

$$GS = S - \Delta p - \Delta n$$

