Sustainable Development AJ 2019-2020

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(op basis van de slides)

SUSTAINABLE DEVELOPMENT 2019-2020

LECTURE 1

reflection on the achievements of modern society

- how realistic is a collapse scenario?
- (how) should we intervene? YES!

traditional view on development = GDP growth

→ need for a new paradigm: sustainable development

RAPA NUI

= collapsed society on Easter Island (Chili) in the stone age

Moai statues, signs of a powerful past

Unsustainable behavior: overhunting & deforestation

COLLAPSE: HOW SOCIETIES CHOOSE TO FAIL OR SUCCEED? (2005, JARED DIAMOND)

Research:

- Comparative method
- Input & output variables
- Regression model

Diamond looks into a number of past and present societies to come up with a unified theory about why societies fail or succeed

FIVE FACTORS THAT CONTRIBUTE TO COLLAPSE (MOSTLY A COMBINATION OF THESE)

1. Climate change
2. Hostile neighbours
3. Collapse of essential trading partners
4. Environmental problems
5. Failure to adapt to environmental issues

The most important underlying reason = overpopulation relative to the practicable carrying capacity

"It would be absurd to claim that environmental damage must be a major factor in all collapses ... It's obviously true that military or economic factors alone may suffice"

TEDTALK JARED DIAMOND

Why do societies fail? With lessons from the Norse of Iron Age Greenland, deforested Easter Island and present-day Montana, Jared Diamond talks about the signs that collapse is near, and how -- if we see it in time -- we can prevent it.

Five point framework (example: Norse of Greenland)

- Human impacts on environment
- Climate change
- Relations with other countries
- Relations with hostile societies
- Political, social, cultural and economical factors

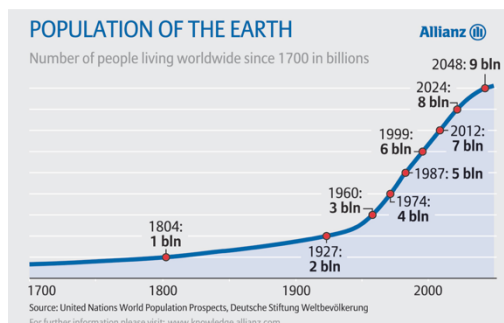## KEEPING SYSTEMS IN BALANCE

- The relationship between humans and their natural environment is one of give and take
- Sustainability concerns
- Rules for sustainable use of the environment
- REFLECTION! (what happened in the past? Learn from it and avoid a collapse)

HOW ARE WE DOING?

World GDP increased sixfold from 1950 to 1998 with an average growth of 3,9% a year = very good

	0-1000	1000-2000
World Population	x1,167	x22
Per Capita Income	equal	x13
World GDP	x1,167	x300

- increases in global life expectancy at birth
- social revolutions
- information age
- multiplication of possibilities / choices
- globalisation

POPULATION OF THE EARTH — Allianz
Number of people living worldwide since 1700 in billions
1804: 1 bln
1927: 2 bln
1960: 3 bln
1974: 4 bln
1987: 5 bln
1999: 6 bln
2012: 7 bln
2024: 8 bln
2048: 9 bln
Source: United Nations World Population Prospects, Deutsche Stiftung Weltbevölkerung
For further information please visit: www.knowledge.allianz.com

CLOUDS ON THE HORIZON

"If everyone used energy and resources the same way we do in the Western World, we need three more earths at least. And we have only one." → large economical footprint

Large inequalities (on a national and on a global scale):

- economic
- access to water & sanitation, energy, health care, education,…

→ developing VS developed countries

Growing population → increased impact on the environment

- resources and waste sinks
- climate change
- ethical aspect

   → keep the systems in balance!

IPAT EQUATION

Contribution to understanding the multiple causes of environmental impact via applications and limitations

I = P x A x T

I = environmental impact

P = population   → driving impact

A = affluence (richness)   → driving impact

T = technology   → reducing impact

ECOLOGICAL FOOTPRINT
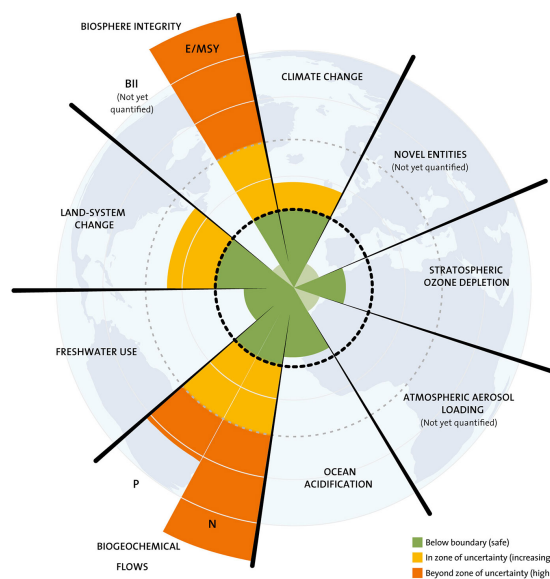
= calculates human pressure on the planet

Accounts for resource and land use, waste absorption, energy production

Today, humanity uses the equivalent of 1.5 planets to provide the resources we use and absorb our waste

= global ecological overshoot

Earth Overshoot Day 2018 = August, 1st

Climate change is not the only ecological problem (see: biodiversity loss)

COLLAPSE II

Environmental problems today (Diamond):

- Deforestation and habitat destruction
- Soil problems (erosion, salinization, and soil fertility losses)
- Water management problems
- Overhunting
- Overfishing
- Effects of introduced species on native species
- Overpopulation
- Increased per-capita impact of people
- Anthropogenic climate change
- Buildup of toxins in the environment

- Energy shortages
- Full human utilization of the Earth's photosynthetic capacity

EARLY WARNINGS

- Stories similar to 'Collapse'
- "Doom scenarios"
- Underline the importance of values and beliefs
- Have not become reality (yet)
- Optimists versus pessimists

THOMAS MALTHUS

"An Essay on the Principle of Population", 1798

Malthus observed that sooner or later population gets checked by famine and disease

"The power of population is indefinitely greater than the power in the earth to produce subsistence for man"

Malthusian Trap (Een malthusiaanse catastrofe is een hypothetische situatie waarbijeen catastrofe zou ontstaan als de landbouwproductie door bevolkingsgroei overtroffen zou worden.)

Malthus proposed positive and preventive checks as a solution

However, he did not allow for technological improvements in the production of food

Industrial Revolution (1800s)

- beginning use of machinery, crop rotation, ...
- later: fertilizers, genetically modified crops, ...

GIORGIS KALLIS

"Limits", 2019

Why Malthus was wrong

Limits as an external idea imposed on us VS desired self-limitation

"THE LIMITS TO GROWTH"

1972, Club of Rome

Global think tank

→ the authors used the World3 model to simulate the consequence of interactions between the Earth's and human systems

World 3 looks at 5 variables:

- world population
- globalization
- pollution
- food production
- resource use

look for a 'sustainable feedback pattern'

outcome: the current reserves for oil in 1972 would run out over the next twenty years assuming constant exponential growth

book attracted a lot of criticism - data, methodology, conclusions and rhetoric

nevertheless: The Limits to Growth made a huge impact on how we still think about environmental issues

THIS COURSE

Traditional view on development = economic development

- GDP growth (macroeconomics)
- strong belief in power of markets and technology

Sustainable development: much more holistic view on development

→ needs of present and future generations (Brundtland)

IPAT REVISITED

The equation highlights different options to reduce our environmental impact

- population and consumption: difficult
- technology: potential win/win

techno-optimism VS sufficiency
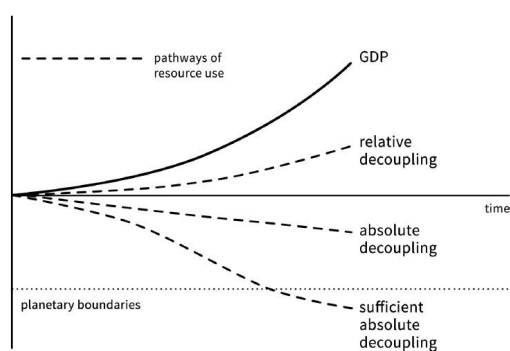
Relative vs. absolute decoupling

$$\Delta I = \Delta P + \Delta A - \Delta T$$

$$\Delta T > \text{or} < \Delta P + \Delta A?$$

$$\Delta T > 0: \text{relative decoupling for sure}$$

Since 1990: carbon intensities dropped by 0.6%/year, yet both P and A increased by 1.3%/year, so I increased by 2%/year, or 62% in total (Jackson, 2017)


The challenge of decoupling. If GDP is to continue growing in high-income countries, its associated resource use must fall not just relatively or absolutely but sufficiently absolutely to move back within planetary boundaries.

ENVIRONMENTAL KUZNETS CURVE

= relation between GDP/capita and environmental quality

Possible explanations for the turning point:

- environmental protection = 'post-materialist need' (As long as the people are poor, they do not care about the environment)
- richer nations are able to develop and afford better technologies
- richer nations – service economies
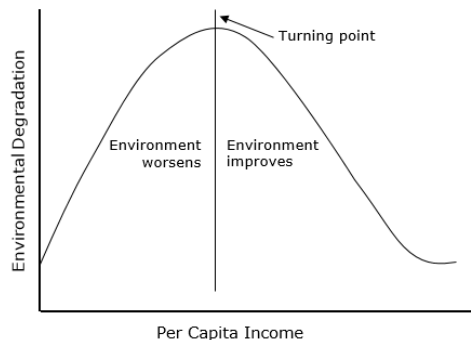
The empirical evidence for this is weak

- reported for specific types of pollutants that are generated and suffered locally, e.g. SO2, NO$_x$
- not for environmental problems that cross national boundaries or have longer-term impacts (e.g. CO2 emissions, or biodiversity losses)
- neither for the ecological footprint

TECHNOLOGY

IPAT challenge: can technological improvements keep up with the increase in world GDP?

TIM JACKSON (2017)

"Is it really possible for a strategy of 'growth with decoupling' to deliver ever-increasing incomes… and yet remain within ecological limits?"

- <u>pessimistic</u>: looking at trends over time in the past, it is hard to find evidence for the widespread techno-optimism…
- <u>future-oriented</u>: Jackson worked out a number of climate change scenarios that indicate that carbon intensity needs to drop by 8.6% per year…

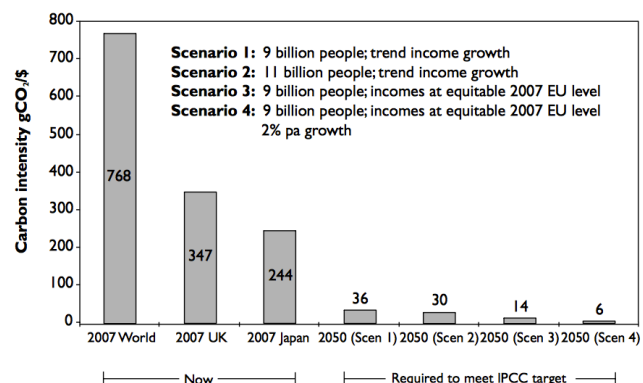 … or, technological progress needs to occur rate that is 50-fold of that the last decade

Figure 5.6 Carbon intensities now and required to meet 450 ppm target[25]

TECHNO-FIX DECOUPLING

2 reasons to be sceptical about techno-fix solutions

1) rebound effects (direct and indirect)
2) technological progress is not always beneficial for the environment

MARKETS AND PRICES

In microeconomics: prices are indicators of scarcity

Natural resources:

- a rising price = a good measure of increasing scarcity
- condition: prices need to signal all present and future opportunity costs of using up a unit of a non-renewable resource today
- rising prices would stimulate the development of (more sustainable) alternatives

Different criticisms:

- influence of producer cartels (oil, tin, …)
- government interventions in resource markets (e.g. minimum or maximum prices)
- natural resource prices do not measure social opportunity costs (e.g. costs from environmental damage caused by extracting and processing)

oil prices
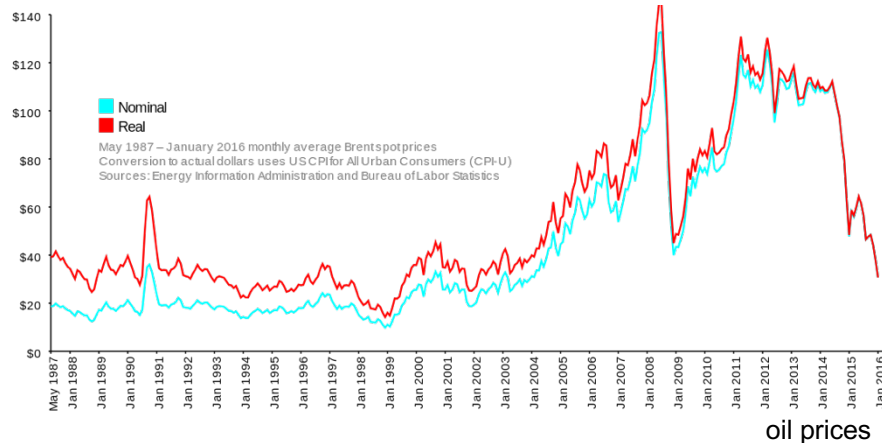
SUSTAINABLE DEVELOPMENT

Brundtland definition:

Sustainable development = development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Aim of the course: different insights on how to look at societal and economic progress, policy choices, sustainability, discount rates, uncertainty, …

sustainable development (SD):

- historical developments
- implementation through MDGs and SDGs
  - MDG = millennium development goals
  - SDG = sustainable development goals

fundamental SD principles

implications for governance

1960S

first signs of sustainability concerns ~ previously: modernism

> *Silent Spring* (Carson, 1962) , *The Population Bomb* (Ehrlich, 1968) + media attention for (local) environmental disasters

environmental movements, environmental law, first concerns about pursuit of unlimited growth

1970S

increasing awareness of global environmental problems

Limits to Growth (Club of Rome, 1972), oil crisis (Amoco Cadiz,1978), Three Mile Island (1979)

United Nations Conference on the Human Environment (UNCHE, 1972) in Stockholm

- environment on political agenda for the first time
- UNEP (= United Nations Environment Programme) was formed

1980S

end of 1970s: first environmental "wave" faded out

> → economic crisis (North) and debt crisis (South) → less attention for other problems

1982: 10th anniversary of Stockholm conference (about Human Environment)

- WCED = World Commission on Environment and Development (1983)
- 4 years of working groups and hearings

DEFINING SUSTAINABLE DEVELOPMENT

THE BRUNDTLAND REPORT, WCED, 1987

received with great enthusiasm

mid 1980s: increased attention for global environmental problems (acid rain, ozone layer depletion, tropical forests, …)

reference work on environment and development

- synthesis of old ideas, yet framed more politically
- combination of both concepts was new

"sustainable development: development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987)

→ most quoted definition of SD, nominal definition

OPERATIONAL DEFINITION

Two key concepts:

1) the concept of '**needs'**, in particular the essential needs of the world's poor, to which overriding priority should be given

2) the idea of **limitations** imposed by the state of technology and social organization on the environment's ability to meet present and future needs

sharing is the solution for the limitations (books, cars,…) but we are more and more individualistic

"In essence, sustainable development is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations."

HDI VERSUS EF

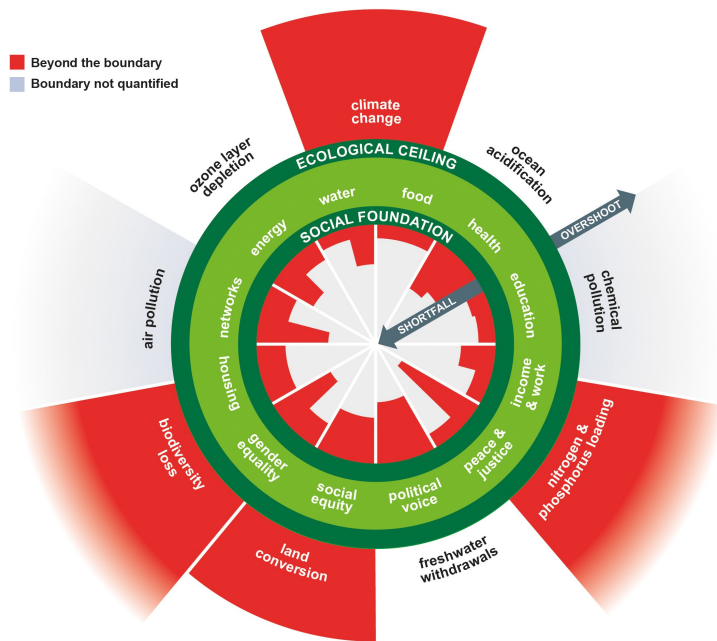Human Development Index VS Ecological Footprint
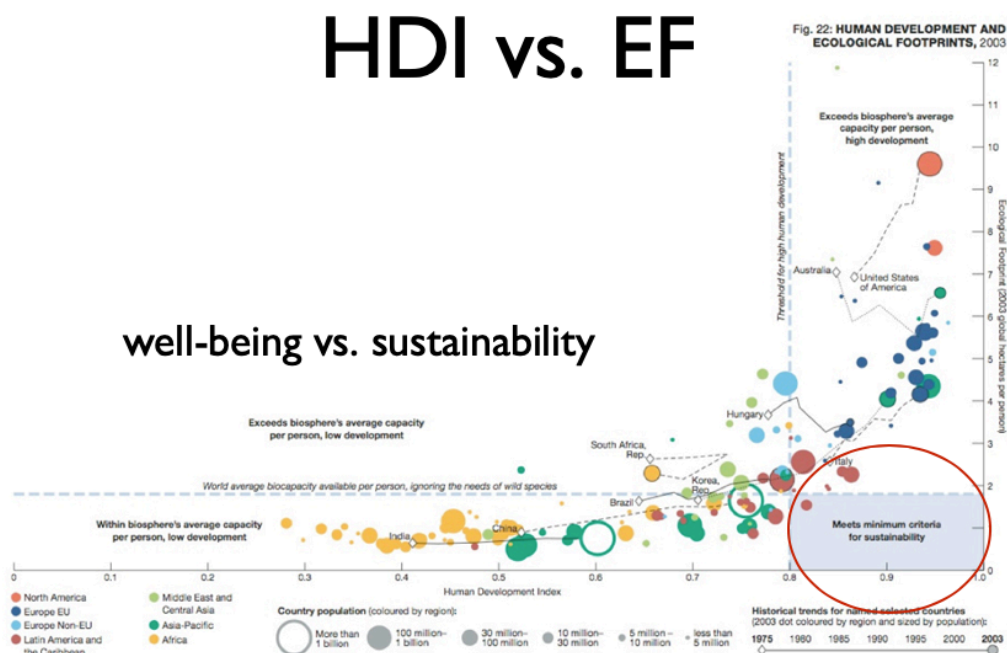
We must want to be in the red circle: high level of development with a low environmental impact
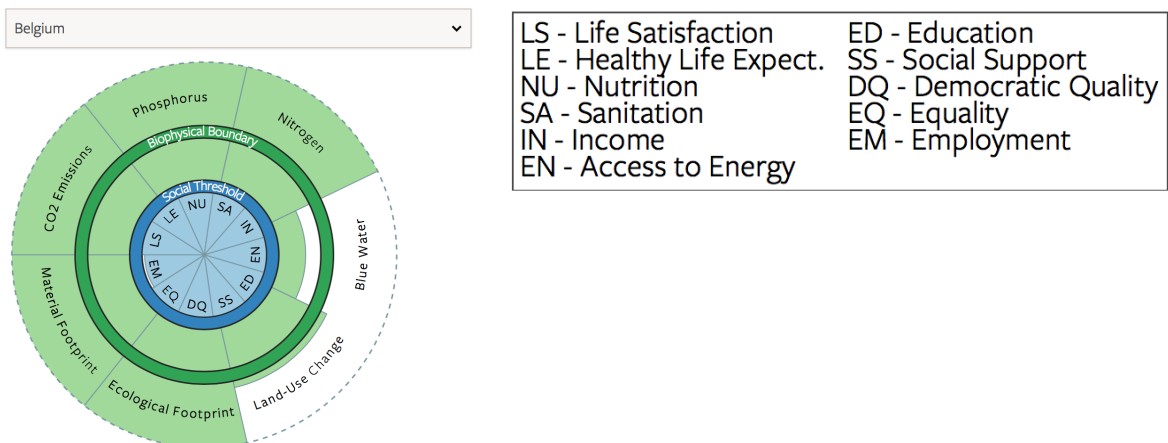
DOUGHNUT ECONOMICS
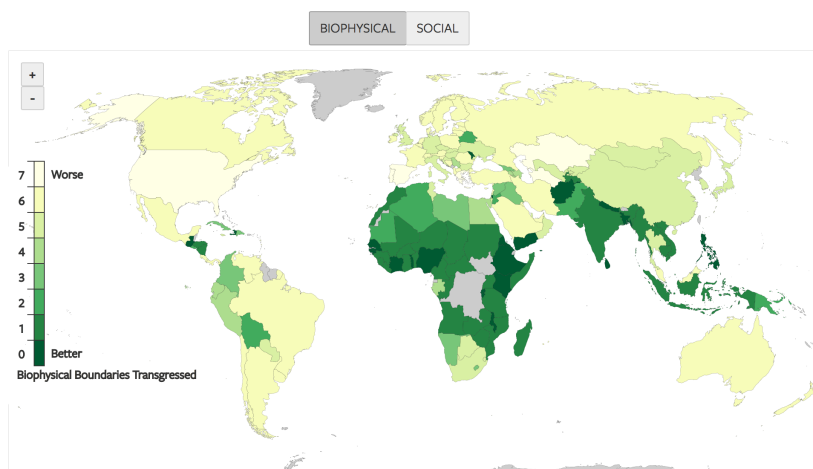
Kate Raworth

Social foundation – Ecological ceiling

Reaching social needs without overshooting our environmental impact

Beyond the boundary
Boundary not quantified

climate change
ocean acidification
ozone layer depletion
ECOLOGICAL CEILING
water
food
energy
SOCIAL FOUNDATION
health
networks
OVERSHOOT
air pollution
housing
SHORTFALL
education
chemical pollution
gender equality
income & work
social equity
political voice
peace & justice
nitrogen & phosphorus loading
biodiversity loss
land conversion
freshwater withdrawals

A GOOD LIFE FOR ALL WITHIN PLANETARY BOUNDARIES

Belgium

LS - Life Satisfaction   ED - Education
LE - Healthy Life Expect.   SS - Social Support
NU - Nutrition   DQ - Democratic Quality
SA - Sanitation   EQ - Equality
IN - Income   EM - Employment
EN - Access to Energy

Belgium scores well on social aspects but we overshoot all boundaries

BIOPHYSICAL   SOCIAL

7 Worse
6
5
4
3
2
1
0 Better
Biophysical Boundaries Transgressed
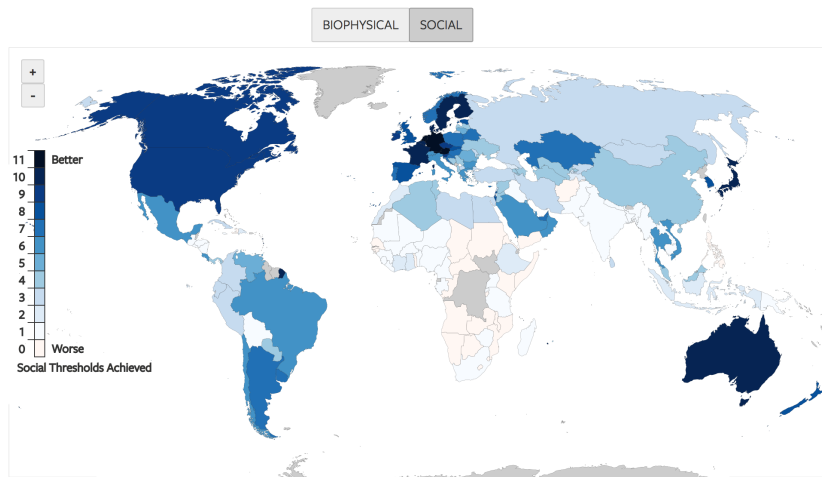
OUR COMMON FUTURE (OCF)

= other name for Brundtland report

concept of SD is rather vague ~ different meanings and interpretations are possible

→ result: idea of SD was rapidly accepted

call for integrating views on the economy, environment and society (pillars)

integrated sustainable solutions need to be found for problems related to population, agriculture, energy use, biodiversity, …

OCF/BRUNDTLAND REPORT IS A MILESTONE IN DEVELOPMENT THINKING

4 reasons:

1) it launched the famous definition of SD
2) it established SD as a substantial component of international development thinking and practice
3) it initiated an explosion of work on the theme
4) it represents the worldwide breakthrough and popularization of the sustainability concept

CRITICISM ON OCF

developing countries (G77): economic development blocked?

environmentalists: lack of attention for overconsumption, problems of economic growth, …

conservatives: SD not needed (technological progress and price mechanism will solve problems)

economists: declining GDP in developed countries? (too idealistic)

AGENDA 21 (1992, BRAZIL)

= outcome of the United Nations Conference on Environment and Development (UNCED) (= 'Earth Summit')

SD action plan for 21st century

→ globally, nationally and locally

→ by organizations of the UN, governments and major groups

40 chapters divided into 4 main sections:

- social and economic dimensions
- conservation and management of resources for development
- strengthening the role of major groups
- means of implementation

Rio:178 governments voted to adopt the program + creation of the Commission on Sustainable Development (UNCSD)

Rio +5: progress made is 'uneven'; promise of further action

Rio +10 (Johannesburg): commitment to 'full implementation' of Agenda 21+ achievement of the Millennium Development Goals

MILLENNIUM DEVELOPMENT GOALS

→ to improve life quality in developing countries

1) eradicate extreme poverty and hunger
2) achieve universal primary education
3) promote gender equality and empower women
4) reduce child mortality
5) improve maternal health
6) combat HIV/AIDS, malaria and other diseases
7) ensure environmental sustainability
8) global partnership for development

MILLENNIUM DEVELOPMENT GOALS
to achieve by 2015

1 **eradicate extreme poverty & hunger**
to halve the proportion of people whose income is < $1 a day and halve the proportion of people who suffer from hunger.

2 **achieve universal primary education**
to ensure that children everywhere will be able to complete full primary education.

3 **promote gender equality & empower women**
to elimate gender disparity in all levels of primary and secondary education.

4 **reduce child mortality**
to reduce by two-thirds the under-five mortality rate.

5 **improve maternal health**
to reduce by three-quarters the maternal mortality ratio and to achieve universal access to reproductive health.

6 **combat HIV/AIDS, malaria & other diseases**
to halt and reverse the spread of HIV/AIDS, to achieve universal access to HIV/AIDS treatment and to halt and reverse the incidence of malaria and other diseases.

7 **environmental sustainability**
to integrate sustainable development into country policies. To reverse loss of environmental resources. To reduce biodiversity loss. **To halve the proportion of the population living without access to safe drinking water and sanitation.** To improve lives of at least 100 million slum-dwellers.

8 **global partnership**
To develop a non-discriminatory trading and financial system. To address the needs of least developed, land-locked and small island developing countries. To deal with developing countries' debt. To provide access to affordable drugs. To make technology more available.

VIDEOS

MDGs: What we met and what we missed (https://www.youtube.com/watch?v=A5giOGjj5X8)

MDGs 2015 report (summary of achievements) (https://www.youtube.com/watch?v=pk58PVfL3s4)

The Future We Want (Rio+20 advertisement)
(http://www.youtube.com/watch?feature=player_embedded&v=KvosscrwZSg)

THE FUTURE WE WANT (2012, BRAZIL)

= Rio +20 Summit

- renewing political commitment
- green economy in the context of sustainable development and poverty eradication
- institutional framework
- framework for action and follow-up
- means of implementation

Evaluation:

- political commitment was renewed, yet ...
  - improvements in practical implementation were limited
  - there was no consensus on the Sustainable Development Goals (SDGs) as follow-up on the MDGs
  - the notion of a "green economy" is not appealing to developing countries
- positive: SDGs are to be defined by 2015

SUSTAINABLE DEVELOPMENT GOALS

Tabel 5   Vooruitgang van België naar de SDG's – Balans 2019 – samenvatting

| Resultaat	Trendevaluatie				Totaal
	naar cijferdoel		in gewenste richting		
GUNSTIG	+	4	+	11	15
ONMOGELIJK / ONBEPAALD	O	1	O	12	13
ONGUNSTIG	−	17	−	6	23
Totaal		**22**		**29**	**51**

SUSTAINABLE DEVELOPMENT PRINCIPLES

many other SD definitions are available, yet the underlying ideas are more or less the same

sustainability bottom line: "good lives for all people in harmony with nature" (cfr. EF vs HDI)

beware: wide range of interpretations + common misconceptions (e.g. SD is primarily about the environment)

range of interpretations:
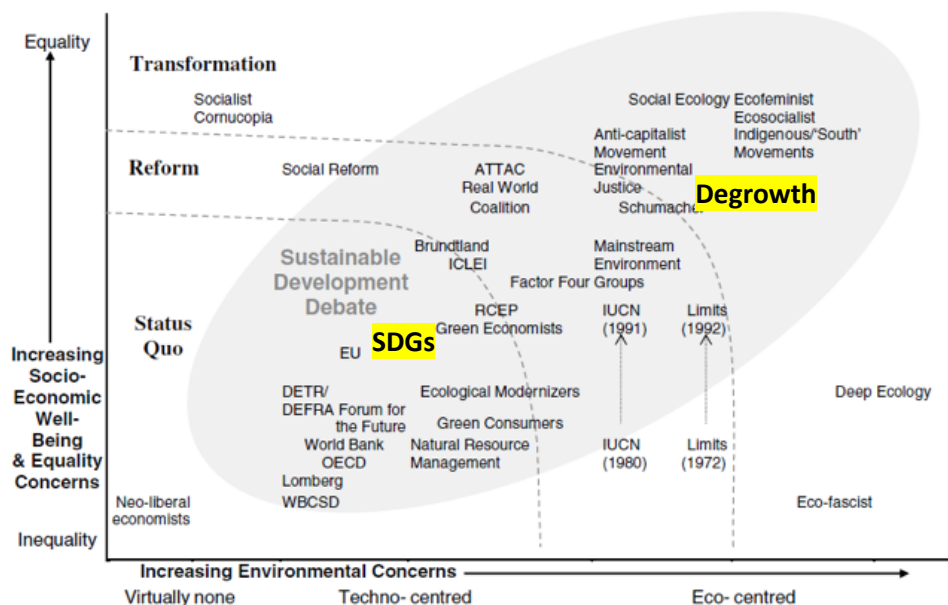
sustainability scholars identify a number of fundamental SD principles ~ "*rules of action towards sustainable development*" (Waas et al., 2011):

- normativity principle
- equity principle(s) ~ justice / fairness
- integration principle
- dynamism principle

NORMATIVITY PRINCIPLE

SD is a social construct ~ implies making societal and normative choices

- ultimately depends on our values and norms and on our worldview
- differ culturally - different views on SD exist

SD is not an objectifiable "theory"

as a result, SD cannot be empirically proven

EQUITY PRINCIPLE(S)

intergenerational equity

→ refers to the long term or futurity aspect of sustainability (future generations)

"*We have not inherited the Earth from our parents, we have borrowed it from our children*"

intragenerational equity

→ refers to the realization of contemporary social equity (decent quality of life for every human being)

geographical equity (global responsibility)

→ need for worldwide cooperation ~ shared but differentiated responsibilities; think local, act global

procedural equity

→ democratic and participatory governance systems

interspecies equity

→ preserving ecosystems integrity and maintaining biodiversity
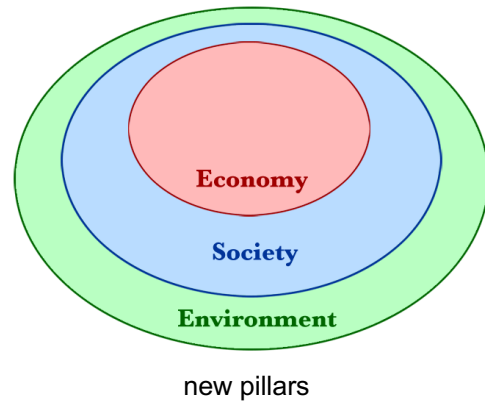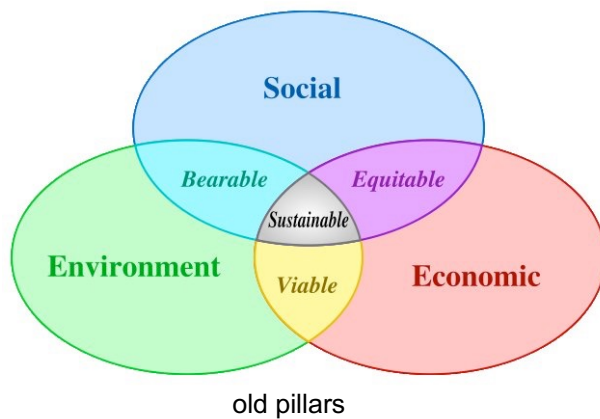
INTEGRATION PRINCIPLE

SD is a concept of integration:

→ sustainability should harmoniously integrate various traditional development objectives with environmental ones

→ **triple bottom line**: people - planet - profit (PPP) or social, environmental and economic pillars

(institutions can be added as a fourth pillar)

integration contrasts with the idea of balancing or trading-off

Social

Bearable | Equitable

Sustainable

Environment | Economic

Viable

old pillars

Economy

Society

Environment

new pillars

<u>substitutability</u>

can any of the three pillars be substituted for the two others, and, if so, to what extent?

spectrum of possible answers:

- yes: weak sustainability
- no: strong sustainability
- in between: critical capital

weak versus strong sustainability: a matter of beliefs?

often linked to the capital approach (economists' point of view)

critical natural capital as an in-between idea?

DYNAMISM PRINCIPLE

SD is a **process** of direct - sustainability oriented - change, not an end state

- SD is not a "*fixed state of harmony*", yet should be regarded as an on-going evolutionary process
- SD can be regarded as a continuous search for a delicate equilibrium in a dynamic setting

GOVERNING SUSTAINABLE DEVELOPMENT

how to set up adequate sustainability governance systems and policies?

- where are we now?
- where do we want to go?
- how do we get there?

key concepts: governance, participation, transition management and resilience

GOVERNANCE

SD requires a special kind of governing (referred to as "governance")

move away from the traditional compartmental approach to policymaking

move away from the idea that only governments can steer a society ~ **multi-actor governance**

PARTICIPATION

More participation in decision-making of democratic governing systems

inclusion of NGOs and other stakeholders in public decision-making process

participatory processes require careful management

TRANSITION MANAGEMENT

increasingly proposed as a concept to understand and manage societal progress towards SD

transition = gradual and continuous process of structural change with 4 different phases:

1) predevelopment
2) take-off
3) acceleration
4) stabilisation

RESILIENCE

dynamic interactions between the environment and society (future is uncertain, surprise likely) require adaptive forms of governance

resilience = the capacity of a socio-ecological system to absorb disturbance and reorganise while undergoing change

adaptability = the capacity of actors in a socio-ecological system to influence / manage resilience

LECTURE 3

THE BRUNDTLAND DEFINITION OF SD

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs

How to measure? Which indicators? → need a framework

WHAT IS DEVELOPMENT?

Making '**something**' better, '**something**' growing / improving in a **sustainable** way

What is '**something**'? Needs?

- Income per capita? Opportunities? Environmental quality? Education and health? …
- What should be taken into consideration?
- Common: "making humans better off" (anthropocentric)
- What would you put in such a list?
- Can you judge for someone else? The future? A country?

Increasing human **welfare** (well-being?)

- A judgment of the fulfilment of needs
- Across time

WHAT TO MEASURE? INDICATORS - A FRAMEWORK

INDIVIDUAL UTILITY u_h

Individual utility u_h : benefit a person h gets from consuming M goods and services

→ Not only market goods but Also: health, environmental quality, education…

$$x_h = \left(x_h^1 \dots x_h^M\right)$$

$$u_h = u_h(x_h)$$

INDIVIDUAL WELFARE U_h

Individual welfare U_h : a person's discounted present value of utility

- Time dimension: at time t
- "The value an individual attaches to his or her personal circumstances in a particular social state"
- Important: access to goods and services! Choice opportunity, 'ability to enjoy the goods and services'
- Important aspect: availability of capital

$$x_{ht} = \left(x_{ht}^1 \dots x_{ht}^M\right)$$

$$u_{ht} = u_h(x_{ht})$$

$$U_h = \sum_{t=0}^{T} \frac{u_h(x_{ht})}{(1+\delta)^t}$$

SOCIAL WELFARE W

Social welfare W : sum welfare across individuals

- Inequality between individuals at time t
- Inequality between generations

$$W = \sum_{h=1}^{H} \sum_{t=0}^{T} \frac{u_h(x_{ht})}{(1+\delta)^t}$$

Two interpretations:

1) Take welfare of all individuals today and sum across time
2) Take welfare of one individual across time and sum across individuals

Separation of elements

- Sustainable development: Is W increasing?
- Needs:
    - which elements in x_h?
    - How important are the elements?
    - Inequality between individuals at each point in time?
- Time:
    - how to discount the future? (how long is the future?)
    - How important are future generations compared to those alive today?

THERE ARE MANY INDICATORS

MOST COMMON SD INDICATORS

Rank	Broad indicators	Number of indicator sets where found*
1.	Greenhouse gas emissions	22
2.	Education attainment	19
3.	GDP *per capita*	18
4.	Collection and disposal of waste	18
5.	Biodiversity	18

6.	Official Development Assistance	17
7.	Unemployment rate	16
8.	Life expectancy (or Healthy Life Years)	15
9.	Share of energy from renewable sources	15
10.	Risk of poverty	14
11.	Air pollution	14
12.	Energy use and intensity	14
13.	Water quality	14
14.	General government net debt	13
15.	Research & Development expenditure	13
16.	Organic farming	13
17.	Area of protected land	13
18.	Mortality due to selected key illnesses	12
19.	Energy consumption	12
20.	Employment rate	12
21.	Emission of ozone precursors	11
22.	Fishing stock within safe biological limits	11
23.	Use of fertilisers and pesticides	10
24.	Freight transport by mode	10
25.	Passenger transport by mode	10
26.	Intensity of water use	10
27.	Forest area and its utilisation	10

UNIVERSITEIT GENT

- Which indicators should we choose?
- Choosing is losing: be aware of the consequences
- "What gets measured, gets improved"
- …

ATTENTION TO 4 ELEMENTS

1) **Distinction level and sustainability**
    - Level of current situation (welfare today)
    - Is the current level sustainable?
2) **Investment and Capital**
    - Discounting the future?
3) **Aggregation** (adding up things)
    - Requires the same units? (monetary approach?)
    - Aggregation weights: dangerous…
    - Trade-off based on what?
4) **Distinction Capital and Capital services**
    - Income is the return of capital

Comparable with a reference? A threshold?

Interpretation of increases and decreases?

Express everything in euro?

Weak or strong sustainability?

THE ROLE OF CAPITAL

Distinction between **capital** and the **return of capital**

From a capital perspective, SD can be defined as **non-declining *per capita* wealth over time** (UN, 2003)

→ SD has to do with managing capital

Many types of capital

- Physical capital (machines, houses, buildings, agricultural land,…)
- Human capital (education level, experience, skills,…)
- Natural capital (forests, the climate,…)
- Institutional capital (laws and regulations, values, trust,…)
- Social capital (social networks,…)

INVESTING IN THE FUTURE

Invest today, reap benefits in the future

Investment => Capital (of different forms)

Which investments to improve the future?

- Productive investments?
- Limiting extraction of exhaustible resource?
- Preserving the environment?
- Limit greenhouse gas emissions?
- Education?
- Institutional capital?

DISCOUNTING THE FUTURE

Impatience: compare **Net Present Value** for you of

- 100 euro today
- 100 euro in the future

Discount rate ρ : suppose $\rho = 0.02$

The higher it is, the more impatient you are

$$\textbf{NPV} = \frac{\textbf{100}}{(\textbf{1}+\rho)^t}$$

100 today (t = 0) : $\frac{100}{(1+0.02)^0} = 100$

100 in 1 year (t = 1) : $\frac{100}{(1+0.02)^1} = 98.04$

100 in 100 years (t = 100) : $\frac{100}{(1+0.02)^{100}} = 13.80$

SHOULD WE DISCOUNT THE FUTURE?

Opinions about the role for impatience:

Ramsey (1928) : "It is assumed that we do not discount later enjoyments in comparison with earlier ones, a practice which is ethically indefensible and arises merely from the weakness of the imagination."

Harrod: "Pure time preference [is] a polite expression for rapacity and the conquest of reason by passion."

Koopmans: "[I have] an ethical preference for neutrality as between the welfare of different generations."

Solow: "In solemn conclave assembled, so to speak, we ought to act as if the social rate of pure time preference were zero."

Imagine we will be richer in the future:

- The economy grows at **rate g**
- Intertemporal judgment for inequality in consumption
- Do we discount the future?
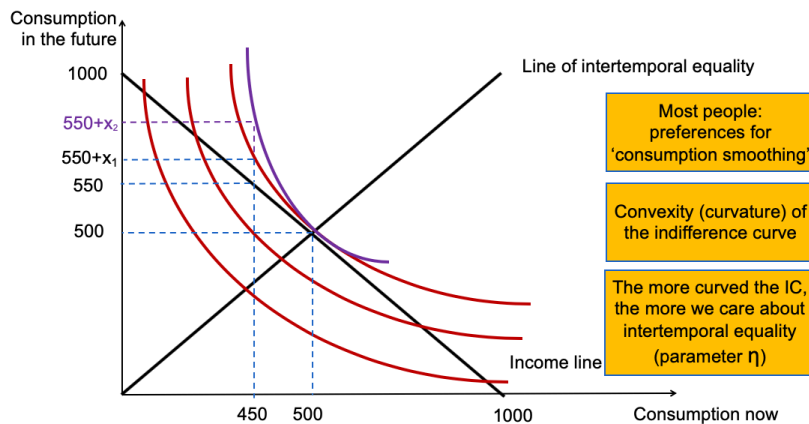
Consumption smoothing = the desire of people to have a stable path of consumption

THE DISCOUNT RATE

Ramsey formula : δ **= ρ + ηg**

Time preference **ρ**

- Intergenerational time preference?
- Behavioural observation: 2%-3%. Ethically...

Economic growth **g**

- Range 1%-3%

Consumption elasticity of marginal utility **η**

- Aversion for intertemporal inequality in consumption
- Measure of the extent to which we want intergenerational equity
- Imagine η large and g negative => $\delta < 0$ (we care a lot for future generations because they will be poorer)
- Range 1 to 4

A lot of attention to equality → ρ = 0 and η large

No attention to equality: ρ large en η = 0

Example: δ = 1,5% + 1*2,5% = 4%

> **η**
>
> if future generations have higher incomes, their consumption is higher and marginal utility of their consumption is lower.
>
> It can also be interpreted as a *social* preference for equality of consumption among generations

$$W = \sum_{h=1}^{H} \sum_{t=0}^{T} \frac{u_h(x_{ht})}{(1 + \delta)^t}$$

AGGREGATION

Suppose only two forms of capital

- Physical Capital Stock (quantity of factories, houses,…): K_F
- Natural Capital Stock (quantity of natural resources, forests…): K_N

Path

→ Change in Physical Capital Stock (=flow)

→ Change in Natural Capital Stock (=flow)
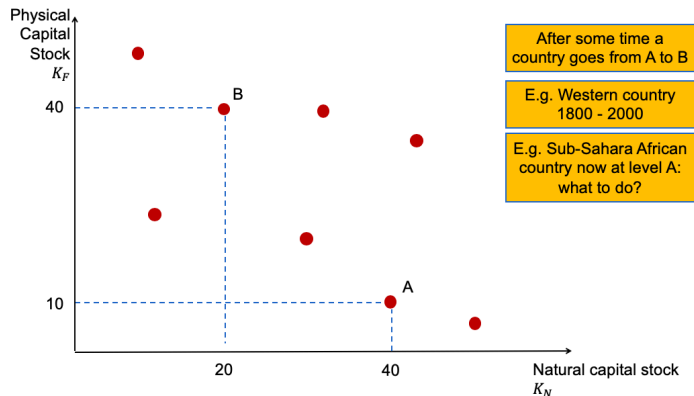
Sustainable if 'the capital stock' remains unchanged

Trade-off? Substitutable or Complementary?
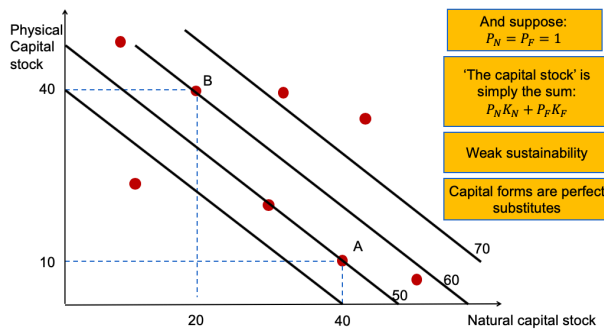
Example: change in the capital stock	
(savings/investment flow as % of GDP)	
Physical Investment :	+3.7
Education:	+5.6
CO_2:	-0.3

DEVELOPMENT PATH A → PATH B

After some time a country goes from A to B

E.g. Western country 1800 - 2000

E.g. Sub-Sahara African country now at level A: what to do?

Suppose perfect substitution:

And suppose: $P_N = P_F = 1$

'The capital stock' is simply the sum: $P_N K_N + P_F K_F$

Weak sustainability

Capital forms are perfect substitutes

Suppose no substitution

'The capital stock' based only on the level of each

No decrease allowed… Improvement only if physical capital stock or natural capital stock increase

Strong sustainability

$K_N = 50, K_F = 20$
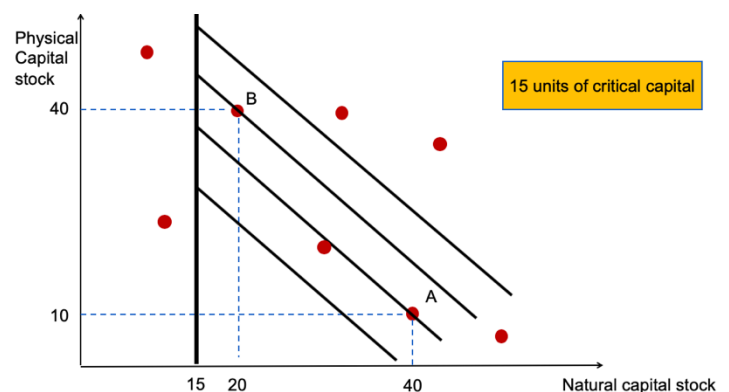$K_N = 40, K_F = 10$
$K_N = 35, K_F = 5$
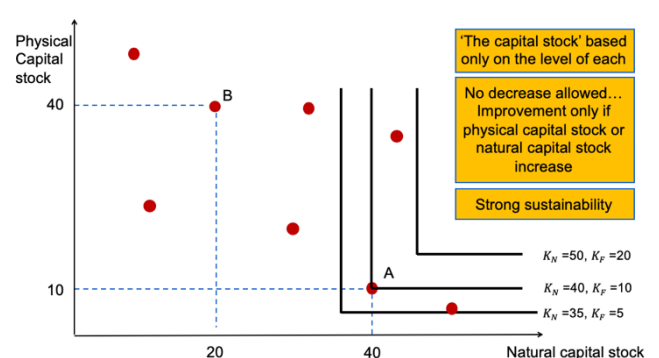
TRADE-OFF
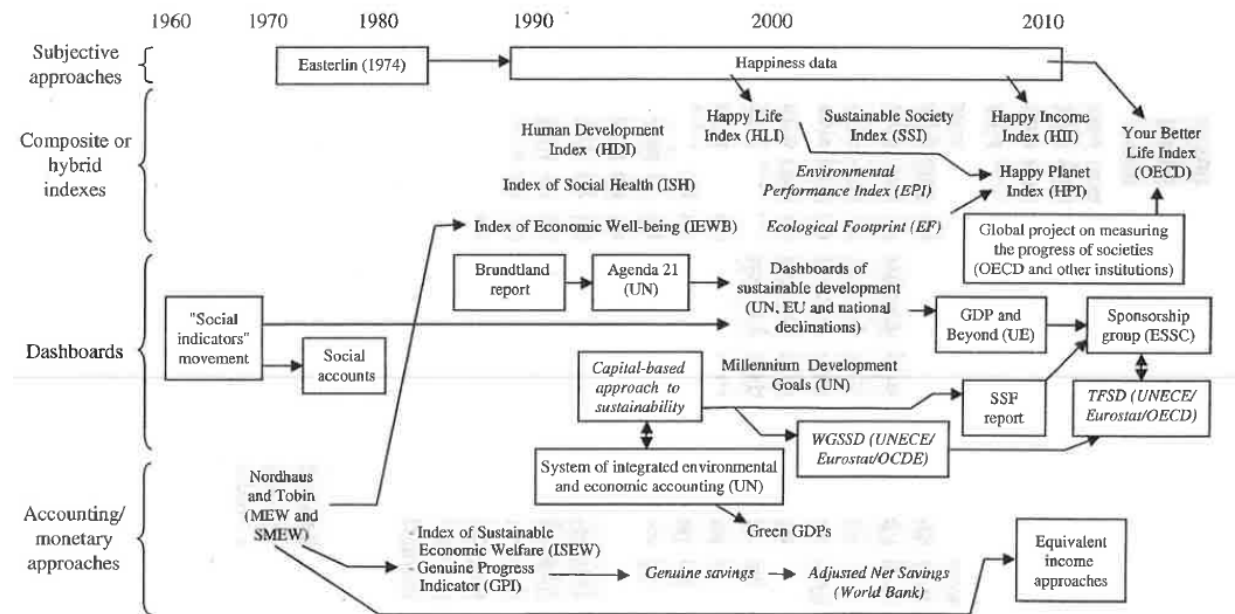
Is trade-off allowed between capital forms?

- Weak sustainability
- Strong sustainability
- Also applicable to the three pillars approach

Idea of **critical capital**

- Natural capital that is necessary for human survival
- Irreplaceable (ozone layer, species extinction, the climate…)
- Trade-off allowed until a specific point

15 units of critical capital

GDP OR INCOME PER CAPITA

= measure of economic activity based on national accounts

But… GDP measures 'how fast the wheels of the car are turning but not where the car is going'

→ measures all transactions (income/consumption)

→ are GDP and income a good welfare measure?

CRITICISMS ON GDP PER CAPITA (OR INCOME PER CAPITA)

- It does not measure everything
- It measures what it measures in the wrong way
- Not a good welfare measure

If it increases, we can't really say if it is 'better' than before.

<u>Does not measure everything</u>

Only **official** market transactions (non market activities?)

- Domestic work? (imagine everyone cleans the neighbours' house)
- Black market? (mafia: 3,5% of Italian GDP)
- Volunteer work? Sharing economy
- Imagine a country with subsistence agriculture not sold on the market

Externalities (hours lost in traffic, environmental damage, traffic fatalities, CO_2 emissions…)

- Not measured in GDP
- Imagine a new sector emerges to repair damages to the environment

Investment (I) and depreciation (DEP): Net investment = I - DEP

- Only in produced capital (machines, equipment, cars,…)
- Natural capital or human capital?
- Imagine Canada cuts all forests and sells the wood

<u>Measures in the wrong way</u>

Quantity of goods and services, but not quality (computers, mobile phones)

- Spend same amount of money on army or education
- GDP doesn't change

Intertemporal mix of

- Consumption (yields well-being today)
- Investment (yields well-being of the future)

Valuation of non market activities (e.g. public sector activities)

- Only the cost of public sector activities
- Not the value of the public sector activities

<u>Not a good welfare measure</u>

Leisure? Health? Social contacts?

- Imagine: everyone works twice as many hours
- GDP increases! But do we consider it better? Is it a better life?
  - Stress? Happiness? Work life balance?

Rich and poor (inequality)

- Average income does not say anything about inequality
- Imagine two countries with same GDP per capita (e.g. Chile and Latvia)
  - Chile: Gini coefficient > 0.50
  - Latvia: Gini coefficient around 0.35

Easterlin Paradox : Increasing income does not make us happier
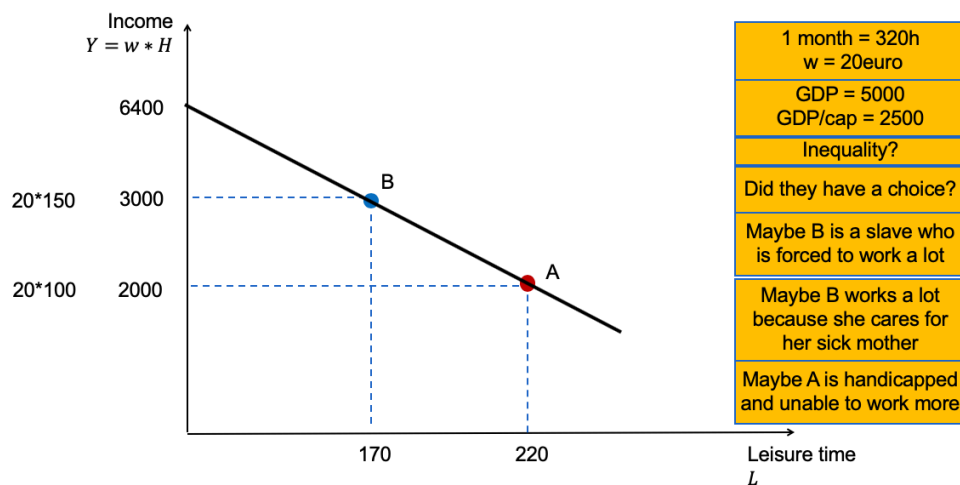
PREFERENCES?

In GDP: revealed preference → value of a good = its price

But: shadow prices?

- Taking into consideration the externality

- Value of environmental quality

TAKE 2 INDIVIDUAL COUNTRY

Income
$Y = w * H$

6400

20*150   3000   B

20*100   2000   A

170   220

Leisure time
L

| 1 month = 320h w = 20euro |
| GDP = 5000 GDP/cap = 2500 |
| Inequality? |
| Did they have a choice? |
| Maybe B is a slave who is forced to work a lot |
| Maybe B works a lot because she cares for her sick mother |
| Maybe A is handicapped and unable to work more |

TAKE 2 INDIVIDUALS

Income
$Y = w * H$

6400

20*150   3000   B   U$_B$

20*100   2000   A   U$_A$

170   220

Leisure time
L

1 month = 320h
w = 20euro

| Do A and B like their situation? |
| What are their preferences? |
| Indifference curves for A and B |
| A does not like B's situation B does not like A's situation |
| Revealed preferences |
| If yes: better look at the choice set 'full income'. 20*320 = 6400 |
| 'choice opportunity' |

TAKE 2 INDIVIDUALS, NON CHOICE

Income
$Y = w * H$

20*150   3000   B

20*100   2000   A   U$_B$
                        U$_A$

Not
so healthy   Healthier   Health

| How to evaluate A and B? |
| What are their preferences? |
| How important is health compared to income? |
| Suppose B does not care so much for health and A cares a lot for health |
| Suppose it's the other way around… |
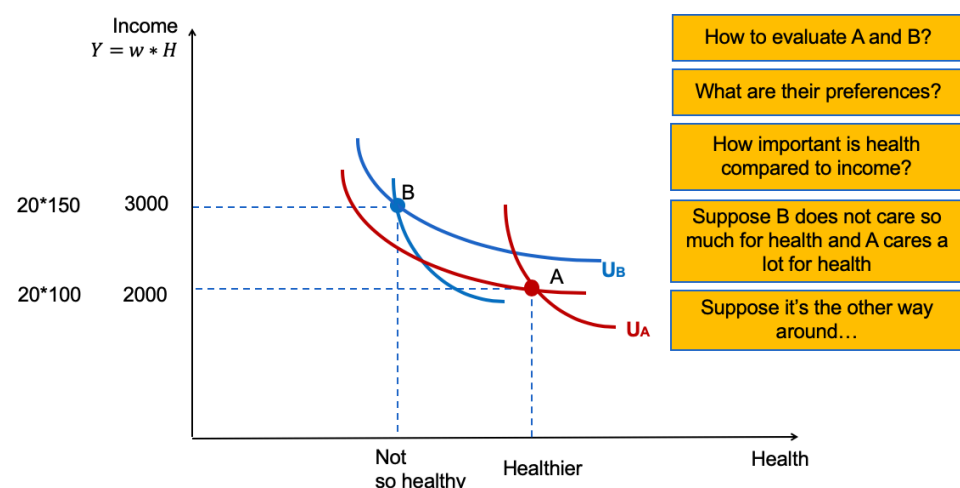
IT IS VERY COMPLEX

What to evaluate?

- The choice set / opportunities? How to evaluate the choice set?
- Only income? Full income?
- What people reach in life?
- Trade off? Weights? Based on what?

Better to take explicit decisions than 'let the data decide'

- Important ethical choices...
- Take the three elements into consideration

MONETARY APPROACHES/ACCOUNTING

GDP measures income, but in a strange way

- **Income** is a quantity received by an individual, a group or a nation that is usually recurrent. It ordinarily derives from wages, property rent, earned interest, or profits.
- Consumption (today) + Investment (leads to future consumption)
- Better: 'use of capital', 'services provided by capital' instead of 'investment'

Can we do better (conceptually)?

- Better income measures: Hicksian and Fisherian income
- **Hicksian income** = The maximum value which the income recipient can consume during a period of time and still expect to be as well off at the end of the period as he was at the beginning (i.e. same level of capital)
  - o Lawn 2006: Maximum amount that can be produced and consumed in the present without compromising the ability to do likewise in the future (i.e. same level of all types of capital)
- **Fisherian income** ('psychic income') = The sum of all services yielded by consumption and investment

Monetary approaches try to measure Hicksian or Fisherian income

GDP = C + I + G + X – M

Keep the good elements of GDP : Consumption (private and public)

Delete the bad elements of GDP : Investment (Expenditures for the army?)

Correct GDP for missing elements / considerations

- Household work, damage to the environment, investment in education, leisure time,…
- Inequality
- Use of capital

=> indicator ((S)MEW, ISEW, SNB, …)

MEASURE OF ECONOMIC WELFARE (MEW, NORDHAUS & TOBIN 1972)

Reclassification of GDP expenditures as

- Consumption
- Investment
- Intermediate

Imputation for

- the services of consumer capital
- for leisure
- for the product of household work

Correction for some of the disamenities of urbanization

PROCEDURE

Starting point: only **final consumption** (private and public)

1) Delete **intermediary consumption**

   - Intermediary: the value of certain goods is completely incorporated in other goods and services (e.g. (future) wage increase, so consumption) (aim is to avoid double counting)
   - Intermediary: health expenditures, replacement investments, expenditures for education,…

2) Delete **instrumental consumption** ('regrettables')

   - Instrumental for reaching another good or service
   - Commuting costs, army, police, road maintenance, lawyers,…
   - Reasoning: no impact on welfare today, only instrumental
   - The army or the police are inputs (a requirement for the economic process), not an output

3) **Investments** should be deleted

   - We should count the use, not the acquisition (E.g. Cars, construction of houses,…)

4) Add some activities : Use of capital

5) **Services** of capital goods : Use of cars, houses (rent), public buildings, roads…

   - Health and education: no correction because they lead to a higher wage (so consumption)

6) **Leisure** time :Leisure is valued by households (it increases welfare)

7) **Non market** activities : Household work, volunteer work,…
   - How to value these activities?

8) Correct for some 'disamenities of urbanisation' (i.e. pollution)

9) Externalities : Environmental damage in the city
   - How to value?
     - Observation: high wage/high congestion vs. Low wage/low congestion
     - 'valuation of the damage' based on wage differences
10) Natural capital (forests, oil supplies,…) : Delivers services but not taken into account (lack of data)

LAST STEP: DISTINGUISH MEW AND SMEW

MEW = Measure of Economic Welfare = A comprehensive measure of the annual real consumption of households = GDP after some corrections

SMEW = sustainable Measure of Economic Welfare = the amount of consumption in any year that is consistent with sustained steady growth in per capita consumption at the trend rate of technological progress

Level of MEW compatible with preserving capital stock (but only physical capital!)

CALCULATING SMEW

Calculate 'Net investment in capital'

- Physical capital (machines, buildings,...)
- Land (E.g. improvements in quality of agricultural land)
- Net foreign capital
- Human capital (Valued as the wage cost of the years spent at school by people over 18)

SMEW = MEW + net investment in capital

- If Net investment in capital > 0 => MEW < SMEW

    - Idea: consumption could have increased
    - The country is sustainable

- If Net investment in capital < 0 => MEW > SMEW

    - Idea: consumption is too high, level of capital decreases
    - The country is unsustainable

Calculations MEW and SMEW (for U.S.), 1965	
Personal consumption	397,7
Private instrumental expenditures	-30,9
Durable good purchases	-60,9
Other hh investment	-30,1
Imputation of consumer capital	62,3
Imputation for leisure	626,9
Imputation for non market activities	295,4
Disamenity correction (externalities)	-34,6
Government consumption	1,2
Imputation of government capital	16,6
Actual MEW	1243,6
Net investment	-2,5
SMEW	1241,1
Population (millions)	194,6
MEW/cap	6391
SMEW/cap	6378

ADVANTAGES SMEW

Clear distinction between SMEW and MEW

→ Clear idea about what is sustainable: comparison with a 'reference'

MEW>SMEW => unsustainable!

MEW<SMEW => sustainable

Clear choices

> Distinction between welfare and sustainability

> But! Only investment in physical and human capital

- What is in it and what not
- Weights applied (valuations, prices,...)
- Conceptual framework: Hicksian income

PROBLEMS WITH SMEW

No correction for **inequality**

Health, schooling?

- No final consumption? The only aim of studying or getting well is having a **higher wage?**

Can we value everything in **monetary terms?**

Sensitive for the **valuation** for leisure time and externalities

(Final) **Consumption is always good** (revealed preference)

- Sustainable vs. non-sustainable consumption? Cigarettes? Weapons? (yield welfare?)

Valuation of **natural capital**

- Not taken into consideration
- Optimistic about technological progress, they assume a high level of substitutability
- = weak sustainability

Aggregation of everything: **weak sustainability**

Ad hoc choices: 'lack of data'

'GREEN GDP'S'

Dissatisfaction with SMEW

=> The 'Green GDPs' : Sustainable Net Benefits, Index of Sustainable Economic Welfare, Genuine Progress Indicator, …

Procedure: like MEW, but

Extra deductions :

- Social (inequality, watching tv, 50% publicity expenditures, 50% of education expenditures, costs of divorce)
- Environment (damage and exhaustion)

Extra addition:

- Leisure time (but imperfect)
- Capital services, natural capital services

SUSTAINABLE NET BENEFITS (SNB) (LAWN AND SANDERS, 1999)

'**Uncancelled benefits**' of the economy

> Net psychic income (Fisherian): the national dividend consists not of the goods produced in a particular year, but of the **services enjoyed** by the ultimate consumers of all human-made goods

> **Psychic income – psychic outgo**

Like green GDP

'**Uncancelled costs**' of the economy

Psychic income: consumption, domestic work, volunteering, leisure, use of capital…
Psychic outgo: Road accidents, noise pollution, air pollution, unemployment (psychic cost for unemployed), underemployment, commuting, crime, divorce
Natural capital: valuation of the evolution of spieces, natural resources, pollution…

> Costs of the **use of natural capital** (Source, Sink, Life support)

> **Loss of natural capital**

SNB = UB – UC (as alternative for GDP)

> **Economic growth** when SNB and GDP grow

Uneconomic growth (SNB decrease when GDP grows)

UNCANCELLED COSTS

Express everything in monetary units:

Source

- How much we use (renewable and non renewable)
- Metal, charcoal, petrol, wood, fish stocks
- Loss of agricultural land due to erosion

Sink

- Regeneration of the environment
- Costs of water and air pollution, waste… (how fast can nature regenerate?)

Life support

- How many renewable resources necessary to compensate for loss of non-renewables?
- 2,5$ per barrel crude oil
- Ecosystem health index: number between 0 and 1 to weight uncancelled costs

EXAMPLES OF NON MARKET SERVICES

- Domestic labour: 7,14 $/h (wage of house staff)
- Value of higher education 16 000$ per year per college-educated worker
- Volunteer work: 15,68 $/h (hourly wage in NGOs)
- Services of private capital (cars…): assumption: depreciation 15% per year + intrest rate 7,5%
- Services of roads: assumption: 2,5% depreciation, interest rate 7,5% and 75% of traffic is commuting. So 75% of 10% is 7,5% of the net worth of roads
- Many 'ad hoc' choices, many assumptions…
- Unavoidable

SNB

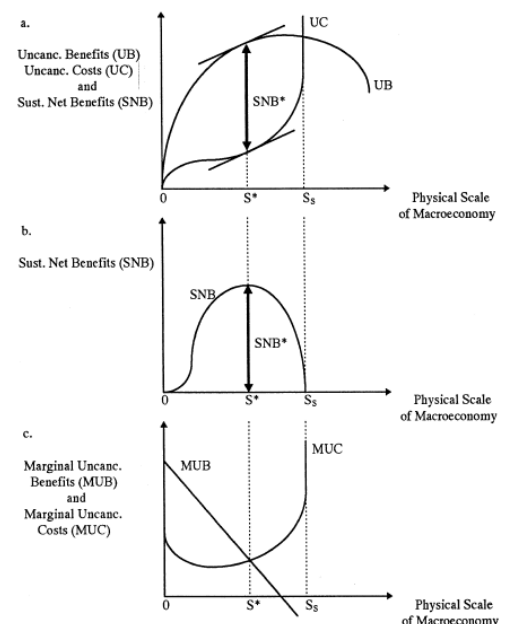Uncancelled Benefits UB : Psychic income – psychic outgo

Uncancelled Costs UC

- Loss of natural capital services
- Increasing marginal costs
  E.g.: when non renewable resource is exhausted: find a new one (but more expensive)
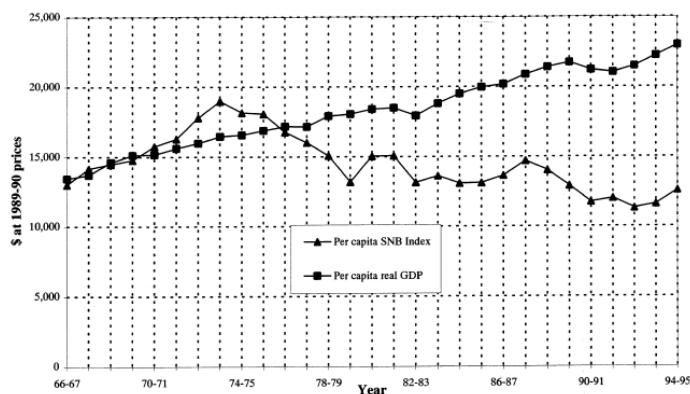
Ss

- Maximum sustainable macroeconomic scale
- UC very high when Physical scale of macroeconomy > Ss

S*

REAL GDP AND SNB

TRESHOLD HYPOTHESIS

Idea that there is an optimal level of GDP

- That level for which the ISEW, GPI, SNB is maximal
- If GDP increases more, ISEW, GPI, SNB decrease

So here: not a comparison with a 'reference', but distinction between economic and uneconomic growth

Max-Neef (1995): *"for every society there seems to be a period in which economic growth seems to bring about an improvement in the quality-of-life, but only up to a point - the threshold point - beyond which, if there is more economic growth, quality-of-life may begin to deteriorate."*

CORRELATION BETWEEN GDP AND GPI
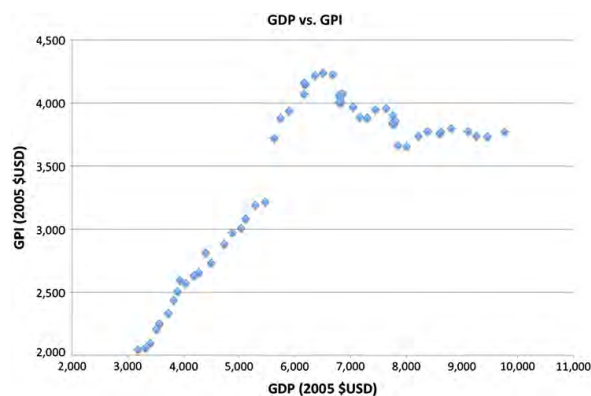
EVALUATION 'GREEN GDP'

Welfare and sustainability?

- No clear difference between the two (sum)
- Threshold...

Weak sustainability, although authors claim to be in favour of strong sustainability

Choices ad hoc (50% of something)

Choice contains value judgment

- Cost of divorce

- Cost of watching television

Data availability…

A lot of work, but better than GDP?

How to value what doesn't have a price? (environmental damage, domestic work ...)

THE CAPITAL APPROACH

Portfolio approach

→ Capital exists in different forms

- **Financial** capital: stocks, bonds and currency deposits…
- **Produced/physical** capital: machinery, buildings, telecommunications and other types of infrastructure
- **Natural** capital: natural resources, land and ecosystems providing services like waste absorption… (source, sink, life support functions)
- **Human** capital: education and health
- **Social** capital: social networks
- **Institutions**

→ Fisher (1906): income is the return on capital/wealth

→ Development as the increase of the amount of available capital

GDP growth that diminishes the amount of capital is not sustainable

Development is a process of building up and managing a portfolio of capital: how much and which composition?

Question for SD:

- How much capital for future generations? What kind of capital for future generations?
- Strong or weak?

DISTINCTION BETWEEN STOCK AND FLOW

Stock measure = measure the amount of each type of capital

Flow measure = investment or savings

Sustainable development is development that ensures a non-declining amount of capital per capita"

But hard to calculate…

'total wealth': produced capital, natural capital, and human, social and institutional capital

'change of wealth': change in produced capital, natural capital, and human, social and institutional capital

TWO APPROACHES

Measuring the value W of the capital stock:

$$W = P_{phys} * K_{phys} + P_{nat} * K_{nat} + P_{hum} * K_{hum} + P_{soc} * K_{soc} + P_{inst} * K_{inst}$$

- Calculate a monetary value P_i for each component
- Theoretically ideal accounting prices… but how to calculate?
- Weak or strong sustainability?
- One idea: the Hartwick Rule

Measuring flow of investments and savings dW

- Adjusted Net Savings (ANS)
- Genuine Savings GS / Genuine Investment GI
- Application: "Are we consuming too much?" (Arrow et al. 2004)

VALUATION DIFFICULTIES

Produced capital/physical capital → expressed in euro

Other types of capital: more difficult

Value based on stream of rent

$$NPV_i = \sum_{t=0}^{\infty} \frac{R_{i,t}}{(1+r)^t}$$

- Natural capital (natural resources, protected areas,…)
    - If property: easy (oil, forests,…)
    - Most cases:
        - property rights not well defined
        - Natural capital has many functions
        - Interlinkages
- Human capital
- Social and institutional capital
    - Millennium capital assessment
    - Idea: SD means: managing forms of capital, which are given to future generations
    - Estimations for 120 countries, 3 years

"**shadow prices**" are needed → assumptions are necessary

Figure 2.2. Estimating the components of wealth
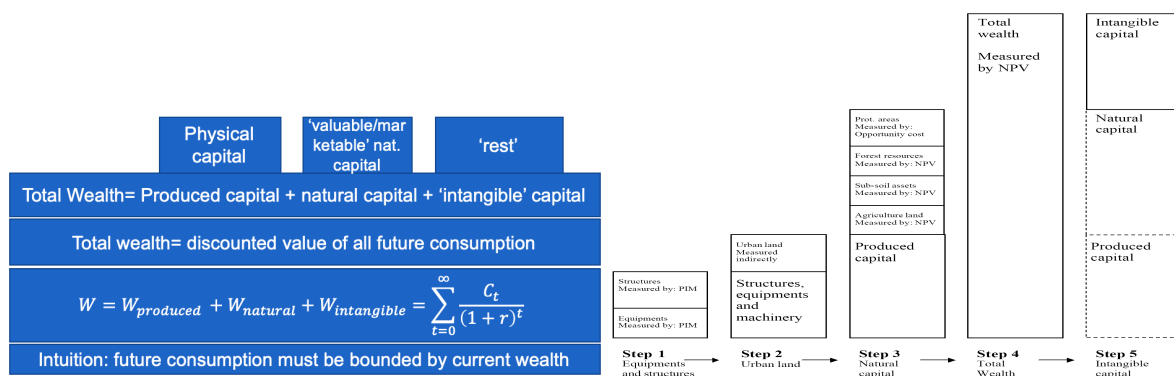
Attention needed for natural capital: "Losses and degradation of natural capital may lead to irreversible changes in the provision of ecosystem services and biodiversity, and the potential for substitution is limited."

HARTWICK RULE

Hartwick rule: consumption can be maintained if the rents from nonrenewable resources are continuously invested rather than used for consumption

$$W = \sum_{h=1}^{H} \sum_{t=0}^{T} \frac{u_h(x_{ht})}{(1+\delta)^t}$$

- A country has a non-renewable resource and produced capital
- "A constant level of consumption (= intergenerational egalitarianism) can be sustained if the value of investment equals the value of rents on extracted resources at each point in time"
- Invest all resource rents into new capital formation (investment)
- Intuition:
    - Income is the return to capital
    - Keep level of capital constant
    - So income or consumption remains constant forever

FIGURE 1.3
Resource Abundance and Capital Accumulation: Where Has the Hartwick Rule Been Applied?
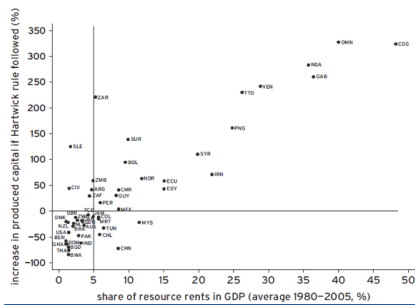
	Under the line: invested more than Hartwick rule prescribed
	Observation: the greater the dependence on mineral rents, the greater the gap between actual produced capital and hypothetical capital
	Sign of a 'resource curse'
	But not deterministic (Botswana, Norway, Chile)
	Important role for institutions

Three advices:
- Promote efficient resource extraction in order to maximize resource rent generated
- A system of taxes and royalties that enables governments to recover rent
- A clear policy for investment of resource rent in productive assets

GENUINE SAVINGS/INVESTMENT OR ADJUSTED NET SAVINGS

Wealth: difficult to measure…

- Many assumptions needed
- Alternative: ANS, GS, GI (yearly basis)
- Depends more on policy changes

Traditional measure of savings: gross savings

- Depreciation
- Expansion of capital (net investment)

Is this the only form of savings/investment?

- Investment in human capital?
- Use of non renewable resources?

If **GS < 0: sign of unsustainable development**

Calculation of Genuine Savings (GS):

$$GS = GNS - D + CEE - NRD - PD$$

GS = genuine savings
GNS = gross national savings
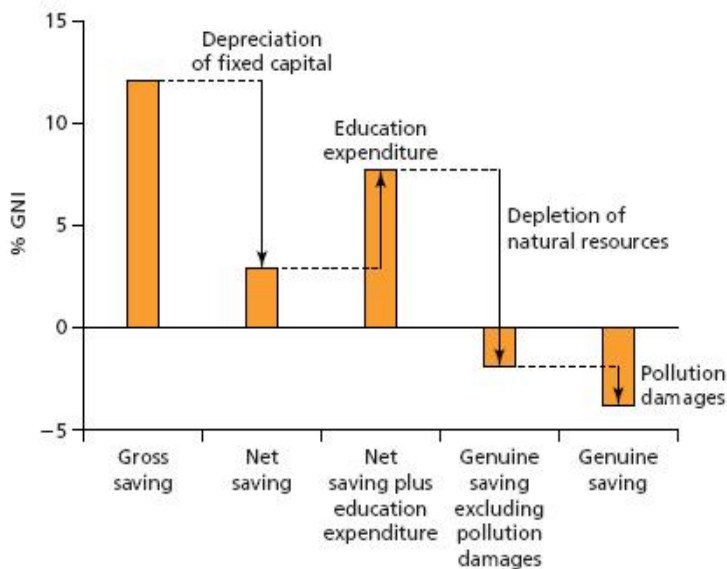**NNS** = net national savings
D = depreciation
CEE = current expenditure on education
NRD = natural resource depletion (minerals, energy, forests)
PD = pollution damage (carbon dioxide, particulates)

GS measures the amount of capital a country has gathered (+) or lost (-) in the course of one year

Imagine: cut all forests: GNI very high but depletion of natural resources

ARROW ET AL. (2004)

Table 1

Genuine Investment and Components as Percentage of GDP

Country	Domestic net investment	Education expenditure	Natural Resource Depletion				Genuine investment
			Damage from CO₂ emissions	Energy depletion	Mineral depletion	Net forest depletion	
Bangladesh 1973–2001	7.89	1.53	0.25	0.61	0.00	1.41	7.14
India 1970–2001	11.74	3.29	1.17	2.89	0.46	1.05	9.47
Nepal 1970–2001	14.82	2.65	0.20	0.00	0.30	3.67	13.31
Pakistan 1970–2001	10.92	2.02	0.75	2.60	0.00	0.84	8.75
China 1982–2001 (without 1994)	30.06	1.96	2.48	6.11	0.50	0.22	22.72
Sub-Saharan Africa 1974–82; 1986–2001	3.49	4.78	0.81	7.31	1.71	0.52	−2.09
Middle East & North Africa 1976–89; 1991–2001	14.72	4.70	0.80	25.54	0.12	0.06	−7.09
United Kingdom 1971–2001	3.70	5.21	0.32	1.20	0.00	0.00	7.38
United States 1970–2001	5.73	5.62	0.42	1.95	0.05	0.00	8.94

Source: Authors' calculations, using data from World Bank (2003).

Side notes:

- Valuation: Use of market prices can bias estimates upwards (as natural capital is typically underpriced)
- Are we counting everything? Biodiversity? Water quality?
- Substitutability? High level of aggregation, so details missing e.g. Water sources in subsaharan africa: hard to find substitutes (weak vs. strong…)
- Human capital: measured as education expenditure? (depreciation? Other skills?)
- Rich countries are doing fine?
  - Success of rich due to failure of poor?
  - Resource based export: a kind of subsidy to rich countries
- Developing countries: GS<0: So they should save more?
  - Not a good conclusion...
  - Better: institutional reforms for better management of resources and education

Genuine savings VS the ecological footprint:
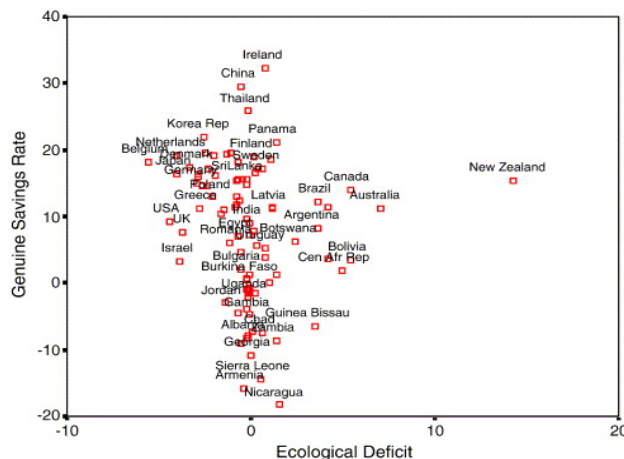
CONCLUSIONS ABOUT GENUINE SAVINGS:

Big differences in GS across countries

GS lowest in countries with non renewable resources

- But: non deterministic
- Can be a sign of bad management and missed opportunities: lack of investment in education and institutional capital
- Hartwick rule

Different messages given by different indicators

ADVANTAGES OF THE CAPITAL APPROACH

Sustainability clearly defined

- Increase in the amount of capital/wealth (stock)
- GS > 0 (flow)

Based on a clear and well-established conceptual framework

- Useful guidance when analysing the indicators
- Clear relationship between indicators

Small compact set is possible (or one number)

DISADVANTAGES OF THE CAPITAL APPROACH

Substitutability between capital forms…

- Scarcity leads to higher prices and so: substitution
- No threshold => weak sustainability (imagine Brazil cuts all forests)

Rising **population** => Attention to capital stock per person, so GS should be > 0

Idea of **sustainability = constant consumption**

- This is a technical interpretation, not based on a conception of SD
- No information on whether the current consumption level is sustainable
- Does consumption equal well-being?

Measurement problems

- Possible to include every capital form?

- How to value Natural Capital? Human capital?

Nuanced policy **recommendations**? (Sub-Sahara Africa should consume less?)

Only individual consumption

- What about collective consumption? Social capital…

- Role for natural capital: only with the purpose of consuming its benefits?

DASHBOARDS APPROACH (INDICATOR SETS)

Evaluating SD has many dimensions

- Three pillars: social, economic, environmental
- Aggregation leads to weak sustainability
- If strong sustainability: No aggregation & No weights

> In reality: partial aggregation and limited use of weights unavoidable

Clear choices

- No hidden weights, no theories
- Shows complexity of the matter
- Only a list made by statistician
- The user has to evaluate

MANY DASHBOARDS

UNCSD:

- 134 indicators (1995), 58 indicators (1996), 50 core indicators (2007)
- Sustainable Development goals (http://www.un.org/sustainabledevelopment/sustainable-development-goals/)

OECD: social indicators and environmental indicators

European sustainability indicators (http://ec.europa.eu/eurostat/web/sdi/indicators)

- 130 indicators & 10 headline indicators

Many countries have their own indicator set

- For Belgium: www.indicators.be
- 75 indicators, of which 25 key indicators
- Find the set for your own country

ADVANTAGES OF DASHBOARDS

- **Less** prominent place for **GDP or monetary indicators**
- Shows **complexity** of reality
- **Avoids aggregation**, avoids choices made in composite indicators
    - Aggregation is possible, but by the user
    - 'What gets measured, gets improved': focus on each dimension
- **Splits up current** level of well-being **and sustainability**
- **Stimulates research** into new indicators
    - Gaps in existing lists? Wrong indicators in existing lists?
- **Easy to use** and understand
    - Easily adaptable to needs
    - Open to new issues as they emerge
    - Individual, municipal, regional, national, international level indicators
- Relate directly to national **policy** frameworks for SD.
- Selected through direct **interaction with stakeholders**, ensuring an audience for the indicators

DISADVANTAGES OF DASHBOARDS

- Many lists exist, many indicators in each list, **lack of harmonization**
    - Comparability across countries?
    - List influenced by data availability. If something is not measured, is the issue overlooked? Or not important?

- **Lack of overview** or focus
    - Often many indicators: difficult to determine whether D is S or not
    - Link between some indicators and SD is sometimes hard to find

- Composition is ad hoc, **lack of** a sound **conceptual framework**
    - Often too policy oriented and influenced by politicians (who want to prove they made improvements)
        - Choose those that make you look good
        - Avoid those that evolve in the 'wrong' direction
    - Changes regularly
        - Comparability across years?
        - If policy changes, indicator set also changes

- Communicability: **too much info**rmation
    - Provides a nuanced picture, but, difficult to communicate to the public

HYBRID INDEXES (BASED ON INDICATOR SETS) = COMPOSITE INDICATORS

Procedure

- Select limited number of dimensions (from a dashboard)
- Calculate (weighted) average
- Yields one number

Which dimensions & weights? (ethical theory?)

Examples: HDI, HLE, HI, HPI, ESI, EPI (environmental performance index)

HUMAN DEVELOPMENT INDEX (HDI) – AS AN EXAMPLE

→ We will use it to understand problems with indexes and aggregation

Three components/dimensions

1) Health: life expectancy at birth
2) Income: GNI per capita
3) Education
   - Average number of years of schooling (>25 year olds)
   - Expected number of years of schooling (5 year olds)

Incorporation of inequality: **Atkinson index**

HDI CALCULATION

- $I_{LE} = \dfrac{LE - LE_{min}}{LE_{max} - LE_{min}}$

- $I_{ED1} = \dfrac{ED1 - ED1_{min}}{ED1_{max} - ED1_{min}}$

- $I_{ED2} = \dfrac{ED2 - ED2_{min}}{ED2_{max} - ED2_{min}}$

- $I_Y = \dfrac{ln(Y) - ln(Y_{min})}{ln(Y_{max}) - ln(Y_{min})}$

$$I_{ED} = \frac{I_{ED1} + I_{ED2}}{2}$$

$$HDI = (I_{LE} * I_{ED} * I_Y)^{1/3}$$

Normalisation

$LE_{min} = 20$
$LE_{max} = 85$

$ED1_{min} = 0$
$ED1_{max} = 15$

$ED2_{min} = 0$
$ED2_{max} = 18$

$Y_{min} = 100$
$Y_{max} = 75000$

INEQUALITY ADJUSTMENT

Atkinson measure of inequality (1-A$_x$)

- Collect individual data per country (income, educ, LE)
- Calculate per dimension

  E.g. Education for 3 individuals

  - 4, 10 and 25 years: $A_{ED} = \dfrac{\sqrt[3]{4*10*25}}{13} = \dfrac{10}{13} = 0.769$
  - 13, 13 and 13 years : $A_{ED} = \dfrac{\sqrt[3]{13*13*13}}{13} = 1$

  Multiply each I with A$_x$

$$A_x = \frac{\sqrt[n]{X_1 * X_2 * \cdots * X_n}}{\bar{X}}$$

$$IHDI = \left((A_{LE} * I_{LE}) * (A_{ED} * I_{ED}) * (A_Y * I_Y)\right)^{1/3}$$

ADVANTAGES OF COMPOSITE INDICATORS

Summarise a complex reality

Invites to investigate further

- Why a decrease/increase takes place?
- Which aspect of the index increases or decreases?
- Does an increase in one aspect 'compensate' for a decrease?

Comparability (Across time & Across countries)

Communicability

- One number: easy to communicate
- The number increases: good news
- The number decreases: bad news

DISADVANTAGES OF COMPOSITE INDICATORS

Aggregation of what? (what is well-being?)

- HDI: 3 dimensions (why not 2 or 4?)
- Double counting (income and health? Or income and education?)
- 'Inputs', 'intermediary outcomes and 'outputs' of well-being

Does it make sense to aggregate?

- Imagine indicator that calculates average of car speed and remaining gasoline level

Composite index so trade-off: **Weak Sustainability**

Aggregation implies **weighting**

- Which weights? Hidden weights? Often arbitrary…
- Weights imply ethical choices: how important is health compared to income?
- HDI: normative foundation of the weights?

Problematic way to incorporate inequality measurement in HDI

- Inequality between people or between dimensions of an indicator?

NUMERICAL EXAMPLE

Compare two countries (green and yellow), differing only in terms of income (Y) and life expectancy (LE) (ED is equal)

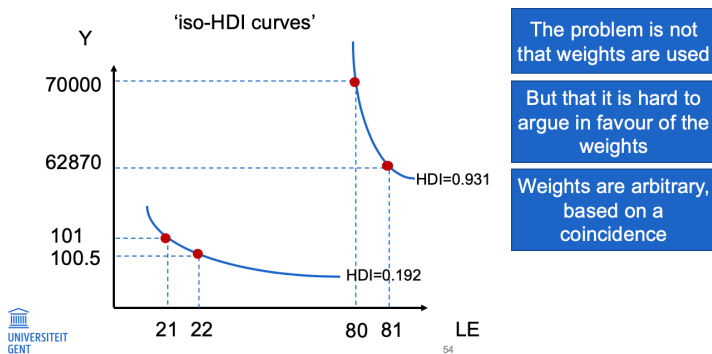| BEFORE	score	Ix		AFTER	score	Ix
lifeexp	22	0,031		lifeexp	21,0	0,015
school	5	0,278		school	5,0	0,278
school2	5	0,333		school2	5,0	0,333
ED		0,306				0,306
income	100,5	0,001		income	101,0	0,002
HDI		**0,0192**				**0,0192**
lifeexp	81	0,938		lifeexp	80	0,923
school	15	0,833		school	15	0,833
school2	14	0,933		school2	14	0,933
ED		0,883				0,883
income	62 870	0,973		income	70 000	0,990
HDI		**0,9310**				**0,9310**

Consequence: If you propose a policy measure that increases income with more than 0.50 dollar, but it decreases life expectancy with one year: HDI increase

One year of life expectancy is worth 0.50 euro in poor country
In rich country:
7130 euro Y/cap

This is arbitrary…

53

TRADE OFF

'iso-HDI curves'

Y

70000

62870

HDI=0.931

101
100.5

HDI=0.192

21 22   80 81   LE

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54

The problem is not that weights are used

But that it is hard to argue in favour of the weights

Weights are arbitrary, based on a coincidence

HDI AND WEIGHTS

Putting a monetary value on a year of life expectancy is controversial

- It is 'avoided' by calculating the HDI
- But it happens implicitly
- In an uncontrolled way
- Weights are unavoidable when aggregation is necessary

Better: be clear about the weights

Ethical theory?

OTHER COMPOSITE INDICATORS

Social sustainability index : Three pillars or SD in 24 items

Happy income index : H*I

Happy planet index : $HPI = \frac{H*LE}{EF}$

Your better life index

- Weighted average of scores on dimensions
- User determined weights
- Try: https://www.oecdbetterlifeindex.org

Environmental sustainability index (ESI)

Environmental performance index (EPI)

THE ECOLOGICAL FOOTPRINT

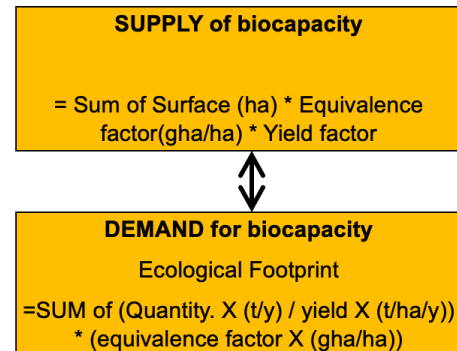Measure of the demand for the Earth's ecosystem

- Can be contrasted with the ecosystem's supply (how many Earths)
  - Supply: the capacity to regenerate
  - Natural capital here: only those aspects that are biologically productive
- Interesting: 'level' versus 'sustainable level'

Demand for: vegetables, meat, fish, housing, CO2 emissions, nuclear energy…

- Need for biologially productive land
- Resource use and waste assimilation
- All expressed in surface 'units'
  - global hectare (gha)
  - A standardized unit of surface
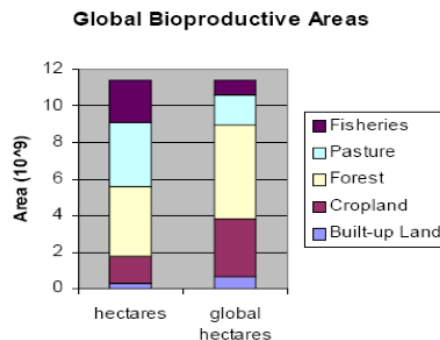
Why do we consider this a hybrid index?

- Several aspects
- One number

SUPPLY of biocapacity
= Sum of Surface (ha) * Equivalence factor(gha/ha) * Yield factor

DEMAND for biocapacity
Ecological Footprint
=SUM of (Quantity. X (t/y) / yield X (t/ha/y)) * (equivalence factor X (gha/ha))

SUPPLY: BIO-PRODUCTIVE HECTARE

- 11.2 billion usable hectare (= 88%, ¼ earth)
  - 1.5 billion ha crop land
  - 3.5 billion ha pasture
  - 3.6 billion ha forests
  - 0.2 billion ha built-up land
  - 2.3 billion ha fishery ground
- NOT: Deserts and deep oceans
- Sum everything? No, Productivity differs!
- => One Global hectare (gha)
  - Same level of biological productivity
  - 1.8 gha per person available
- Equivalence Factors
  - Crop land   2.2 gha/ha
  - Pasture   0.5 gha/ha
  - Forest   1.4 gha/ha
  - Fishery   0.4 gha/ha
  - Built up land   2.2 gha/ha
  - Water power   1.0 gha/ha
  - Fossil fuels   1.4 gha/ha
- Yield factors: differ across countries

Global Bioproductive Areas

Area (10^9)

Legend:
- Fisheries
- Pasture
- Forest
- Cropland
- Built-up Land

hectares | global hectares

DEMAND FOR BIOCAPACITY

How much X is consumed? → Tons per year

How many hectares are needed? → Yield of a specific type of land

How many global hectares are needed? → Depends on the yield factor and the equivalence factor

Also waste flows… (but not pollution)

Sum everything: the Ecological Footprint

- World level
- Country level
- Individual / group level

METHODOLOGICAL PROBLEMS

Carbon dioxide emissions?

- Accumulate in the atmosphere, lead to climate change
- Calculated as the area of forest necessary to sequester the CO2
- Is a strong assumption (transform climate change into land area?)
- Big part of the EF (8 billion hectares out of 18 billion)
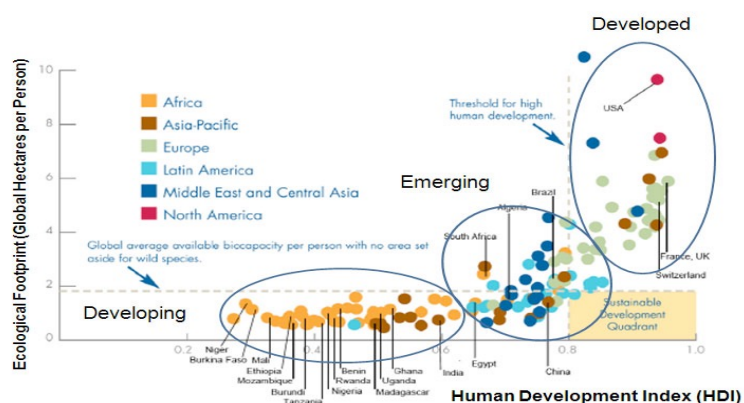
Nuclear energy?

- Recalculated as if electricity were produced by coal
- CO2 emissions (area of forest)
- Is a strong assumption

Chemical / toxic pollution: not measured

Only land

- Soil erosion? Overuse of water reserves?
- EF has no real link with the extent to which these supplies are influenced
- Technological progress?

FOOTPRINT ACCOUNTING

ADVANTAGES OF ECOLOGICAL FOOTPRINT

Intuitive, easy to communicate

Sustainability

- Possible to compare with a threshold level
- Compare EF with supply of gha

Provides insights in inequality around the world

Role of CO2 emissions

DISADVANTAGES OF ECOLOGICAL FOOTPRINT

Flow measure, not a stock measure

- Like taking money from your account, but you don't know how much you have
- What is the ecological deficit/debt exactly? (a land area?)

Anthropocentric way of defining natural capital (biodiversity?)

Supply = Demand for most types of land (why not just measure carbon footprint?)

Highly populated countries: overconsume per definition, but is this a sign of unsustainability?

Does it stimulate countries to cut all forests and switch to monoculture?

- Biocapacity increases when forest is cut and replaced by cropland
- Organic farming: lower yields so higher footprint…

Underestimates **technological** progress: if a production process gets more eco-efficient…

One number

- Hides the reason for the overshoot
- Inherent trade-off: Higher CO2 emissions compensated by lower food consumption?

What is the connection with our use of resources?

- Equivalence factor does not say anything about sustainable use, it just says: use
- Yields: only one specific use (but e.g. pharmaceutical use of forests?)

Methodology: see previous slide

ENVIRONMENTAL PERFORMANCE INDEX

Two fundamental dimensions:

1) Ecosystem health
    - Measures threats to human health
    - Benefits from economic growth
2) Ecosystem vitality
    - Measures natural resources and ecosystem services
    - Suffers from economic growth
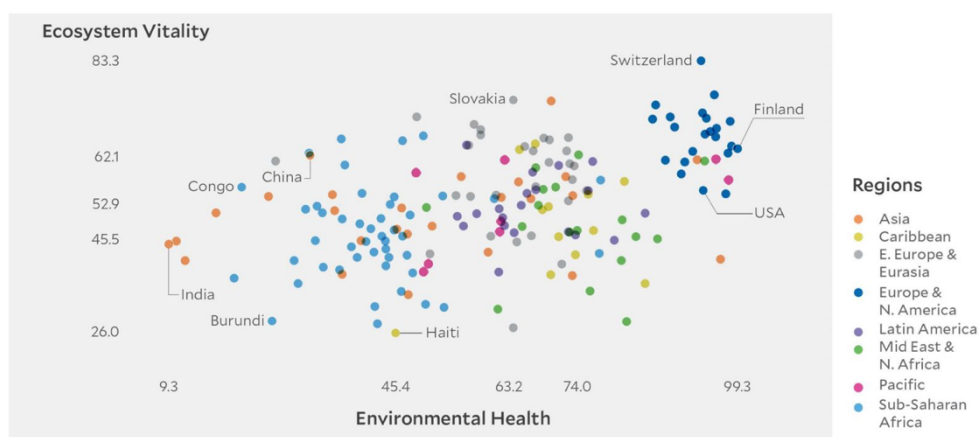
STRUCTURE

- 24 indicators
- 10 issue categories (with weights)
- Normalisation like HDI

WELFARE MEASUREMENT

At the individual level: what to measure? What is a good life?

- Subjective well-being (SWB)?
    - Too subjective? (is SWB all in life?)
    - Only one dimension?
- Lists: 'Multidimensional well-being'?
    - Current living situation? (several dimensions of life)
    - Fulfilment of basic needs?
    - Opportunities? Capabilities?
    - How to aggregate these dimensions?
- Trade-off?

How to aggregate individuals? Attention to inequality?

(in)equality of what?

MULTIDIMENSIONAL WELL-BEING

A good life consists of achievements in a number of dimensions of life

Which dimensions to take into account?

- Functionings
    - What people manage to do or to be in life
    - How healthy they are, how well educated they are,…
    - E.g. not consumption, but what people manage to do with the goods they consume
- Capabilities
    - All achievable combinations of functionings
    - 'freedom'

Aggregation across dimensions?

How? Which weights to use?

- Weights defined by the researcher?
- Weights based on an individual judgment? Voting?

From 'Stiglitz, Sen, Fitoussi (2009)'

Well-being is multi-dimensional

To define what well-being means a multidimensional definition has to be used. Based on academic research and a number of concrete initiatives developed around the world, the Commission has identified the following key dimension that should be taken into account. At least in principle, these dimensions should be considered simultaneously:

i.   Material living standards (income, consumption and wealth);
ii. Health;
iii. Education;
iv. Personal activities including work
v.   Political voice and governance;
vi. Social connections and relationships;
vii. Environment (present and future conditions);
viii. Insecurity, of an economic as well as a physical nature.

All these dimensions shape people's well-being, and yet many of them are missed by conventional income measures.

SUBJECTIVE WELL-BEING (SWB)

Individual assessment about his/her own well-being

Three types

1) Happiness
2) Satisfaction
3) Eudaemonia

1 "How **happy** are you at the moment, on a scale from 0 (very unhappy) to 10 (very happy)?".
2 "How **satisfied** are you with your life as a whole, on a scale from 0 (very unsatisfied) to 10 (very satisfied)?".
3 "To what extent do you consider what you do in life as **valuable**, on a scale from 0 (not valuable at all) to 10 (very valuable)?".

A lot of research

Connection with important aspects of life (Health, job satisfaction, Individual characteristics)

'Individual sovereignty'

But is it also a good indicator of well-being from an objective point of view? (point of view of a policymaker)

PROBLEMS WITH SWB

Very hedonic

- Give everyone a 'happiness pill' and everyone is happy
- Nozick: the pleasure machine: is there something other than pleasure that is valuable?
- Not what we mean with 'a good life'

Too subjective (two critiques by A.Sen)

- Physical condition neglect
- Valuation neglect

What goes through people's minds when they answer the happiness question?

- Are the answers interpersonally comparable? Is my 8 the same as your 8?
- Cognitive versus affective evaluation (aspirations)
- People adapt to their situation (hedonic adaptation)

ONE PROPOSAL: EQUIVALENT INCOME

Life consists of dimensions: what do people consider important in life?

- 'functionings': 'beings and doings'?
- **Select a list of functionings**
- Need for a 'synthetic indicator', one aggregated measure of individual well-being

How to aggregate across dimensions?

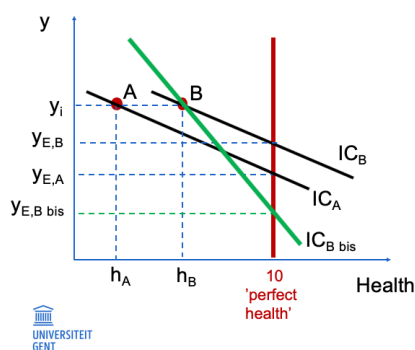- Which weighting system? Based on preferences? Needs?
- Is trade-off between dimensions allowed? If no: no aggregation allowed

Equivalent income: translates all dimensions in one dimension

- The level of income that makes an individual indifferent between her actual situation and a hypothetical situation with reference achievements in the other dimensions of well-being
- 'money metric utility'

EQUIVALENT INCOME

y

A   B

y_i

$y_{E,B}$

$y_{E,A}$

$y_{E,B\,bis}$

IC_B

IC_A

$IC_{B\,bis}$

h_A h_B 10
'perfect
health'

Health

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Suppose a person's situation is observed in several dimensions

Suppose IC reflects the trade-off: the individual values one unit of health as 100 euro
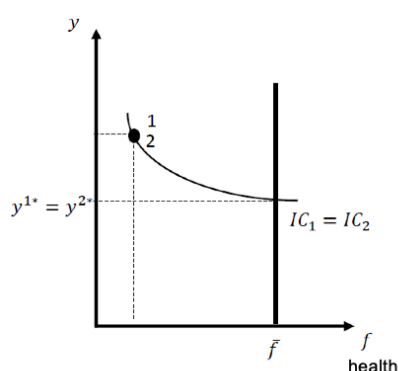
$$y_{Ei} = y_i - w_{health,i} * (10 - h_i)$$

$$y_{EA} = 2000 - 100 * (10 - 3) = 1300$$
$$y_{EB} = 2000 - 100 * (10 - 6) = 1600$$

Suppose B values health more

EQUIVALENT INCOME FOR IDENTICAL FUNCTIONINGS ACHIEVEMENT

y

1
2

$y^{1*} = y^{2*}$

$IC_1 = IC_2$

$\bar{f}$ f
health

y

1
2

y^{1*}

IC_1

y^{2*}

IC_2

$\bar{f}$ f
health

– Respects individuals' judgment about their lives
– Clearly defined
  – Dimensions
  – Preferences
  – Equivalent income

DISADVANTAGES

Trade-offs across the dimensions of life is controversial

- Are people informed about their preferences? Do people agree to trade-off?
- Are people allowed to say: 'I don't care for my health'? Or: 'the only thing that matters to me is my religion'?
- What is people are moved 'far away' from their observed bundle?
- Imagine: low EI but happy

Only well-being, no sustainability

- Natural capital / the environment as a dimension?
- But what if people don't value the environment?
- How to know future generations' preferences?

Is the environment simply a dimension that people value?

Today:

Standard macro-economic model: aim is GDP growth

- Which factors determine GDP growth?
- What inhibits growth?

Why aim for GDP growth?

Can we grow "sustainably"?

Ecological economics: steady-state economics (old)

Three other proposals: prosperity economics, degrowth and a-growth (new)

- Ecological macroeconomics
- Emerging "consensus": post-growth
- EU Green Deal

Challenges + (silent) Discussion

GDP GROWTH

Explicit target since 1950s ~ development of System of National Accounts

Modernism / belief in progress

- the Enlightenment
- human rights, individual liberties, separation of church and state, representative democracy, private property, …

Keynes ~ two issues:
- Absence of technical improvements
- Failure of capital to accumulate
Accumulation of capital started in the 16th Century
Emergence of capitalism

Two elements

1) science, technology (16th-17th C): progress, has direction and increased the living standard
2) interaction with societal changes (contract law, individual liberties,…)

Before: cyclical (seasonal), stability, 'steady state'

ECONOMIC MODELS UNTIL 1950S

Thinking in terms of **equilibrium**, adjustment until supply = demand

- Less attention to growth
- Growth as intermediary stadium between one 'steady state' (equilibrium) and another 'steady state' (equilibrium)

Classical (19th C) economists (Malthus, Smith,…) warned for long run problems

- Population growth => lower wages
- Resource scarcity
- Thinking in terms of markets (employment, unemployment…)

Keynes: idea that the **government** can influence employment

1930s: development of the concept of GDP

Focus on savings and accumulation

- Savings => capital accumulation
- Savings => investment in research and development => technological progress
- Role for (inclusive) institutions

> Capitalism: using 'savings' (unconsumed income) for investment instead of consumption for the rich or religious buildings (?)

PROBLEMS WITH GROWTH

IPAT equation:

Technology? Carbon efficiency (dollar GDP per CO_2) has to increase a lot.

Decrease population? Yes, but political feasibility?

Affluence…

Problems with GDP (see previous lecture)

> GDP growth / income growth is not always good…

> So why do we grow?

EASTERLIN PARADOX

The '**Easterlin Paradox**' states that at a point in time happiness varies directly with income both among and within nations, but over time happiness does not trend upward as income continues to grow.

- Hedonic adaptation: people adapt preferences as income rises (aspirations)
- Decision utility vs. experienced utility?
- Rising incomes bring social and environmental externalities?
- Conspicuous consumption?
  - o possession of positional goods leads to social congestion
  - o happier but the neighbours are less happy
  - o 'the hedonic treadmill' ~ 'keeping up with the Joneses'

KEYNES: "ECONOMIC POSSIBILITIES FOR OUR GRANDCHILDREN" (1930)

1930-2030: Standard of living time 4 to 8 (due to technological progress)

- Absolute human needs: satiable
- Relative human needs (in comparison with others, 'desire for superiority'): unsatiable?

The economic problem (the struggle for subsistence) will be solved

- 3-hour shifts, 15-hour weeks, enough to satisfy our needs
- More leisure

Four things to control:

1) Population
2) Our determination to avoid wars
3) Willingness to entrust in science the direction of those matters which are the concern of science
4) The rate of accumulation (margin between production and consumption)

WHY GROW?

ECONOMIC

Growth => Choice (everything becomes easier)

<u>Growth => Savings</u>

⇒ technological progress,…

⇒ better lives in the future

<u>Growth => Higher needs</u>

Consumption and basic needs

Richer => 'higher' needs (psychological needs)

If GDP growth stops, these needs need to fulfilled in other ways

<u>Economic stability</u>

- Growth necessary for avoiding employment losses
- Shrinking economy implies also decreasing wages

+

People aim for income increase, 'desire for continued material progress' (we aim for level or for growth?)

Growth leads to positive emotions, shrink implies worries

The iron cage of consumerism

SOCIAL/ENVIRONMENTAL

Increased GDP/cap implies also other societal goals

- Environmental Kuznets curve, health
- Social: decreasing poverty, malnutrition, illiteracy, infant mortality…

Social stability: "A rising tide lifts all boats"

POLITICAL

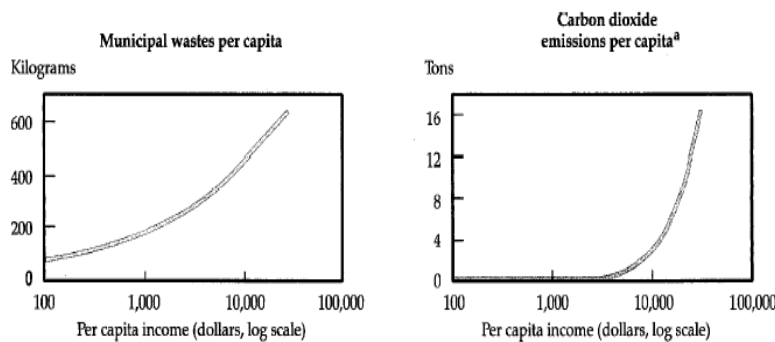Neighbouring or hostile countries grow now

Political elements

- GDP growth => rising tax revenue => easier than lower revenue
- Competition between politicians: the one who promises the highest growth, wins elections

ENVIRONMENTAL KUZNETS CURVE

BUT....

Municipal wastes per capita / Carbon dioxide emissions per capita[a]
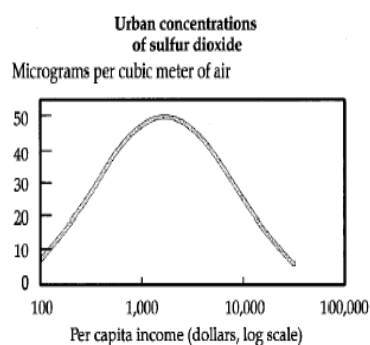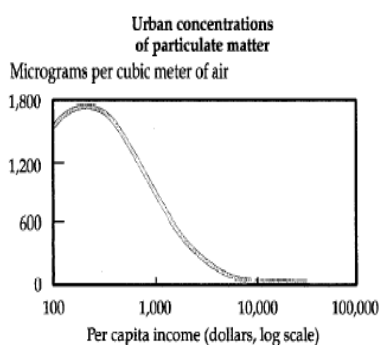
GREEN GROWTH?

combining economic growth with a reduced environmental impact (circular / service economy)

decoupling (feasible?)

> EEB - "decoupling debunked"
> (2019); Kallis & Hickel (2019)
>
> Reasons:
>
> - rebound effects
> - *problem shifting*
> - service economy on top of a material economy (not "instead of")
> - limited potential for recycling
> - Insufficient and inappropriate technological progress
> - *cost shifting* ~ consumption vs. production
> - increasing energy expenses

THE IRON CAGE OF CONSUMERISM

Supply side: 'Creative destruction'

- Profit stimulates innovation, efficiency improvements
    - Cheaper and better products
    - Room for new sectors
- 'Old' sectors go bankrupt
- Say's Law: "each supply creates its own demand"

Demand side: social logic

- Goods play important role in life ~ identity, communication, …
- What we consume shows who we are (identity)
- 'Cathexis': a process of attachment that makes us think of material possessions as part of an extended self
- 'keeping up with the Joneses' and conspicuous consumption

=> producing and consuming more ('how much is enough?')

SUSTAINABLE GROWTH?

traditional view on the economy

- closed system, economic system independent of the environment
- natural resources are abundant

ecological economists' view on the economy

- the economy is an open system
    - Inflow and outflow of energy (solar energy / loss of heat)
    - Throughput of flows of energy and material
- the Earth is a closed system
- natural resources are scarce, sustainability rules should be defined

source = renewable and non renewable resources: materials and energy

sink = absorption of waste and emissions by nature

TWO LAWS OF THERMODYNAMICS

1st law:

The Earth is a closed system in which a finite set of resources is available for current and future growth, so that the capacity of the economy to produce still more goods is constrained by the availability of resources. Matter and energy can be changed, but neither created or destroyed.

2nd law:

Whilst energy can be changed from one form into another, it tends to become "degraded" into less useful and potentially environmentally damaging forms during the process of change. This implies limits to recycling / re-use.

BEYOND GROWTH

1997 - Herman Daly

Ecological Economics - Professor at the University of Maryland

STEADY-STATE ECONOMY

Daly proposes to move towards a steady-state economy

- constant level of "throughput" (lowest level of material and energy)
- growth still possible, but… ! uneconomic growth (youtube.com/watch?v=fnqFrs4X5iQ)
- threshold hypothesis

On the social side: population control and redistribution of wealth and income

Daly defines **sustainability** as:

development without growth beyond environmental carrying capacity, where development means qualitative improvement and growth means quantitative increase

Daly's rules for sustainable use of the natural environment

- renewable resources (fish, soil, groundwater, ...) must be used no faster than the rate at which they regenerate
- non-renewable resources (minerals, fossil fuels, ...) must be used no faster than renewable substitutes for them can be put in place
- pollution and wastes must be emitted no faster than natural systems can absorb them, recycle them, or render them harmless

THREE OTHER PROPOSALS

1) Define prosperity differently
   - Tim Jackson (Prosperity without growth, 2016)
   - Peter Victor (Managing without growth, 2008)
2) Degrowth (since 2008)
   - We should aim for GDP decrease (but not just any recession!)
   - Giorgos Kallis et al.
3) A-growth
   - Organize society without looking at GDP growth
   - Jeroen Van den Bergh (2011), Kate Raworth (2017)

DEFINE PROSPERITY DIFFERENTLY

Focus on a 'good life' instead of GDP or income or consumption

- Human flourishing
- Happiness, quality of life, functionings achievement,…
- Role for leisure / other types of needs fulfilment than consumption

Policy

- Population decrease
- Environment:
  - Daly's rules on resource use
  - Environmental policy: limits on throughput, environmental taxes
- Social
  - Poverty reduction
  - Reduced work time (+ increased productivity)
- Investment in low carbon economy (not only for increasing GDP)

'FLOURISHING WITHIN LIMITS' (JACKSON)

Escape from the 'iron cage of consumerism'

- Welfare: ability/capability to flourish
- Attention for public goods instead of private goods
- Attention for sharing goods in a community

Proposal: alternative hedonism

- Find sources of satisfaction outside the conventional market
- E.g. social contacts
- A more sustainable life that makes us happier

Proposal: voluntary simplicity

- Live simply that others might live simply (Gandhi)
- Satisfying lives which are purposeful but materially light

BEYOND GDP INDICATORS

Beyond GDP indicators are not often used in policy assessments (Bleys & Whitby, 2015)

- (Too) many indicators
- Fierce competition
- Most indicators are compiled ex post (e.g. ISEW for Flanders –> data for 2015 were published in November 2017)

Policy-makers want to have tools to conduct ex ante assessments of policy choices

- (Macro)economic models
- Mostly rooted in traditional economic worldviews (economy as a closed system + little attention paid to ecosystem services)
- Do not allow to assess post-growth policies (too radical)

ECOLOGICAL MACROECONOMICS (EME)

New academic discipline: merging ecological economics with macroeconomics

- Scrieciu et al. (2013): focus in EME is not on optimisation (welfare functions or describing behavior of agents)
- Hardt & O'Neill (2017): literature review of models and post-growth policies
- Promising avenue: stock-flow consistent system dynamic modelling (type World3)

Main focuses in research area:

- Inequalities
- Finance and financialization
- Resource use and waste flows (Input-Output Tables)
- Alternative measures of progress

DEGROWTH (KALLIS, 2011)

Proposals:

1) 'Exit from the economy' (ecovillages, consumer-producer cooperatives, …)
2) Redistribution
3) Work
   - Shorter working week (21 hours)
   - Labour market policy aimed at human contact, not aimed at productivity
4) Financial markets and money
   - Limits to capital movements
   - 'Abolish money' (alternative currencies)
   - Decentralisation of the financial system
5) Environment
   - Cap carbon
   - Tax carbon (green taxes)
6) Basic income proposal / maximum income

DEGROWTH CRITICIZED (VAN DEN BERGH, 2011)

'Degrowth' can mean

- GDP degrowth
- Consumption degrowth
- Work time degrowth
- Radical degrowth
- Physical degrowth

Degrowth
Is a confusing concept
Not an effective way
and not efficient way to reduce environmental pressure

'Degrowth is a bad idea' (van den Bergh 2011)

- Environmental consequences unsure (degrowth is 'too blunt') : Rebound effect
- Politically unfeasible: People do not want it (?) Which % of degrowth?

ENVIRONMENTAL CONSEQUENCES UNSURE

GDP degrowth implies lower investments, also in sustainable technology, renewable energy,…

- Idea that degrowth => better environment is too simple
- Better: good environmental policy => effect on growth can be + of −

Important question

- Consequences of degrowth for production and consumption?
- Degrowth can result in less efficient production: lower output with more inputs

Work fewer hours

- What is the consequence for consumption: dirtier?
- Higher use of capital, less labour: effect on resource use?
- Some people like to work a lot (~ work fulfillment)

'Escape from the capitalist economy'

- Is a normative point of view
- Against the human nature?
- Not an effective way to combat pollution

A-GROWTH (VAN DEN BERGH, 2011)

= ignore GDP

→ Degrowth is too extreme and lacks focus

→ A-growth: be indifferent about the consequences for GDP (also in "Doughnut Economics, Kate Raworth, 2017)

Policy proposals

- Make sure prices are correct (taxes, subsidies)
- 'Selective degrowth'
- Hard limits on the use of the environment
- Change norms and values (work, pro-environmental behaviour,…)

This might lead to degrowth, but not as the aim

POST-GROWTH: UMBRELLA?

- 238 scientists put forward an open letter in different European newspapers

- united call to move "beyond growth" ~ degrowth proponents, Tim Jackson, Kate Raworth, Kate Pickett, …

- yet, still a lot of "loose" initiatives ~ Well-Being Alliance (We-All), individual authors pushing their own agendas, …

- Hoekstra (2019): "cottage farming" vs. GDP industry

## POST-GROWTH: POLICY CLAIMS

Four concrete policy proposals (september 2018):

1) constitute a special commission on Post-Growth Futures in the EU Parliament
2) incorporate alternative indicators into the macroeconomic framework of the EU and its member states
3) turn the Stability and Growth Pact (SGP) into a Stability and Wellbeing Pact
4) establish a Ministry for Economic Transition in each member state

Post-growth workshop with high-level representatives of different DGs in December 2019

EU GREEN DEAL

"[This] is our new growth strategy, for a growth that gives back more than it takes away," she said. "It shows how to transform our way of living and working, of producing and consuming, so that we live healthier [lives] and make our businesses innovate. We will help our economy to be a global leader by moving first and moving fast."
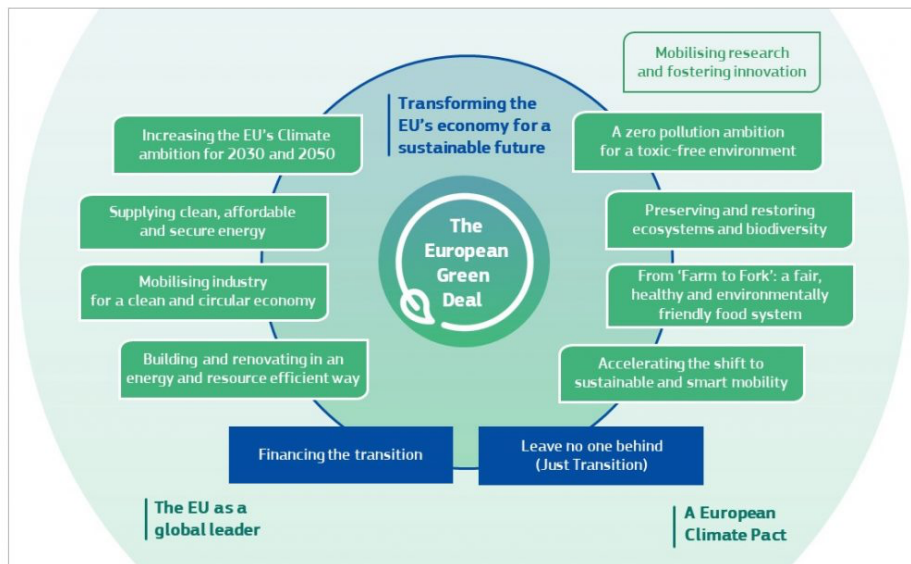
CHALLENGES

Individual mindsets

- How much is enough?
- Attention to conspicuous consumption, locked-in behaviour

Energy consumption : Travelling, commuting, heating

Rethinking : Cities, transport, housing, Work

Recycling and sharing

Population

Distribution (intergenerational and intragenerational)

Investment and technology: Reduction of throughput

Intragenerational equity = now

Intergenerational equity = the further generations

Two interpretations:

1. Take welfare of **all individuals today** and **sum across time**

2. Take welfare of **one individual across time** and **sum across individuals**

A SIMPLE MODEL: THE SOLOW MODEL

= a long run growth model

Production function

- $Y = AK^{\alpha}L^{1-\alpha}$
 GDP, $0 < \alpha < 1$

- Per capita: $\frac{Y}{L} = \frac{A}{L}\frac{K^{\alpha}L^{1-\alpha}}{L}$
 GDP per capita
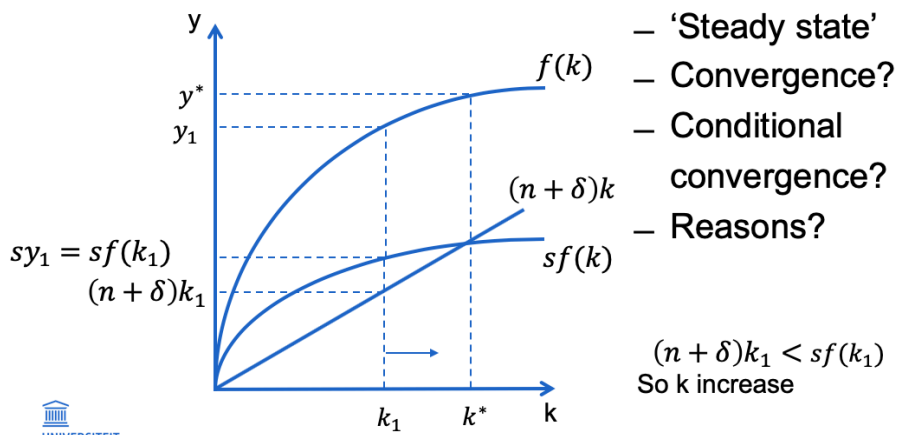
- $y = ak^{\alpha}$
 $y = f(k)$
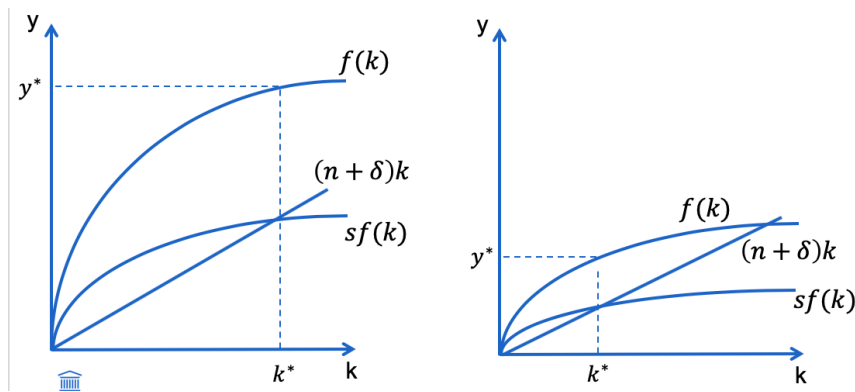
How does $k = \frac{K}{L}$ evolve?

→K depreciates at rate δ

→L increases at rate n

→ K increases due to investment: a fraction s of y

$$\Delta k = sy - (n + \delta)k$$

– 'Steady state'
– Convergence?
– Conditional convergence?
– Reasons?

$(n + \delta)k_1 < sf(k_1)$
So k increase

INCOME IS THE RETURN ON CAPITAL

- Physical capital (infrastructure, roads, factories, machines,…)
- Human capital (education level…)
- Natural capital
- Institutional capital
  - Formal institutions
    - Governance, democracy
    - Corruption
    - Local associations (e.g. farmers' unions)
  - Informal institutions
    - Social connections
    - Mutual trust
    - Social norms

→ savings and investments needed in these capital forms

DATA

GDP per capita : constant PPP $

Literacy rate: > 15% of people

Poverty headcount : < 1,9$/day = poverty gap index

MULTIDIMENSIONAL POVERTY INDEX (MPI)
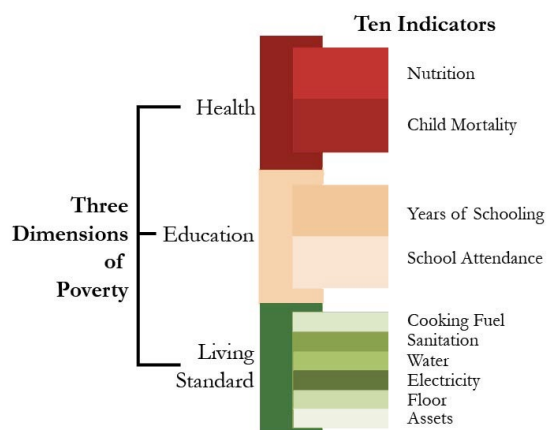
- People who experience deprivation in at least one third of these weighted indicators fall into the category of multidimensionally poor

- MPI is estimated for 102 countries; 75% of global population

- 1.334 billion people are MPI poor (20% of total)

- many MPI poor people live in middle-income countries

- 41% of the MPI poor live in South Asia, 42% in Sub-Saharan Africa

- MPI varies within countries & poverty reduction over time varies by dimension

CONSEQUENCES OF POVERTY

Growing up in poverty and malnutrition

- ⇒ Influences brain development (influence on ability later in life)
- ⇒ Even before birth…

Economic growth and 'trickle down'?

- 'pro poor growth'
- Evidence, but differences between countries
- Not automatic… inequality actually reduces pro-poor growth

Trickle down?

Income elasticity of poverty

Inequality elasticity of poverty

$2.50 poverty line

	1980s	1990s	2000-	Overall
Income elasticity				
Global	−1.344	−1.196	−1.296	−1.261
East Asia and Pacific (EAP)	−1.112	−1.164	−1.339	−1.196
Europe and Central Asia (EECA)	−3.027	−2.136	−2.142	−2.274
Latin America and The Caribbean (LAC)	−1.508	−1.598	−1.651	−1.597
Middle East and North Africa (MENA)	−1.737	−1.809	−1.762	−1.782
South Asia (SAS)	−1.149	−1.208	−1.098	−1.143
Sub-Saharan Africa (SSA)	−0.682	−0.383	−0.573	−0.494
Inequality elasticity				
Global	1.333	1.235	1.423	1.321
East Asia and Pacific (EAP)	0.651	0.880	1.237	0.922
Europe and Central Asia (EECA)	3.265	2.287	2.343	2.457
Latin America and The Caribbean (LAC)	2.184	2.296	2.436	2.323
Middle East and North Africa (MENA)	2.092	2.056	1.998	2.043
South Asia (SAS)	0.545	0.721	0.804	0.668
Sub-Saharan Africa (SSA)	0.410	0.124	0.302	0.229

EXPLANATIONS FOR DIFFERENCES

- Genetic / biological / ability / creativity / intelligence
- Culture / religion / attitudes / values (Max Weber)
- Geography / environment (climate, topography, disease environments etc.)
- Institutions and institutional capital
- …?
- Acemoglu (book)
- Jared diamond (book)

JARED DIAMOND – GUNS, GERMS AND STEEL

- 'Why did the rate of progress differ so much for cultures on different continents?"
- Geographic and environmental factors dictate / influence / limit development
- Reasoning   (starting point: hunter gatherers)
    - o Domestication of plants and animals depends on availability, geography, climate, environment
    - o Agriculture emerged in several places and spread
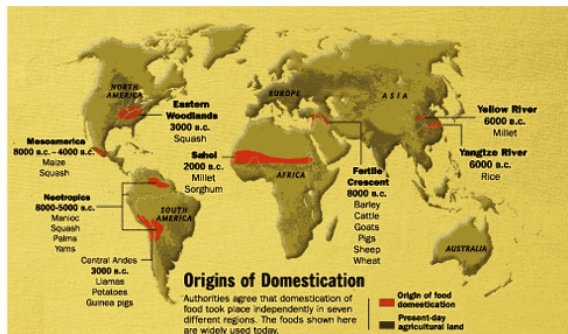   - o Population increase due to agriculture, so more warriors
    - o Germs

Examples:

- East-West orientation versus North-South orientation
- Seeds in Europe and Africa / Australia
- Geographic fragmentation and exchange in Europe versus China

'deterministic'

Idea: that innovation does not come from necessity but from human curiosity

<u>Domestication</u>

Europe:

1. Availability of plants & animals

2. East-West orientation

3. Diffusion of ideas easy (no mountains, oceans)

4. Fragmentation

ACEMOGLU AND ROBINSON – WHY NATIONS FAIL

<u>Extractive institutions:</u>

Extractive political institutions: Political institutions concentrating power in the hands of a few, without constraints, checks and balances or 'rule of law'

Extractive economic institutions: Institutions designed by the politically powerful elites to extract resources from the rest of society

<u>Inclusive institutions:</u>

Inclusive political institutions: Political institutions allowing broad participation and placing constraints and checks on politicians; rule of law (closely related to pluralism).

Inclusive economic institutions: Secure property rights, law and order, markets and state support (public services and regulation) for markets; open to relatively free entry of new businesses; uphold contracts; access to education and opportunity for the great majority of citizens, i.e. create incentives for investment and innovation and a level playing field

<u>Conclusion</u>

Inclusive institutions

- Openness for (technological) innovation, creative destruction
- Provision of public goods: education, justice system,…
- Winners and losers
  - Switch to inclusive economic institutions may imply the current leaders lose their privileged position

Extractive institutions:

- Elites / the vested interests block progress/change/innovation
- Only accept if it is in their advantage (public choice)

Move from extractive to inclusive? (the French) Revolution…

or extractive to extractive… (Congo before and after independence)

Many examples

- Spread of Industrial Revolution took a while
- Congo: tribal chiefs, Leopold II, Mobutu, Kabila
- Printing press (1445, but in Turkey only in 1727 –under supervision)
- North and South Korea, North of Mexico and US
- China in 15th Century: Emperor forbids explorations

Not deterministic. Idea that history is random

A small change can make a big difference, leading to inclusive or extractive institutions

SOLUTIONS: HOW TO PROMOTE GROWTH?

Traditionally: promote growth ~ convergence (Solow)

- 'big push': investment in capital
- But many (geo)political issues at the donor country side…

Tool: **ODA** (official development assistance): did it lead to economic growth?

Need for a new economic model, attention to

- All aspects of a project … Institutions, the local situation
- Small scale instead of big scale projects?

'BIG PUSH'

$(n + \delta)k_1 > sf(k_1)$
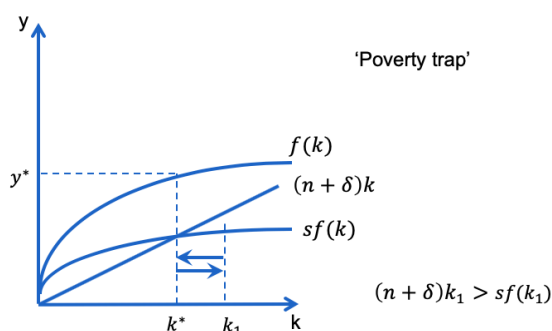
ODA (OFFICIAL DEVELOPMENT ASSISTANCE)

The **ODA grant equivalent** is a measure of donor effort. Grants, loans and other flows entering the calculation of the ODA grant equivalent measure are referred to as **ODA flows**.

ODA flows: those flows to countries and territories on the DAC (OECD Development Assistance Committee) list of ODA Recipients and to multilateral development institutions which are:

- provided by official agencies, including state and local governments, or by their executive agencies; and
- each transaction of which:
  - o a) is administered with the promotion of the economic development and welfare of developing countries as its main objective; and
  - o b) is concessional in character

Ada as % of GNI
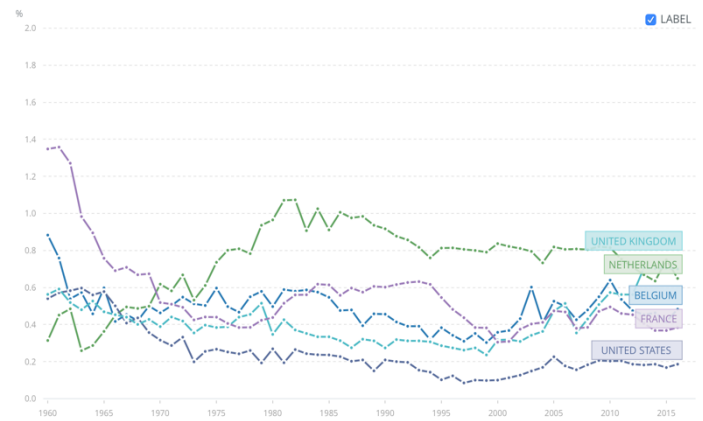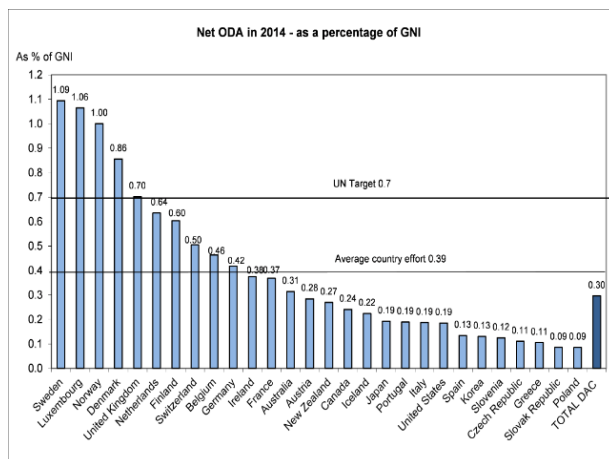
Shortcomings of ODA

It contains too much

- ODA: amount of money spent, not what the money does
- E.g. student from the global south studies in EU
- E.g. EU support for Syrian refugees in Turkey

Does not measure everything: e.g. only DAC, not China

Transparency?

Aid and economic growth
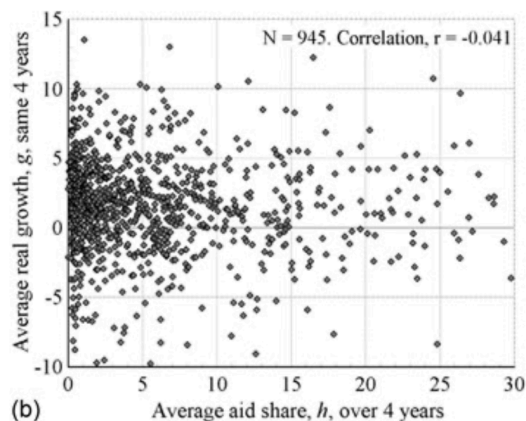
Aid effectiveness?

Effect of aid on growth: maybe small and positive, probably zero (Doucouliagor & Paldam 2009)

- 'Reluctance to report negative results'
- LT aid creates dependence
- Aid transparency and corruption
- Hidden political agenda of donor countries

Progress on some domains, but not overall

SOLUTIONS?

Projects provide public goods, collective resources management

- E.g. irrigation infrastructure, toilets, education, renewable resources (fishing grounds), access to healthcare, …
- Characteristics: non rival and non-excludable

Conventional view: the market fails, the state should provide

But: too extreme, also the state can fail

- Ostrom: "polycentric governance"
- Role for the market and the state?
  - Ostrom: build 'trust' between stakeholders (as an informal institution)
  - Involvement of stakeholders
- Multidimensional, many stakeholders involved

Leapfrogging

Micro versus macro debate

$\Rightarrow$ Micro: projects have an impact
$\Rightarrow$ Macro: no change

OSTROM (application: overfishing)
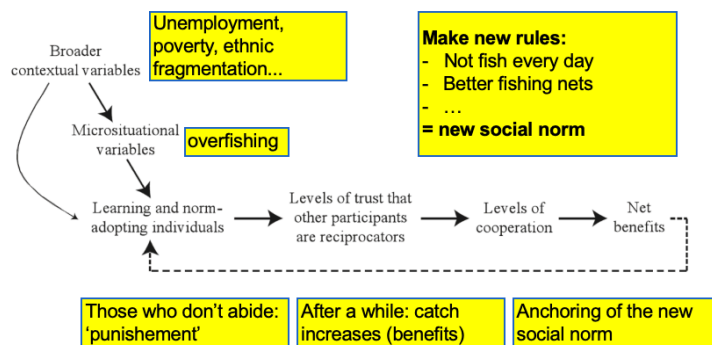
Example: water supply

NGO provides a village water pump (infrastructure)

- In collaboration with local stakeholders
- Brings: access to water, health
- Indirect effects? (effects on time use, working hours,…)

Management of the water pump: local level

Project delivers not just the pump, but capacity building

- Management board (users, municipality,…)
- Education: water and sanitation training
- Water and sanitation training in schools

LEAPFROGGING

Bypassing" or "leapfrogging": accelerate development by skipping traditional technologies which are inferior, less efficient, more polluting and move directly to more sustainable technologies

Energy for opportunity (Siera Leone)

Solar power installation

Brings more than just light:

$\Rightarrow$ business development (new shopping area)
$\Rightarrow$ educational opportunities (electrician,...)
$\Rightarrow$ healthier life circumstances

Promising

- E.g. mobile phone to check bank account, to receive (micro)credit, to check prices of agricultural products…
- Drones to deliver medication to remote areas

But conditions must be met

- investment in infrastructure
- the right regulatory environment for new business models
- Education: literacy and math

STEREOTYPES VS REALITY

THE FOUR HORSEMEN OF THE APOCALYPSE IN AFRICA?	Proportion of African population
Average annual war deaths as proportion of population, 1965–2005	0.0001
Proportion of male children ages 10–17 who were child soldiers in 1999	0.0019
Average annual proportion affected by famine, 1990–2005	0.0029
Proportion of population who are refugees or internally displaced persons, 2005	0.0053
Proportion of population who died from AIDS in 2007	0.0020

BEFORE & NOW

- Before:
  - Aim was 'big push'
    => convergence
  - State oriented
  - ODA

- Now
  - More goals
    - Convergence
    - Access to essential services (SDG)
    - GPG (global safety)
  - Actors
    - NGOs, China, private sector…
    - More people oriented
  - Instruments / flows
    - Private donations
    - Remittances
    - FDI

CAN THE WEST 'SAVE' AFRICA?

| **Transformational approach**	**Marginal approach**
'save Africa comprehensively', 'end poverty', 'end civil war', 'big push forward', 'economic growth', rapid, broad social and economic aims	'one step at the time', 'aim for increasing well-being/welfare of individual Africans', more gradual, one specific target

Two themes in the transformational approach

1) Escalation
2) The cycle of ideas (little evidence of learning)

The marginal approach is more successful?

- Randomized Controlled Trials = **RCTs**
- But: extrapolation possible?

Success in specific domains (education, health), but not 'transformational'
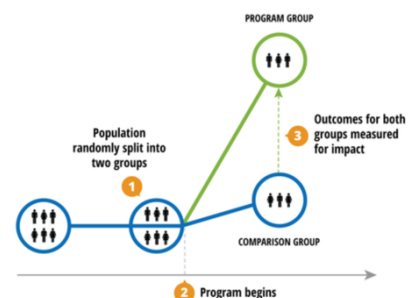
Randomized Controlled Trials (RCTs)

- Merit scholarship for girls improves their test scores (and has positive effects on the boys in class) (Kenya)
- Giving textbooks to students does not improve test scores (Kenya)
- Providing meals in schools raised attendance (but only positive effect on test scores if well-trained teacher)
- Progresa project in Mexico (CCT): Giving cash grants to families keeps children in school (CCT - conditional cash transfers), raises schooling (avoids child work)

Conclusion: some things work, but under the right circumstances

MICRO AND MACRO

Micro evidence but no macro effect? 2 reasons

1) **Fungibility** (a general equilibrium consideration):
   - Government receives money for A (schools)
   - It spends less on A and more on B (the army)
   $\Rightarrow$ Macro effect = zero

2) **Idiosyncratic** aspects of the Random Control Trials (black box)
   - It says that it works but not why
   - It does not say whether it would work in another context
   - Check the complete value chain of the project
   - **Systemic effects** not at play in one experiment (e.g. donation of medication that does not reach the beneficiaries because the system is corrupt), problems of teacher absenteeism,…

EASTERLY ON INSTITUTIONS (EASTERLY ON INSTITUTIONS)

About Acemoglu etc: good idea, good direction

But 1: donors can argue: aha this is the reason why our efforts did not work in the past, we have to realize even more! Donors evaded responsibility in this way

But 2: strengthens the idea that the Western efforts are the right ones, there is always a factor missing (this time: institutions)

But 3: if making change is already difficult, changing deep-rooted phenomena like corruption or democracy even more difficult

If you ask poor people how they got out of poverty

- 0,3%: due to charity
- 88%: personal initiative and hard work

  So, stop 'compassionate paternalism' and

- provide individual liberty to poor people
- let the poor take their own future in their hands
- let them decide, offer them the opportunity

IN CONCLUSION

Development is complex in nature, multidimensional

- Project: not just one aim (water, or health)
  - Need for capacity building, connections between stakeholders
  - Attention to all aspects of a project

- Give a voice to those to be helped: Avoid paternalism, let people be the architect of their own lives
- Involve local authorities
  - Better to make local authority accountable than to give too much responsibility to NGOs
  - Local authories need to be supported as well

Randomised Controlled Trials : Small scale evaluation

But: generalizability?

NGOS

Characteristics of NGOs:

- acting in a legally independent way from the state founded by private initiative
- a non-profit legal status.

Many types / aims

$\Rightarrow$ Nature, environment (e.g. WWF), Humanitarian (e.g. msf), Development

number of international NGOs

Focus: development NGO's:

- Aim: Public service delivery (and also advocacy)
- 'a non-profit and non-governmental aid intermediary that provides a public good or a public service and channels donors' funds to projects in developing countries'

Development NGOs: why?

Some governments lack

- political will (Corruption, powerful elite, public choice theory and government failure)
- resources

Idea: private actors (NGOs) are more effective in realizing development outcomes

- Democracy (women's rights)
- Poverty reduction
- Public good provision

Advantages & disadvantages NGO

Advantages	Disadvantages
– more **efficient, effective, flexible and innovative** than government;	– **Dependency on donors**, fragile roots in civil society, and technocratic approaches to complex developmental challenges.
– more other-oriented and ideologically **committed** to democracy and participatory pro-poor development; more transparent	– Intervene more where success is easier to reach (easier to prove to donors)?
	– Clustering of NGO's
– NGO mobilizes people, encourages increased information sharing, fosters alternative political ideas, and empowers the disadvantaged	– 'Bureaucratization' of NGO work (accountability to donor, not to recipients), often difficult in development setting
	– Fear of reporting failures
– Not for profit => **commitment** device to overcome informational and contractual problems (credibility, no freeriding)	– Relation with local public sector
	– Can draw the most competent employees out of the public sector, reducing public sector productivity
	– Can threaten to undermine government legitimacy
	– NGOs as part of an ''aid machine'' that operates mainly to perpetuate itself
	– Exaggerate stereotypes in Africa

UNIVERSITEIT GENT

51

NGO aid per capita

NGO's clustering…

Extra aid leads to more NGO's in a country
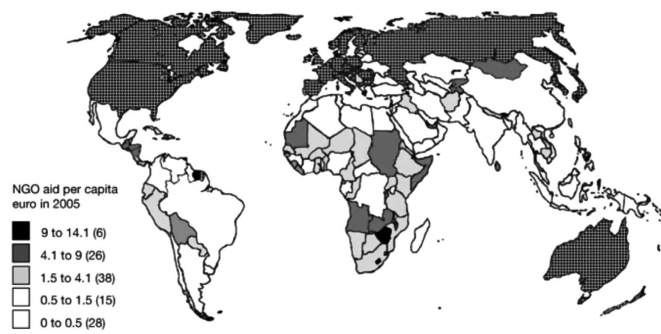
Figure 8 – Worldwide distribution of NGO aid in 2005.
Notes: Hatched areas are non-recipient countries.
Source: Koch 2009.

Example in Tanzania:
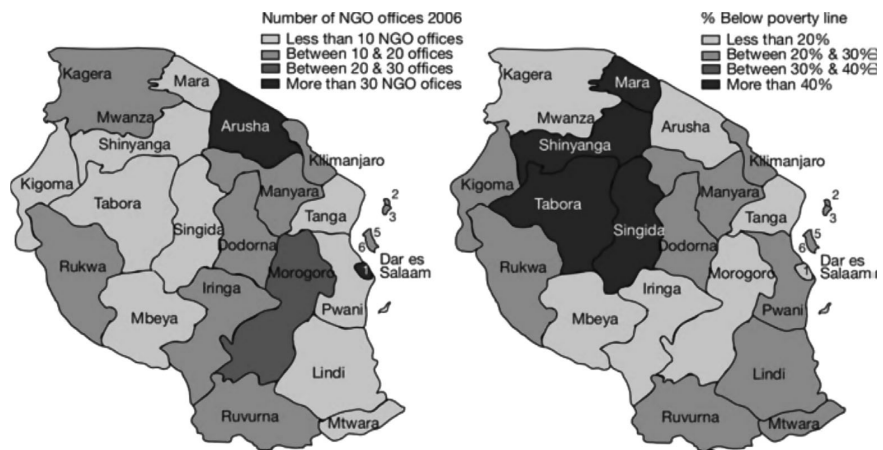
Figure 9 – Distribution of NGO offices and poverty rates in 2006, across Tanzanian regions.
Source: Koch 2009.

A FAIR SHARE BETWEEN GENERATIONS

intergenerational equity

problem: people who live in the future cannot defend their rights

"the future is now"

- health, pensions or public debt
- but also: (global) environmental problems

PUBLIC GOODS

Two defining features of public goods:

1) **non-rivalry** = one person's enjoyment of a good does not diminish the ability of other people to enjoy the same good.
2) **non-excludability** = people cannot be prevented from enjoying the good.

<-> private goods
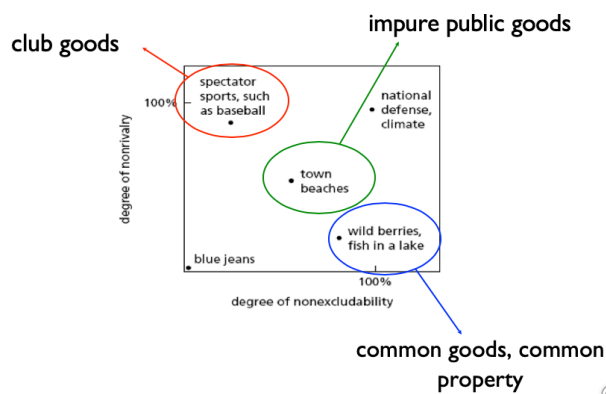
GLOBAL PUBLIC GOODS

Many environmental resources are characterized as (global) public goods

⇒ examples: water quality, open space, biodiversity, and a stable climate

Impure public goods ~ congestion, not accessible to everyone

Economic theory: market failure, free-riding (too little provision) ~ economic rationale for government intervention

Markets fail to deliver public goods

Governments should step in to do so

Three important questions:

1) what is the optimal quantity of public goods?
2) how to organise the market for public goods?
3) how to finance the provision of public goods?

OPTIMAL QUANTITY OF PUBLIC GOODS

Marginal WTP = marginal (social) benefits at last unit

Vertical sum of individual demand curves

⇒ e.g. "How much is society willing to pay for the development of a national park?"

Estimating WTP is difficult:

⇒ strategic answers vis-à-vis quantity provided (exaggerate your needs)
⇒ strategic answers vis-à-vis future prices (downplay WTP)
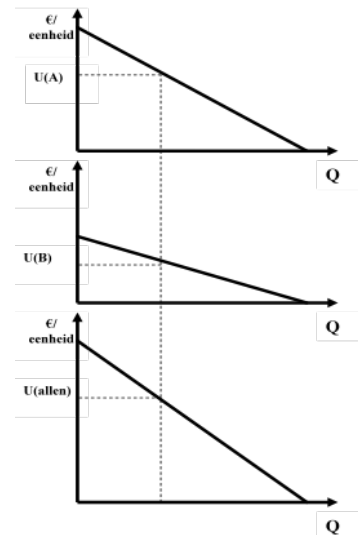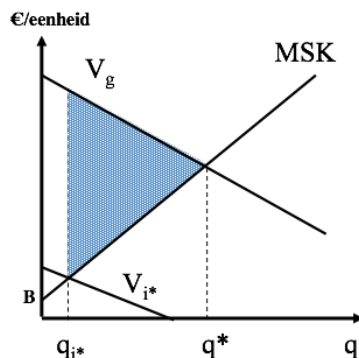
GLOBAL PUBLIC GOODS

Environmental public goods: how to determine WTP?
e.g. improved air quality

⇒ stated preferences techniques (WTP or WTA)
   e.g. contingent valuation methods, choice experiments
⇒ revealed preferences techniques
   e.g. hedonic pricing, travel cost method

global public goods: worse

⇒ larger number of people involved = larger incentives to free-ride
⇒ requires coordination between different sovereign nations

Number of success stories (fighting diseases, ozone hole) vs. number of problems (mitigating climate change)

POLICY OPTIONS

In environmental economics, different policy options are discussed and evaluated to arrive to the optimal level of pollution (public good)

⇒ decentral policy tools ~ property rights, liability regimes
⇒ central policy tools
   o *Command and Control (CAC)*: regulation
   o market oriented tools: taxes and subsidies, tradable pollution permits, …

NOW IS THE TIME TO ACT

Barrier to make changes: degree of uncertainty

• no experiment to "prove" the exact consequences (only one planet)
• risk of irreversible damage

- this should not be used as an excuse

Humankind is moving outside of its safe operating space

Overwhelming evidence of a system failure with devastating consequences

- Hoping for a 'miracle' solution? (cfr. techno-optimists)
- SD: mitigate risks now, in ways to enhance our present, as well as preserve our future

→ 'precautionary principle'

PRECAUTIONARY PRINCIPLE

= "if an action or policy has a suspected risk of causing harm to the public or the environment, in the absence of scientific consensus that the action or policy is harmful, the burden of proof that it is not harmful falls on those taking the action or policy"

PLANNING FOR THE FUTURE

Computer models (e.g. World3)
cfr. ecological macroeconomics (E3ME, GEMMA)

- population, economic growth, technology, environmental variables
- estimate impact of policies

scenario analysis

- compare different scenarios
- transition management (e.g. STS)
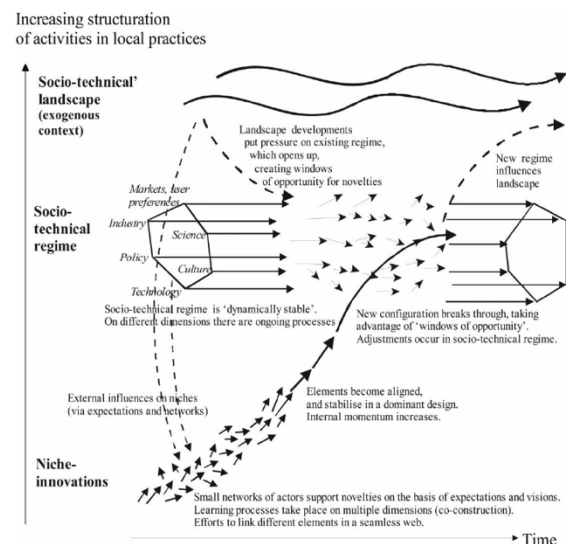
TACKLING 'SUPERSTAR' ISSUES

Climate change and ozone layer depletion = two typical examples of SD issues

- future impact of current actions
- (large) uncertainties
- abatement costs versus costs of inaction
- time to act is now!

Very different outcome in terms of policy success ~ why?

OZONE LAYER DEPLETION

- Ozone depleting substances (e.g. CFCs)
- Decrease of ozone levels (O3) in stratosphere
- More ultraviolet light reaches the surface of the Earth (increases in skin cancers, cataracts, damage to plants, ...)
- Montreal Protocol (1987) banned the use of ODS - rapid reduction of emissions

CLIMATE CHANGE

- Greenhouse effect and disrupted carbon cycle

- Increase of greenhouse gasses in the atmosphere (ppm CO_2-eq today: 405)
- Impact on food supplies, water, ecosystems, extreme weather events & risks of irreversible changes (Stern Review in 2006)
- CC has been addressed by supranational bodies since the late 1980s

Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (= IPCC)

- scientific body: reviews and assessments
- established in 1988 (WMO and UNEP)
- Nobel Peace Prize in 2007 (with Al Gore)
- investigates impact of implementing UNFCCC

UN FRAMEWORK CONVENTION CLIMATE CHANGE (= UNFCCC)

part of the Earth Summit (1992), annual COP meetings since 1995

objective:

$\Rightarrow$ stabilize GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system

Treaty provides for updates (Protocols), e.g. Kyoto Protocol 1997/2005

KYOTO PROTOCOL

- Signed in 1997, came into force in 2005 (Russia and USA)
- Annex 1 countries: reduction of GHG emissions of 5,2% compared to 1990 levels by 2012
- flexible mechanisms: emissions trading, joint implementation, clean development
- Paris - COP21

THE ECONOMICS OF CLIMATE CHANGE – THE STERN REVIEW (2006)

= 700-page report released for the British government

Two main parts:

1) economic impacts of climate change & economics of stabilizing GHGs in the atmosphere
2) complex policy challenges involved in managing the transition to a low-carbon economy

"Our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes. Tackling climate change is the pro-growth strategy for the longer term and it can be done in a way that does not cap the aspirations for growth of rich or poor countries."

Conclusions:

⇒ 1% of global GDP per annum is required to be invested in order to avoid the worst effects of climate change
⇒ failure to do so could risk global GDP being up to twenty percent lower than it otherwise might be

Stern later increased the estimate for the annual cost of achieving stabilisation (500-550ppm CO_2-eq) to 2% of GDP to account for faster than expected climate change.

DYNAMIC INTEGRATED CLIMATE-ECONOMY MODEL (= DICE)

- allows a weighing of the costs and benefits of taking steps to slow greenhouse warming
- developed by 2018 Nobel Laureate William Nordhaus
- used by EPA (US)

criticism: extreme sensitivity to initial assumptions, choice of discount rate

Nordhaus
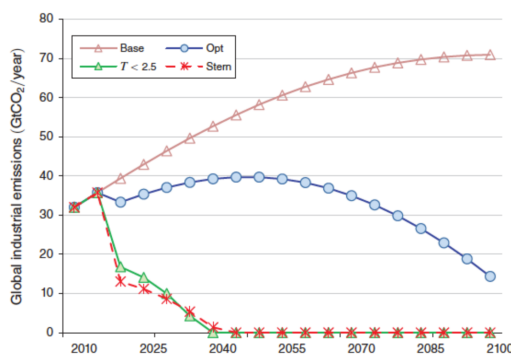
Scenarios: The Nordhaus DICE model indicates paths of future global emissions over time in a baseline no-policy scenario (Base), an optimal scenario (Opt), a scenario that keeps global temperatures from increasing more than 2.5 degrees C (T<2.5) and a scenario using a low discount rate as advocated by the *Stern Review*.
Source: Nordhaus (2018).

Figure 1. Cumulative Global Warming Under Various Policy Options, According to DICE-2016.[7]
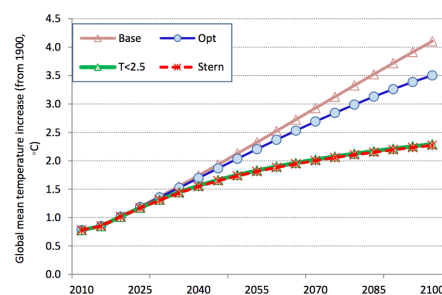
Figure 4. Temperature change in different scenarios
The most ambitious scenarios cannot limit temperature to 2 ½ °C, and the cost-benefit optimum with standard parameters has sharply rising temperatures.[iii]

Source: Figure 4 from Nordhaus (2017).

"optimal" CC mitigation: limit temperature rise to 3,5°C

- further reductions would be too costly (Paris)
- however: SCC estimate for 2025 corrected upwards : from 16$/tCO2 (2007) to 44$/tCO2 (2016) - indicates difficulties with SCC estimates: x3 in 9 years' time
- better (?): precautionary principle, and following recommendations of climate scientist (Paris)?

POTENTIAL PROBLEMS

valuing all CC impacts in monetary terms? (difficult)

uncertainties vs. risks

⇒ worst case scenario: risk or avoid?

discounting ~ process of determining the present value of a payment or a stream of payments that is to be received in the future

Discounting

discounting: high discount rate reduces weight given to distant cost and benefits

⇒ detrimental for future generations

number of views in this matter

- discount rate that decreases over time?
- different discount rate when it comes to environmental goods as compared to money or economic goods? (even negative?)

COP 21 IN PARIS

Key result: a global agreement to set a goal of limiting global warming to less than 2°C compared to pre-industrial levels

Parties will also "pursue efforts" to limit the temperature increase to 1.5°C

Ratified in April 2016 as 174 out of the 196 countries signed the agreement

Prior to COP21: "Intended Nationally Determined Contributions" (INDCs) ~ larger efforts needed

EU POLICY ON CLIMATE CHANGE
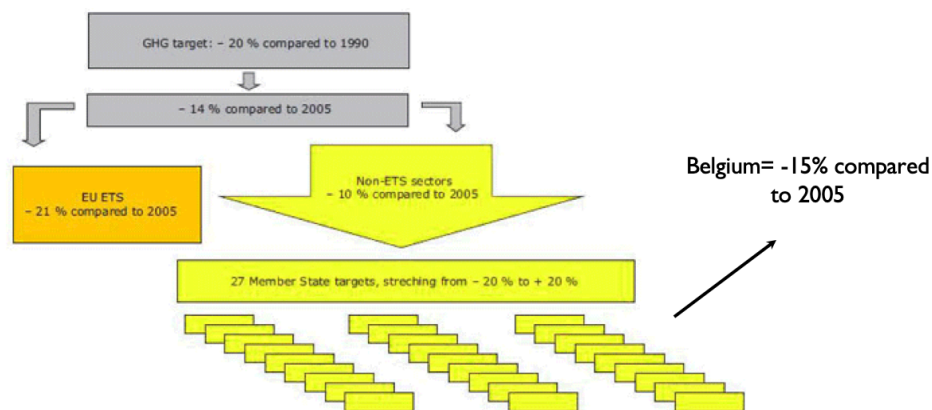
EU 20-20-20: reducing energy use, increase in share of renewable energy, reduction in GHG emissions

Key targets for 2030:

- at least 40% cuts in GHG emissions (1990 levels)
- at least 32% share of renewable energy
- at least 32,5% improvement in energy efficiency

ETS (-43%) and non-ETS (30%)

Green Deal: increase GHG target to -50% à -55%
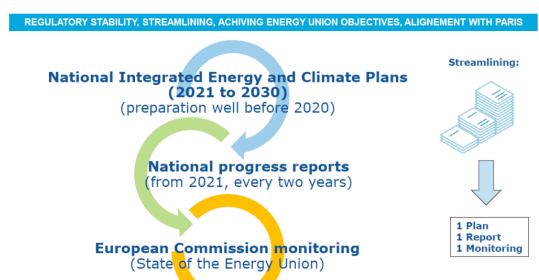
Structure: decarbonisation, energy efficiency, energy security, internal market, R&I and competitiveness

EMISSIONS TRADING SCHEME (ETS)

EU ETS: Emissions Trading Scheme ~ system of tradable emission permits for CO_2

- >11.000 energy-intensive installations (45% EU CO_2 emissions)
- sectors: electricity producers, iron and steel, glass, cement, brickworks and chemistry
- not included: transport and buildings

<u>ETS today:</u>

Agreement in European Parliament to review ETS (adopted February 2018)

- earlier start of the market stability reserve (MSR): by the end of NAP3 instead of 2021
- permits that were taken out of the market through backloading go directly in the MSR (likewise for unallocated allowances)
- goal: double the price of CO_2 by 2020 (17-35€/tonne CO_2)

COMPARISON

International cooperation proved far easier for the depletion of the **ozone layer** than for **climate change**... why?

1) Scientific evidence was much more rapidly accepted for ozone layer depletion than for climate change
2) Financial implications (larger for climate change
3) Problem substances are very different (ODS VS CO2)
4) No need for global intervention for ozone layer depletion (gas used in limited number of developed countries) → climate change: all countries need to help

WHAT'S NEXT?

radical change is needed - e.g. Belgium: -20% reduction since 1990, now we must aim for -50% per decade…

Rockström: feasible, if we really decide to go for it

important: rapid switch to renewable energy production ~ doubling of global capacity every 5 to 7 years…

CARBON TAXES

Taxes (e.g. on carbon)? ~ great idea, but what about effectiveness? when implemented?

- promoted since 1990s (environmental economists)
- calls from entrepreneurs
- recommendations from EC and OECD
- damage costs (SCC) vs. precautionary principle
- political difficulties vs. budget neutral operation

HLC ON CARBON PRICES

start from reduction trajectory & focus on reduction costs (different from Nordhaus' approach)

40-80$/tCO2 in 2020, 50-100$/tCO2 in 2030

important: clear pathway, "predictably flexible"

country-specific prices necessary?

complementary policy is needed (budget neutral) ~ revenues from carbon taxes should go to infrastructure, (re)distribution, renewable energy, R&D, …

IMPACT

Stiglitz: "all prices are wrong"…

40$/tCO2 ~ impact on prices?

- return flight to Berlin / NY: +12€ / +100€
- elasticity of demand
- how would you respond?

GOVERNMENTS

Major role for governments (global commons)

Investments in infrastructure, R&D, …

Financing?

- rethinking European budgetary controls?
- green QE through the European Investment Bank?
- sustainable finance (EC) ~ new risks (stranded assets?), mobilising private money, …

Important to have a clear long-term strategy, that guides short-term policy choices

$\Rightarrow$ climate law? (Belgium vs Green Deal)

Not one externality (GHG emissions), but also externalities with regard to R&D, capital markets, infrastructure (netwerk externalities, lock-ins), imperfect information for consumers, and lack of attention to co-benefits of CC policies

OPEN LETTER IN WSJ

- Carbon price that increases over time (pathway)
- Remove other policy targets - e.g. renewables
- Climate border tax (prevent carbon leakage and protect competitiveness)
- Climate dividends
- Other idea (Netherlands): climate club

FINALE

Paris: strong international commitment, sense of urgency, signal not to be dismissed

also: potential benefits from CC policy (often neglected in the debate)

Time to act is now ~ sense of urgency is strong (climate strikes, climate marches)

CC low on the Belgian / Flemish political agenda

BEHAVIOURAL CHANGE

- ⇒ individual behaviour
- ⇒ social norms and societal values
- ⇒ structural changes in the way we organise our societies

HOMO ECONOMICUS

Economists' view on human beings:

- focused on self-interest ~ maximize utility (consumers) or profits (producers)
- rational ~ act in correspondence to their preferences

Both ideas are being challenged - e.g. see paper of Steed, 2013 (nef) on Ufora

OBJECTIONS TO HOMO ECONOMICUS

Le Texier: Far from being a "homogeneous globule of desire and happiness" freely bargaining on markets the sale and purchase of physical commodities (Veblen, 1898), the human being is "an active person associated with others and participating in and controlled by the practices common to all" (Commons, 1925).

- ⇒ irrational behaviour, altruism, person-in-community, …

STEED (2013)

Challenge 1: are people really utility maximizers?

- people aren't selfish (e.g. the Dictator game)
- people are loss averse (e.g. WTA vs WTP estimates)
- people discount the future (see previous classes)
  people have a time preference, and tend to focus less on long-run impacts ~ pension savings

Challenge 2: do people make rational decisions?

- people are bad at computation when making decisions + not every decision is based on a complex optimization calculation
- people are biased (e.g. willing to spend more on charity helping one person vs. millions of people)
- dynamics of memory often affects how people and governments respond to risk
- people's decisions vary dramatically according to the emotional mood they are in

BEHAVOURIAL THEORIES

- self-efficacy ~ important element
- social learning and social cognitive theory
- reasoned action / planned behaviour
- transtheoretical or stages of change model

→ focus on different factors in attempting to explain behavioural change

core idea of both theories: "intentions" lead to "actions"

Theory of Planned Behaviour (= TPB)

Developed by prof. Izek Ajzen (University of Massachusetts) in the 1980s

Builds on his previous model of the Theory of Reasoned Action (TRA)

"intentions" lead to "actions"

Theory of Reasoned Action

one's intentions are formed by one's attitude and subjective norm towards performing a certain voluntary behaviour

attitude = our beliefs about and self-evaluation of the consequences of particular behaviour

subjective norm = our beliefs about what valued others expect of us

THEORY OF PLANNED BEHAVIOUR (= TPB)

TRA findings: not all behaviour is voluntary

hence: new factor was added in the TPB

> **perceived behavioural control** (PBC) = one's perception of his or her ability to perform a given behaviour

> > ⇒ PBC directly relates to both behavioural intentions and actual behaviour
> > ⇒ PBC ~ self-efficacy and controllability
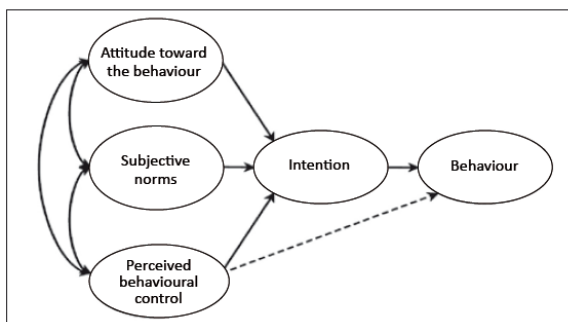
Source: Ajzen, I. (1991). Theory of planned behaviour. *Organizational Behaviour and Human Decision Processes, 50*, 182. http://dx.doi.org/10.1016/0749-5978(91)90020-T

FIGURE 1: Theory of Planned Behaviour.

General rules: one is more likely to perform a behaviour if…

- strong intentions
- strong attitudes
- strong subjective norm
- strong perceived behavioural control

TPB has been effective in predicting health-related behaviours, such as smoking, exercise, safe sex, … ~ researchers have been able to predict how people will react to these things or change their lifestyle, which helps in finding ways to improve health

SURVEY SUSTAINABLE DEVELOPMENT

- AY '18-'19: 41 respondents
- joined with data from last year (71 students)
- dataset with n = 112

DESCRIPTIVES

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Female	112	.00	1.00	.5714	.49710
Non-Belgian	112	.00	1.00	.5268	.50153
Renting a Room	112	.00	1.00	.8036	.39908
Over the last two weeks, I was ... – happiness	112	2.00	10.00	7.2232	1.66960
Taking everything in my life into account, I would say that I am ... – life satisfaction	112	2.00	10.00	7.3393	1.44916
Valid N (listwise)	112				

My relationship status:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I am in a stable relationship	47	42.0	42.0	42.0
	I am in a not so stable relationship(s)	3	2.7	2.7	44.6
	I am single and happy	44	39.3	39.3	83.9
	I am single but looking for a relationship	18	16.1	16.1	100.0
	Total	112	100.0	100.0	

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
I position myself in the political spectre: – economic: left wing (socialist) / right wing (liberal)	112	10.00	100.00	57.0268	20.05059
I position myself in the political spectre: – ethical: left wing (progressive) / right wing (conservative)	112	.00	100.00	37.0893	21.53001
During my childhood, my parents ... – talked about environmental issues	112	.00	85.00	41.1964	24.16566
During my childhood, my parents ... – acted in an environmentally sustainable way	112	.00	96.00	48.4732	21.66450
Valid N (listwise)	112				

Group Statistics

	Non–Belgian	N	Mean	Std. Deviation	Std. Error Mean
I position myself in the political spectre: – economic: left wing (socialist) / right wing (liberal)	Belgian	53	62.5094	17.38658	2.38823
	Non–Belgian	59	52.1017	21.12418	2.75013

Independent Samples Test

		Levene's Test for Equality of Variances				
		F	Sig.	t	df	Sig. (2–tailed)
I position myself in the political spectre: – economic: left wing (socialist) / right wing (liberal)	Equal variances assumed	2.288	.133	2.828	110	.006
	Equal variances not assumed			2.857	109.197	.005

I consider myself to be …

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	roman catholic	30	26.8	26.8	26.8
	islamic	3	2.7	2.7	29.5
	jewish	1	.9	.9	30.4
	other religious denomination	12	10.7	10.7	41.1
	atheist/non believer	66	58.9	58.9	100.0
	Total	112	100.0	100.0	

The neighbourhood in which I grew up (spent most of my time) was …

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	in the centre of a city	18	16.1	16.1	16.1
	suburban (at the side of a city)	39	34.8	34.8	50.9
	in the centre of a village	28	25.0	25.0	75.9
	on the countryside (in between villages/cities)	27	24.1	24.1	100.0
	Total	112	100.0	100.0	

ENVIRONMENTAL IMPACT: CARBON FOOTPRINT AND # DAYS WITH MEAT / FISH

Mean = 12.7
Std. Dev. = 4.067
N = 106

Mean = 4.33
Std. Dev. = 2.376
N = 112
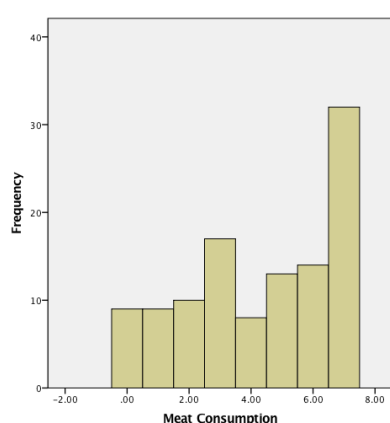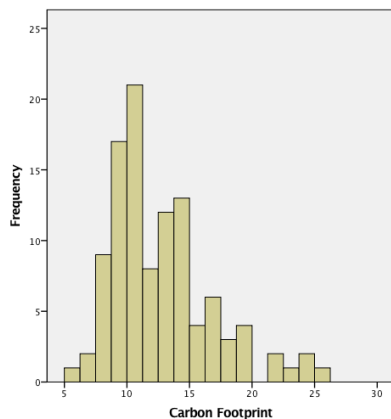
Meat Consumption

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	9	8.0	8.0	8.0
	1.00	9	8.0	8.0	16.1
	2.00	10	8.9	8.9	25.0
	3.00	17	15.2	15.2	40.2
	4.00	8	7.1	7.1	47.3
	5.00	13	11.6	11.6	58.9
	6.00	14	12.5	12.5	71.4
	7.00	32	28.6	28.6	100.0
	Total	112	100.0	100.0	

Correlations

		Carbon Footprint	CF_%Food	CF_%Home	CF_%Travel	CF_%Stuff
Carbon Footprint	Pearson Correlation	1	−.553**	−.021	.493**	−.382**
	Sig. (2−tailed)		.000	.831	.000	.000
	N	106	103	103	103	103
CF_%Food	Pearson Correlation	−.553**	1	−.202*	−.545**	.261**
	Sig. (2−tailed)	.000		.036	.000	.006
	N	103	108	108	108	108
CF_%Home	Pearson Correlation	−.021	−.202*	1	−.576**	−.127
	Sig. (2−tailed)	.831	.036		.000	.191
	N	103	108	108	108	108
CF_%Travel	Pearson Correlation	.493**	−.545**	−.576**	1	−.492**
	Sig. (2−tailed)	.000	.000	.000		.000
	N	103	108	108	108	108
CF_%Stuff	Pearson Correlation	−.382**	.261**	−.127	−.492**	1
	Sig. (2−tailed)	.000	.006	.191	.000	
	N	103	108	108	108	108

**. Correlation is significant at the 0.01 level (2−tailed).
*. Correlation is significant at the 0.05 level (2−tailed).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
CF_%Food	108	8.00	66.00	23.1204	10.58276
CF_%Home	108	1.00	64.00	23.5278	13.44595
CF_%Travel	108	.00	81.00	38.1481	18.12873
CF_%Stuff	108	1.00	39.00	15.1389	8.37381
Valid N (listwise)	108				

DETERMINANTS OF THE CARBON FOOTPRINT

Looking back on the survey you took last week, which determinants of the carbon footprint do you think we can identify in our dataset?

Home

- increasing urbanisation
- smaller / more energy efficient housing

Food

- flexitarianism
- city agriculture

Stuff

- sharing economy
- recycle / reuse / resell

Travel

- commuting
- air travel

Sustainably happy?
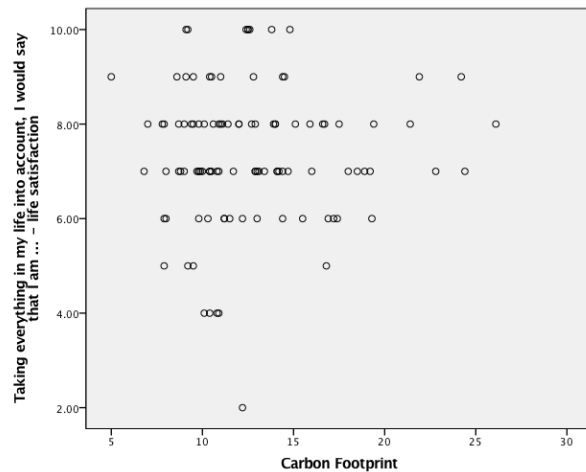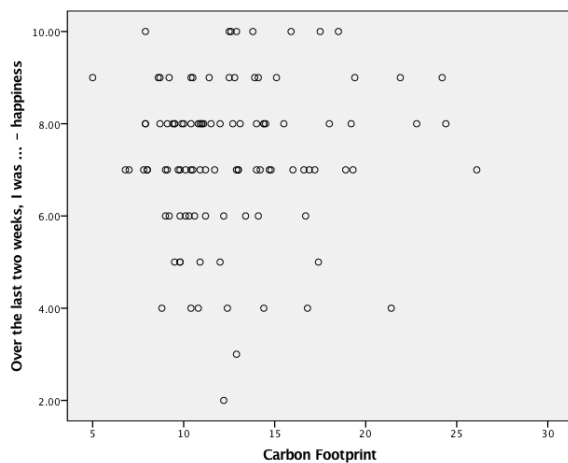
Correlations

		Carbon Footprint	Over the last two weeks, I was ... − happiness	Taking everything in my life into account, I would say that I am ... − life satisfaction
Carbon Footprint	Pearson Correlation	1	.074	.046
	Sig. (2−tailed)		.453	.643
	N	106	106	106
Over the last two weeks, I was ... − happiness	Pearson Correlation	.074	1	.523**
	Sig. (2−tailed)	.453		.000
	N	106	112	112
Taking everything in my life into account, I would say that I am ... − life satisfaction	Pearson Correlation	.046	.523**	1
	Sig. (2−tailed)	.643	.000	
	N	106	112	112

**. Correlation is significant at the 0.01 level (2−tailed).
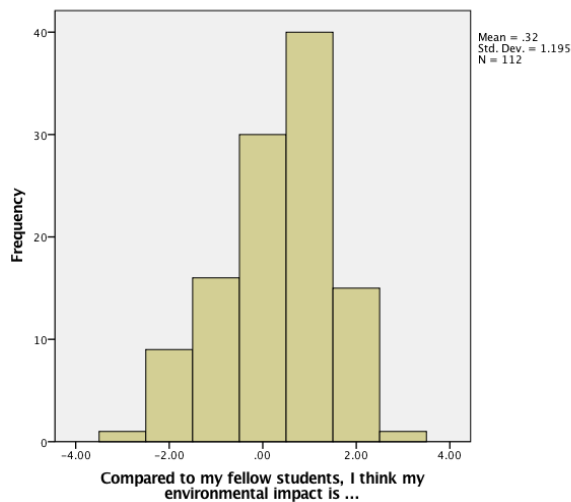
If all people living on the planet would have the same lifestyle as you, …

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	we would use less natural resources than provided for by our planet.	35	31.3	31.3	31.3
	we would use about all natural resources provided for by our planet.	32	28.6	28.6	59.8
	we would use more natural resources than provided for by our planet.	45	40.2	40.2	100.0
	Total	112	100.0	100.0	

Correlations

		Carbon Footprint	Compared to my fellow students, I think my environmental impact is …	If all people living on the planet would have the same lifestyle as you, …
Carbon Footprint	Pearson Correlation	1	.185	.082
	Sig. (2-tailed)		.057	.403
	N	106	106	106
Compared to my fellow students, I think my environmental impact is …	Pearson Correlation	.185	1	.168
	Sig. (2-tailed)	.057		.077
	N	106	112	112
If all people living on the planet would have the same lifestyle as you, …	Pearson Correlation	.082	.168	1
	Sig. (2-tailed)	.403	.077	
	N	106	112	112

Correlations

		Compared to my fellow students, I think my environmental impact is …	CF_%Food	CF_%Home	CF_%Travel	CF_%Stuff
Compared to my fellow students, I think my environmental impact is …	Pearson Correlation	1	−.090	−.119	.130	−.066
	Sig. (2-tailed)		.354	.221	.180	.498
	N	112	108	108	108	108
CF_%Food	Pearson Correlation	−.090	1	−.202*	−.545**	.261**
	Sig. (2-tailed)	.354		.036	.000	.006
	N	108	108	108	108	108
CF_%Home	Pearson Correlation	−.119	−.202*	1	−.576**	−.127
	Sig. (2-tailed)	.221	.036		.000	.191
	N	108	108	108	108	108
CF_%Travel	Pearson Correlation	.130	−.545**	−.576**	1	−.492**
	Sig. (2-tailed)	.180	.000	.000		.000
	N	108	108	108	108	108
CF_%Stuff	Pearson Correlation	−.066	.261**	−.127	−.492**	1
	Sig. (2-tailed)	.498	.006	.191	.000	
	N	108	108	108	108	108

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

THEORY OF PLANNED BEHAVIOUR

Attitudes

Correlations

		Compared to my fellow students, I think my environmental impact is …	CF_%Food	CF_%Home	CF_%Travel	CF_%Stuff
Compared to my fellow students, I think my environmental impact is …	Pearson Correlation	1	−.090	−.119	.130	−.066
	Sig. (2-tailed)		.354	.221	.180	.498
	N	112	108	108	108	108
CF_%Food	Pearson Correlation	−.090	1	−.202*	−.545**	.261**
	Sig. (2-tailed)	.354		.036	.000	.006
	N	108	108	108	108	108
CF_%Home	Pearson Correlation	−.119	−.202*	1	−.576**	−.127
	Sig. (2-tailed)	.221	.036		.000	.191
	N	108	108	108	108	108
CF_%Travel	Pearson Correlation	.130	−.545**	−.576**	1	−.492**
	Sig. (2-tailed)	.180	.000	.000		.000
	N	108	108	108	108	108
CF_%Stuff	Pearson Correlation	−.066	.261**	−.127	−.492**	1
	Sig. (2-tailed)	.498	.006	.191	.000	
	N	108	108	108	108	108

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Inter-Item Correlation Matrix

	In my opinion, it is important to protect the environment.	I am concerned about the long-term future of the environment.	In my opinion, it is important to conserve natural resources.	I actively practice environmental sustainability at home.	Everyone is responsible for caring for the environment.
In my opinion, it is important to protect the environment.	1.000	.528	.474	.284	.269
I am concerned about the long-term future of the environment.	.528	1.000	.352	.319	.153
In my opinion, it is important to conserve natural resources.	.474	.352	1.000	.298	.304
I actively practice environmental sustainability at home.	.284	.319	.298	1.000	.116
Everyone is responsible for caring for the environment.	.269	.153	.304	.116	1.000

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
In my opinion, it is important to protect the environment.	23.28	7.806	.573	.389	.560
I am concerned about the long-term future of the environment.	23.79	6.489	.469	.317	.564
In my opinion, it is important to conserve natural resources.	23.60	7.450	.508	.292	.562
I actively practice environmental sustainability at home.	25.04	6.377	.355	.146	.643
Everyone is responsible for caring for the environment.	23.51	7.856	.264	.112	.662

Subjective norms

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
In my opinion, it is important to protect the environment.	23.28	7.806	.573	.389	.560
I am concerned about the long-term future of the environment.	23.79	6.489	.469	.317	.564
In my opinion, it is important to conserve natural resources.	23.60	7.450	.508	.292	.562
I actively practice environmental sustainability at home.	25.04	6.377	.355	.146	.643
Everyone is responsible for caring for the environment.	23.51	7.856	.264	.112	.662

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.894	.895	7

Perceived control

Item Statistics

	Mean	Std. Deviation	N
It is my decision whether or not to perform environmentally sustainable activities.	5.31	1.107	112
I have the ability to carry out environmentally sustainable activities.	5.09	1.095	112
I have control over my actions to support the environment.	5.08	1.058	112
I have control over performing environmentally sustainable activities.	5.02	1.082	112
It is easy for me to perform environmentally friendly activities.	4.50	1.082	112

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.730	.732	5

Intentions

Item Statistics

	Mean	Std. Deviation	N
I intend to seek out more opportunities to be more environmentally active in the future.	5.4643	1.13048	112
I plan to increase environmentally sustainable activities in the future.	5.3125	1.17811	112
I do NOT expect to increase my level of support for the environment (reversed)	5.5714	1.33366	112
In the future, I plan to look into how I can play a greater role in protecting the environment.	5.2857	1.27646	112

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.853	.855	4

Scales: descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Attitudes	112	4.60	7.00	5.9607	.64310
SubjectiveNorm	112	1.57	6.86	4.6901	.99713
PBC	112	3.00	6.80	5.0000	.75265
Intentions	112	1.25	7.00	5.4085	1.02612
Valid N (listwise)	112				

TPB: equation 1

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	−1.283	.660		−1.944	.054		
	Attitudes	.900	.134	.564	6.719	.000	.644	1.554
	SubjectiveNorm	.188	.085	.182	2.218	.029	.671	1.490
	PBC	.089	.115	.065	.775	.440	.636	1.571

a. Dependent Variable: Intentions

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.714[a]	.510	.496	.72822

a. Predictors: (Constant), PBC, SubjectiveNorm, Attitudes

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	59.601	3	19.867	37.463	.000[b]
	Residual	57.274	108	.530		
	Total	116.874	111			

a. Dependent Variable: Intentions
b. Predictors: (Constant), PBC, SubjectiveNorm, Attitudes

TPB: Equation 2 (Meat)

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	11.183	1.456		7.680	.000		
	Intentions	−.846	.223	−.365	−3.794	.000	.788	1.269
	PBC	−.455	.304	−.144	−1.496	.137	.788	1.269

a. Dependent Variable: Meat Consumption

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.450[a]	.203	.188	2.14104

a. Predictors: (Constant), PBC, Intentions

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	127.116	2	63.558	13.865	.000[b]
	Residual	499.661	109	4.584		
	Total	626.777	111			

a. Dependent Variable: Meat Consumption
b. Predictors: (Constant), PBC, Intentions

TPB: Equation 2 (Carbon footprint)

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	18.976	2.750		6.901	.000		
	Intentions	.318	.423	.080	.751	.454	.792	1.263
	PBC	−1.600	.569	−.300	−2.812	.006	.792	1.263

a. Dependent Variable: Carbon Footprint

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.273[a]	.074	.056	3.950

a. Predictors: (Constant), PBC, Intentions

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	128.978	2	64.489	4.132	.019[b]
	Residual	1607.381	103	15.606		
	Total	1736.358	105			

a. Dependent Variable: Carbon Footprint

b. Predictors: (Constant), PBC, Intentions

TPB: Meat consumption

TPB: Carbon footprint