



Chapter– 2  
Global impact  
inequality

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Ecole  
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de Lausanne

**EPFL**

- Productive base, GDP and sustainable development
- The global impact inequality (focus on natural capital)

# ECOLOGICALLY SUSTAINABLE ECONOMIC POLICY IN THE 2020s

1 June 2022

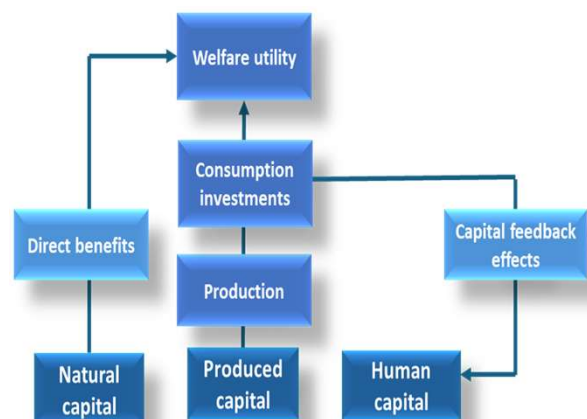
Kuva: Niccolò Caranti



## GDP *versus* the productive base

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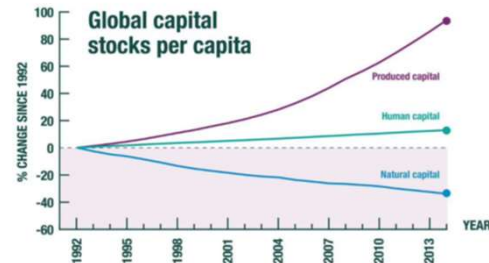
- GDP/capita has increased dramatically and it is not just a statistical artefact – it reflects material progress – however it does not measure some of the cost of economic growth and so provide only a partial and rather wrong measure of the wealth of nations
- GDP is a gross measure which does not integrate capital assets decumulation
- **Productive base** : stock of capital assets on which an economy is undertaking its operation
  - manufactured (technologies) – roads, ports, machines, etc
  - human – population, knowledge & skills acquired by education, health
  - natural – include ecosystems in general
- **Inclusive wealth** reflects the social value of its stock of manufactured, human and natural capital = the accounting value of the stock of all assets



## GDP *versus* the productive base

EPFL

- Inclusive wealth reflects the social value of its stock of manufactured, human and natural capital = the accounting value of the stock of all assets
- What we observe is a significant trend of a decumulation of natural capital
- By one UN estimate, in the period 1992 – 2014, the global stock of produced capital per capita doubled and the stock of HC per capita increased by some 20%, but NC per capita declined by 40%

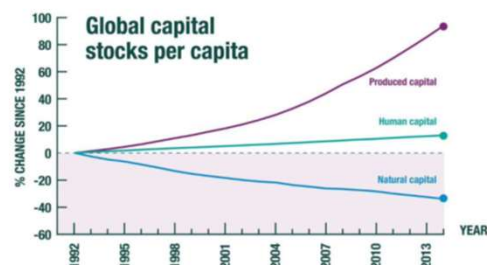


Yet GDP as a flow does not record depreciation of capital

## Productive base and GDP – a growing gap

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- An economy's productive base will shrink if its stock of capital assets depreciate and the economy is not able to improve sufficiently to compensate for that depreciation
- It is possible for a country's productive base to shrink during a period when GDP grows
- But nobody will notice it if every's eyes are riveted on GDP
- GDP growth reflects an extraordinary enrichment which is partially artificial



## Productive base and sustainable development

- « A development that meets the needs of the present without compromising the ability of the future generations to meet their own needs » (Brundtland Report)
- GDP cannot be used to measure sustainability (since it is a gross measure – doesn't account for capital decumulation). Let's use the concept of productive base:
- Sustainable development requires that relative to their population each generation provide to the next ones at least as large **productive base** as it has itself inherited
  - Weak principle of intergenerational justice: next generation has no less – it demands nothing more
- This does not mean the relative proportions of the various types of capital assets should remain fixed
- A productive base declines if the decumulation of assets is not **compensated** by the accumulation of other assets.
- Numerous cases of technologies and labour compensating for the decline of natural capital – Water: better irrigation systems, intelligent distribution networks, desalination
- But compensation works only up to a certain point
  - If you don't have water anymore or too little – there is nothing to recycle, manage, optimize

## Why such divergence between GDP and productive base is happening? EPFL

- Many innovations have both a positive effect on GDP and a negative effect on the productive base – e.g. innovations in industrial fisheries
- Huge effect on productivity (output per workers) and GDP but also on resources depletion, ecosystems destruction, species extinction.
- While industrial fishing companies are facing a set of costs that they try to minimize, they don't have to bear the cost of *consuming the ocean*; this cost is an **externality**
- For many natural resources such as the ocean, externalities are massive because markets not only dysfunctional, they don't even exist
  - Open access resources; ill-specified or unprotected property rights; large temporal distance between cause and effects..
  - ..prevent markets to be formed
- **We don't pay for what we use**
  - The industry doesn't pay for depleting the resource – hence tendency to over fishing and over consuming which can lead to a tragedy of the commons.
- GDP/capita increases while the productive base is shrinking but nobody would notice it if every one's eyes were riveted on GDP

## Negative externalities



- **A phenomenon that arises when an individual or a firm takes an action but does not bear all the costs**
- Examples – firms and consumers use intensively the ocean - for transportation, leisure cruises, deep sea fishing and as a sink for pollutants from land – and thereby inflict great stress on it.
- There are huge environmental costs - enormous pressures on ocean ecosystem while oceans are vital for our existence - which remain **external**
- Companies pay for labour (wages), equipment (ships), energy (fuel), using the port infrastructure (tax), but not for “consuming” the ocean
- **Concerning natural resources – in most cases, we don’t pay for what we use**
- In presence of externalities - we don’t pay for our use of Nature – we are not interested in managing and economizing on it and tend to overuse it
- What we pay for, we manage, what is freely available, we don’t manage



*A negative effect which is not paid by the one generating it and not compensated for those who are suffering from it: the effect remains “external”  
Why perfect internalisation does not happen spontaneously?*

- **A car factory generates toxic discharges** - All resources used to produce cars (steel, labour, machineries) have a price as they are traded on a market – the factory has the correct incentives to economize on them.
  - It can economize on people (automation), on steel (process innovation), on energy (process efficiency & optimization)
- One resource ‘used’ has no price; hence there is no incentives to economize it: **clean air**
- The factory destroys the resource – clean air – but does not pay for it
- This means that the factory will not consider the full cost of its activity – one cost is external (it is transferred to society)
- Hence the firm will not try to correct the problem through innovation and will prefer the status quo : a situation where its private cost is lower (the cost of clean air destruction is not included) than the full social cost it generates

## Cleaning the ocean

EPFL

- Ocean is a global commons or open-access resources (the seas beyond exclusive economic zones)
- Huge activities – ocean transportation – deep sea fishing, cruises, pollutants emanating from land – by companies and communities which don't pay for what they use
- Even worse, deep sea and industrial fishing are heavily subsidized by governments (1.2 Billions/year in the EU) – That amounts to negative price for the ocean
- Because **we don't pay for what we use and we subsidize harmful activities**, we overshoot the resilience capacities of the ocean ecosystem



Stratégies de Spécialisation Intelligente

## Pay for what we use!

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All prices (of products and services) need to reflect the full costs – including external (environmental, etc..) costs: pay for what we use!

- « *If we did, then the system of prices people face would be so different from what it is today that technological change would display a very different character: new technologies and new activities would be far less rapacious of nature* » Dasgupta
- It will become more costly to pollute, to do overfishing, to build another highway or even to market unhealthy funds (full cost includes here public health)..
- **Two big issues** (focus on global ecosystem – ocean, forest..)
  - Cost estimation - the cost of "consuming" an ecosystem = how much should we pay for it?
  - Institutional mechanism: implementing payment systems for consuming global public goods requires global agencies empowered with legal and technological capacities to evaluate damages, identify who is responsible and impose taxations



- Productive base, GDP and sustainable development
- The global impact inequality (focus on natural capital)



## Global impact inequality -- reading 1

$$Ny/\alpha > G(S)$$

An accounting statement on the state of earth ecosystem at a moment in time

$N$  = global pop

$Y$  = global GDP/capita

$\alpha$  = the efficiency through which natural resources are transformed into final products and services

$Ny/\alpha$  = the aggregate demand for Nature's services or a measure of humanity's ecological footprint

$G$  = biosphere net regeneration rate

$S$  = stock of natural capital

$G$  is a function of  $S$  –  $G$  can be made to increase by allowing  $S$  to increase

The size of the inequality is a measure of humanity's ecological overshoot.

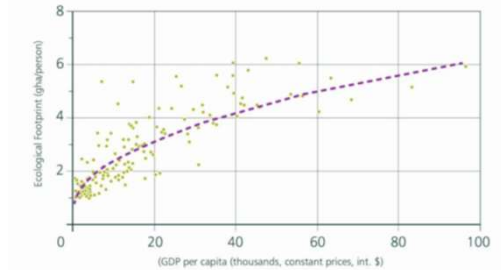
By some estimates the ratio of our demand for natural resources to nature capacity to meet that demand on a sustainable basis is 1.7 – hence the metaphor that we need 1.7 earths to meet our demands

Decrease  $N$ , decrease  $y$ , increase  $\alpha$ , raise  $S$  and therefore  $G$

## Closing the inequality - $Ny/\alpha > G(S)$

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- Reducing  $Ny$ 
  - $N$  – a long run trend – supported by social policies (family planning, reproductive health, education)
  - $y$  – problems within problems
- Increasing  $\alpha$
- Increasing  $G(S)$



We need a growing  $y$  or GDP/capita for:

- Eradicating poverty
- Securing a reasonable rate of material progress for all
- Democratizing our greatest achievements
- Redistribute wealth from rich to poor and keep GDP/capita constant (fiscal policy)
- Mitigate the effects of a growing GDP/capita –how the extra money is spending? This is about  $\alpha$

## Closing the inequality - $Ny/\alpha > G(S)$

EPFL

- Reducing  $Ny$
- Increasing  $\alpha$ 
  - Innovation is crucial
  - But  $\alpha$  cannot be increased indefinitely
- Increasing  $G(S)$
- Discrete innovations
  - better solar panels, more efficient wind turbines, more powerful batteries, hydrogen trucks, new business models in circular economy
- System's transformation
  - establishing a circular economy in the food industry, developing a sustainable mobility system in Lausanne
- Drive:
  - Factor's substitution (e.g. scarce water x improved distribution infrastructure, desalination of sea water)
  - Efficiency (e.g. higher energy efficiency of buildings)
  - Recycling (e.g. waste, products, materials)
  - Management (e.g. forestry, land use, agriculture)

## Closing the inequality - $N_y/\alpha > G(S)$



- Reducing  $N_y$
- Increasing  $\alpha$ 
  - Innovation is crucial
  - But  $\alpha$  cannot be increased indefinitely
- Increasing  $G(S)$

**From:** Partha Dasgupta <partha.dasgupta@econ.cam.ac.uk>  
**Sent:** Monday, August 12, 2024 5:42 PM  
**To:** Dominique Foray <dominique.foray@epfl.ch>  
**Subject:** RE: special issue of EINT in memory of Paul David  
 Dear Dominique,

Many thanks for your email. The matter regarding the efficiency term  $\alpha$  is not related to whether one is a pessimist or optimist; it's an analytical issue. Raising  $\alpha$  involves investment, and to assume that  $\alpha$  can in principle approach infinity over time would be to assume that in the long run the human economy at the margin can free itself from the biosphere, which is another way of saying that asymptotically there will be no additional resource costs in raising  $\alpha$ . Why not then start by assuming  $\alpha$  can move toward infinity exogenously. But if we were to assume that, we could as well assume that there are no costs in raising  $\alpha$ , meaning that we are at one with endogenous growth theorists who claim that if we invest sufficiently, we can enjoy indefinite GDP growth.

I hope this helps.

Warm regards.

Partha

## Closing the inequality - $N_y/\alpha > G(S)$



- Reducing  $N_y$
- Increasing  $\alpha$
- Increasing  $G(S)$ 
  - Raising  $G(S)$  is about investing in Nature – allowing Nature to grow
  - Raising shadow prices of Nature's services
- Investing in Nature is passive in most cases – waiting for its health to improve.
- But waiting is costly, so wetlands, grasslands and forests are at constant threat from bull dozers, drills and chain saws
- Should the preservation of a local forest scupper plans for the development of a new road? The economic case of a new road seems irrefutable.
- It depends how you measure the value (social productivity) and price the local ecosystem
- Estimating social productivity  $\sigma$  (the value of the flow of services provided to society) and social scarcity (or shadow) prices is the relevant approach – although such estimation is a formidable problem
- If shadow or social scarcity price increases relative to produced capital, the waiting may not be costly and restoring the wetland may be a better economic decision than constructing a road

## Closing the inequality - $Ny/\alpha > G(S)$



- Reducing  $Ny$ 
  - $N$  – a long run trend – supported by social policies (family planning, reproductive health, education)
  - $y$  – problems within problems – poverty, equal access to the essential elements of daily life comfort – great achievements (mobility, communication, etc.) for all – need for creating economic opportunities for billions of young people
- Increasing  $\alpha$ 
  - Innovation is crucial – produced capital compensates for natural capital (or human capital) decumulation (substitution, management, efficiency, recycling, medical progress)
  - But  $\alpha$  cannot be increased indefinitely
- Increasing  $G(S)$ 
  - A fundamental distinction – provisional good vs repairing & maintenance services
  - Raising  $G(S)$  is about investing in Nature – allowing Nature to grow
  - Raising shadow prices of Nature's services

## Good innovation economics for hard times



### $Ny/\alpha > G(S)$

For short and medium term results, we need to address both  $\alpha$  and  $G(S)$

And we need to “discover” what is feasible

Banning flight is just unrealistic – generating green innovation for air transportation is feasible

Transformation Innovation Policy is a discovery process

## Investing in innovations & investing in Nature



### Increasing $\alpha$ (many routes)

« Due to technological trajectories set in motion by past policy, a global irreversible solar tipping point may have passed where solar energy gradually comes to dominate global electricity markets without any further climate policies » (Nature, 2023)



### Investing in G(S)

Stopping deforestation

Investing in Nature can be passive – just let Nature recover and grow – but passive does not mean cheap – then we need to estimate the economic value of Nature (e.g. social productivity) to manage it as a capital asset



## To cap it all

- Negative externalities lead to overexploitation of Nature and a decumulation of the stock of natural capital (depletion, overuse, enormous strain on ecosystems)
- Because environmental costs are not internalized, they are not subtracted from revenues and GDP growth does not reflect that at the same time the productive base is shrinking
- A country can grow its GDP while the productive base is shrinking and no one will note it if everyone is watching GDP figures
- Our Dealings with the various forms of capital are full of negative externalities
- Minimizing negative externalities implies putting a value on what is subject to the negative externalities or estimating the cost of the effect (damage, abatement, avoidance)
- **Paying for what we use is crucial but not sufficient – as facing new cost structures**
  - firms will need new (cleaner) technologies or business models,
  - consumers need to shift to responsible consumption and new social norms

