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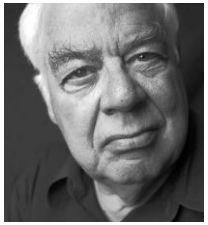
„A lack of commitment in practice easily leads to hallucinations in theory.“



Richard Rorty (1931 – 2007)

Economic Growth, Structural Change and Transformation: What's important now?

Andreas Pyka

Istanbul, May 12th 2022

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Starting Point and Objective

- Our prevailing economic understanding of a sustainable re-design of economies is based on the idea of **substitution**.
- This perspective falls short of a better and thorough intellectual apprehension of the required multiple dimensions in the transformation towards higher degrees of sustainability.
- To improve on this, and for the design of promising new policy-strategies for this transformation, we need to distinguish between economic growth, structural change and transformation.

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Economic Development is characterized by three different but mutually influencing dimensions:

- Economic Growth → quantitative dimension
- Structural Change → qualitative dimension
- Transformation → paradigmatic dimension

All these processes take place simultaneously (Saviotti, Pyka, Jun (2019), JEEC and Pyka, Urmetzer (2019), UN Handbook)

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Example: The Bioeconomy

As defined by the German government, the bioeconomy encompasses the production, development and use of biological resources, processes and systems to provide products, processes and services in all economic sectors as part of a sustainable economic system. It holds the potential for sustainable solutions that conserve resources while creating prosperity.

Bundesministerium für Bildung und Forschung

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The prevailing view on the Bioeconomy builds on traditional engineering and neoclassical economic perspectives:

- Efficiency considerations are decisive (e.g. questions of scaling-up).
- The neoclassical paradigm with its orientation towards economic growth shapes our reasoning (i.e. increasing incomes, securing jobs etc.).
- Sustainability orientation certainly plays a role today, but must assert itself within this framework (green washing etc.).

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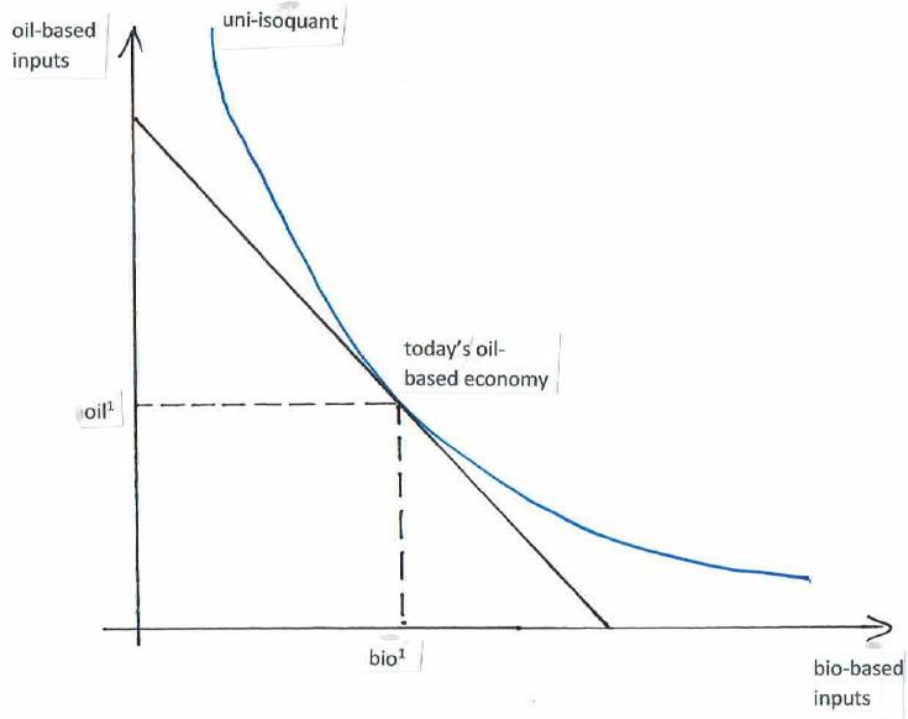
Supply side-substitution along the oil-bio-isoquant

Depending on the relative prices p^{bio}/p^{oil} an optimal (*cost-minimizing*) technology is chosen.

To increase the bio-based share, the substitution perspective asks for lower prices of bio-based inputs:

→ process innovation to increase production efficiency

→ subsidies to accelerate substitution



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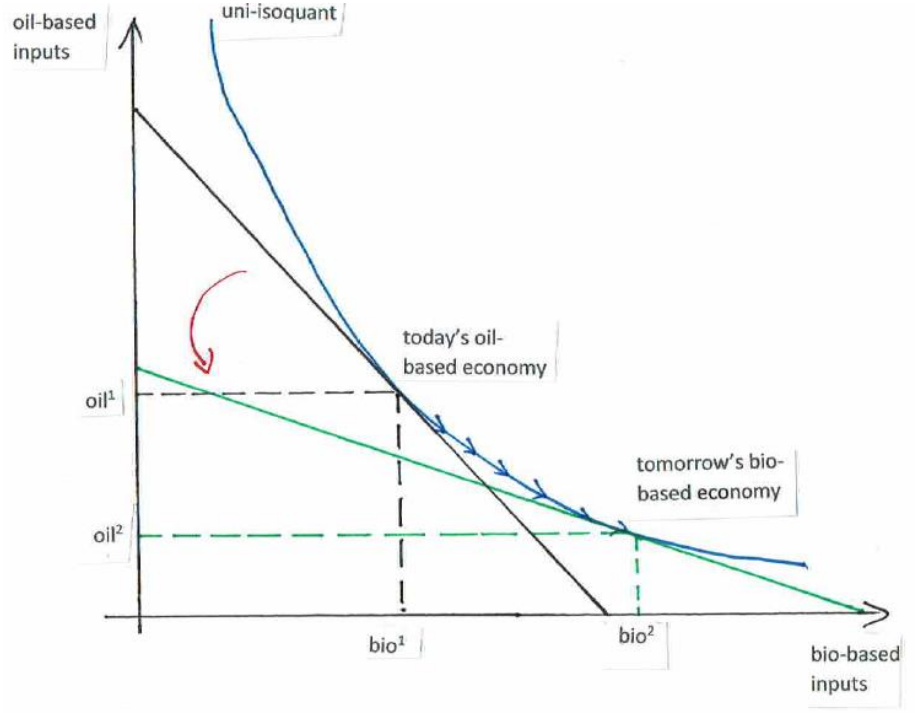
Supply side-substitution along the oil-bio-isoquant

Step-by-step substitution of oil-based technologies by bio-based technologies (price competition decides).

The bioeconomy is gradually assuming a greater role in the national economy, following the cost trend.

Nothing changes in terms of economic output (same isoquant). **Simple** (mechanical) equilibrium-oriented system).



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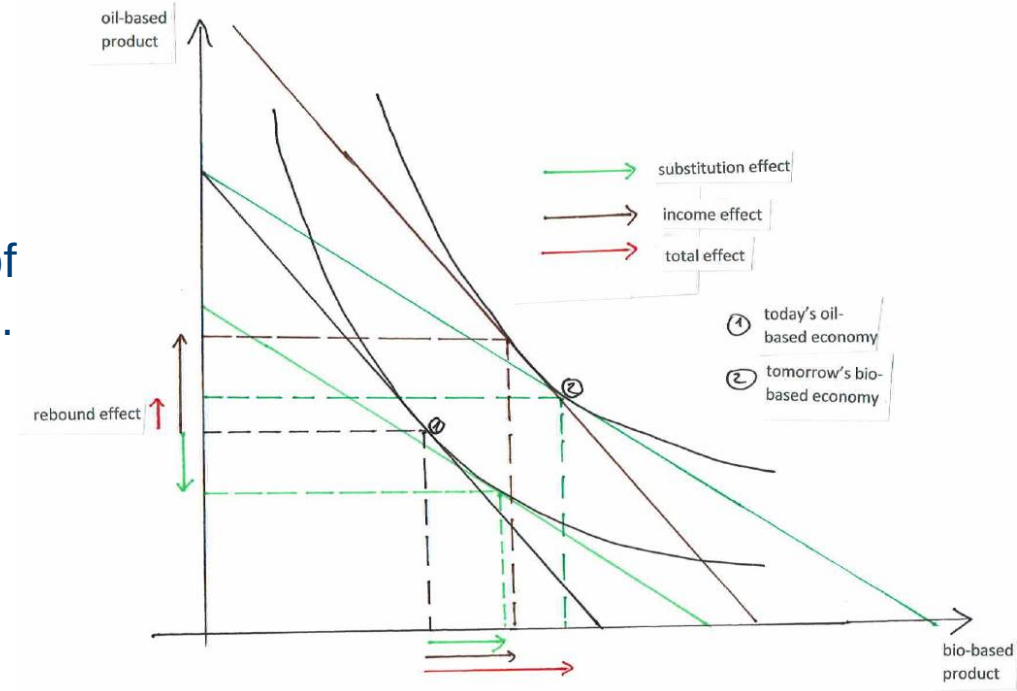
Substitution for consumers

Consumers buy more bio-based products if the price is decreasing.

Nota bene: This is not an expression of a higher valuing of bio-based products. The preferences remain unchanged.

→ rebound effects are possible!



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The Substitution Approach

- Gradually, the share of the bioeconomy will increase due to successful (= cost-reducing = price decreasing) innovations. There is, however, no significant influence either on value creation chains and economic structures (sector composition) nor consumer preferences or the emergence of new life styles (as an expression of appreciation and learning).
- For example, bioplastics substitute conventional plastics: Unchanged production becomes possible with fewer greenhouse gas emissions and fewer oil-based raw materials.
- Economic growth is possible (*more of the same*). But be aware of rebound effects.

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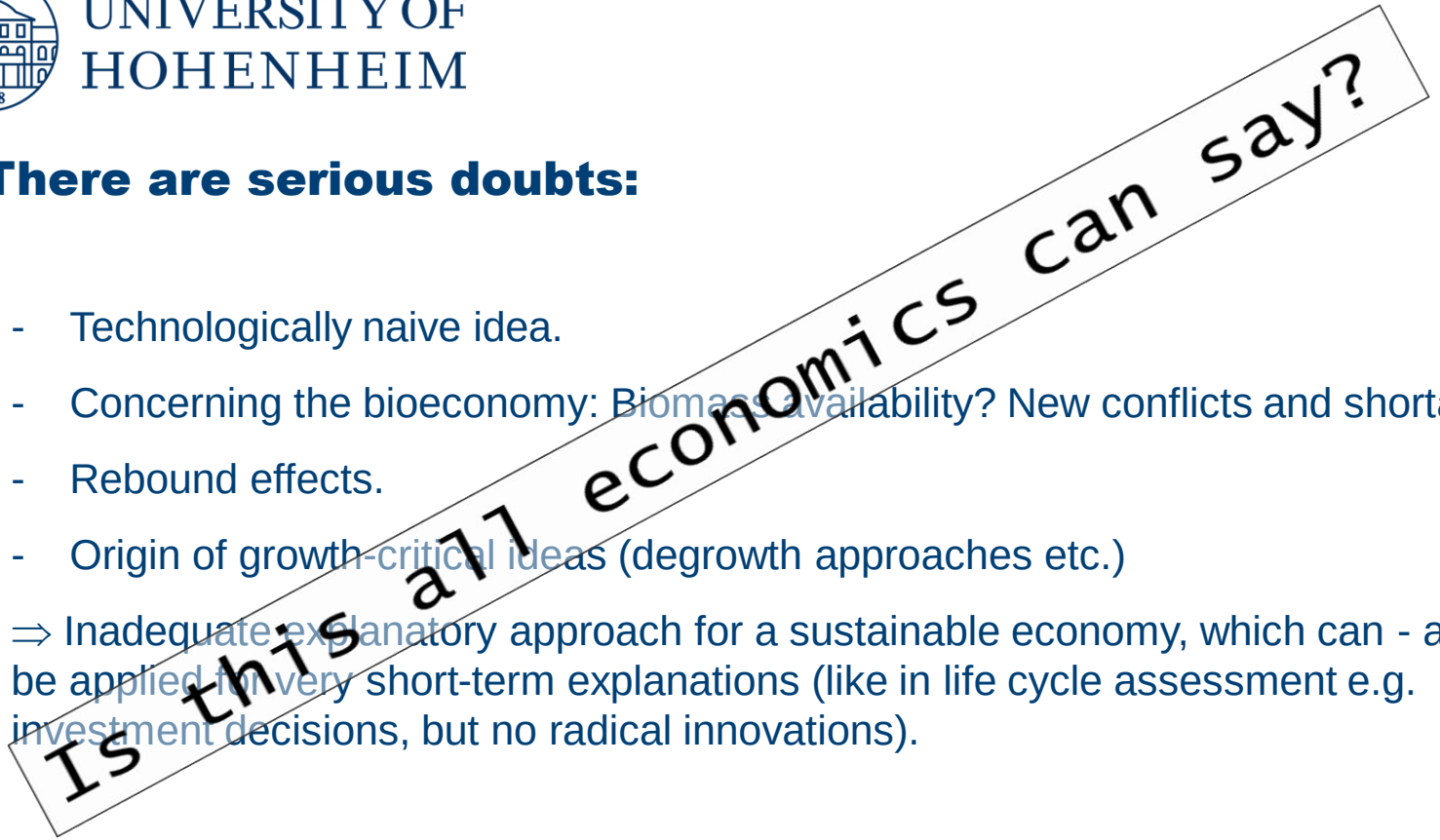
There are serious doubts:

- Technologically naive idea.
- Concerning the bioeconomy: Biomass availability? New conflicts and shortages.
- Rebound effects.
- Origin of growth-critical ideas (degrowth approaches etc.)

⇒ Inadequate explanatory approach for a sustainable economy, which can - at best - be applied for very short-term explanations (like in life cycle assessment e.g. investment decisions, but no radical innovations).



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Modern approaches from evolutionary innovation economics

- Optimization considerations are replaced by approaches that rely on experimental behavior (learning) of the actors (innovation competition instead of price competition, long-term perspective).
- The quantitative dimension (per capita income) is replaced by a qualitative dimension (diversity, structural change and development).
- Innovation thus takes on a complete new meaning: economic growth becomes economic development. Structural change is driven by innovations and the emergence of new industries.
- The simple systems of neoclassical economics become the complex systems of evolutionary economics.

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"But in capitalist reality as distinguished from its textbook picture, it is not that kind of competition which counts but the competition from the new commodity, the new technology …. This kind of competition is as much more effective than the other as a bombardment is in comparison with forcing a door, and so much more important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly;" **Schumpeter**, J.A. CSD, 1943

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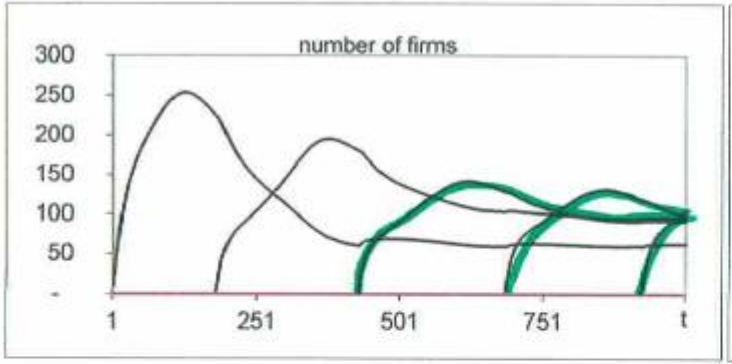
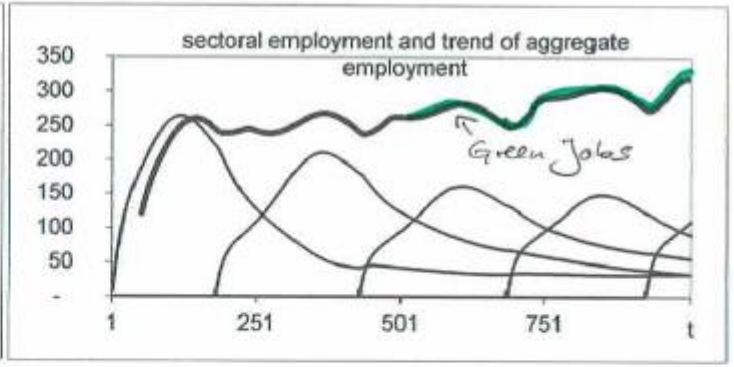
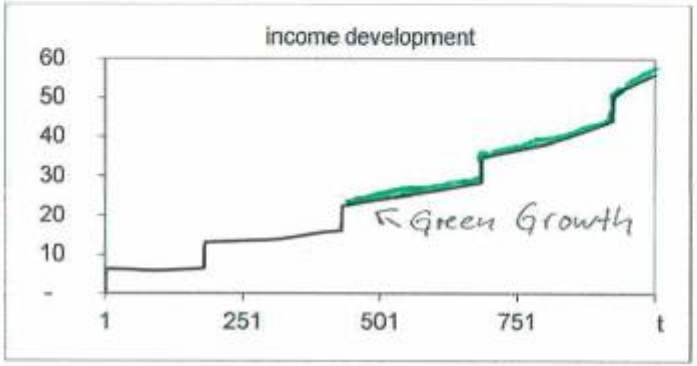
Structural Change and Qualitative Development







- Economic Development as a sequence of overlapping industry life cycles.
- New green sectors replace or co-exist with fossil-based industries.
- Despite fluctuations, the economic system remains resilient and effective.

Pyka und Saviotti, 2011, 2020

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Criticism against the evolutionary economics approach

- The evolutionary economics approach is also based on the traditional growth-oriented paradigm. The major advantage is, that with innovation competition, long-term considerations come into play.
- Innovation systems are the infrastructure of creative knowledge flows and explain the resilience of capitalistic organized economies which remain powerful innovation engines despite severe fluctuations.
- **The other side of the resilience coin is the fact that also deeply undesirable system patterns of socioeconomic systems, that produce, among others, economic inequalities or environmental degradation tend to linger and are extremely hard to overcome**.
- It remains unclear how sustainability considerations can create space and what changing role consumers have to play.

Good. But is this all economics can say?

⇒ For a sustainable economic organization, the focus on supply-side innovation competition falls short.

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A closer look on the idea of innovation systems:

An i**nnovation system** “can be thought of as a system which creates and distributes knowledge, utilizes this knowledge by introducing it into the economy in the form of innovations, diffuses it and **transforms it into something valuable**, for example, international competitiveness and economic growth”. (Gregersen and Johnson (1997))

Until recently, the question of what exactly ‘**something valuable**’ is, has not been raised. The exclusive focus on economic growth is a paradigmatic constant.

→ we need a paradigmatic change, in other words: sustainability requires a paradigmatic implementation.

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Characteristics of Innovation Systems

- Innovation is knowledge-based (mutual learning, searching, exploring in innovation networks).
- Innovation follows evolutionary trajectories (history and geography matter, no optimal solutions, feedback effects, lock-in effects, path dependencies …).
- Innovation is a complex processes (punctuated equilibria, threshold effects, temporary stable patterns and disruptive phase transitions).

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Limits of conventional innovation systems

- The idea of innovation systems is to strengthen the innovation performance and with it competitiveness. This was considered to be a powerful tool for fighting against overall increasing unemployment rates in the 1980s and 90s.
- The system boundaries are tight and despite the systemic orientation, a focus on economic systems as well as their exploitation (and path dependent exploration) is prevailing.

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Limits of conventional innovation systems

- While the IS perspective guides science, technology, and innovation policies, sustainability issues are often not considered at all or remain decorative add-ons.
- No surprise, as there was only limited awareness of climate change and sustainability when the concept was developed in the 1980s.
- Innovation is considered as the panacea to cure all social, economic and ecological problems.

→ **The Directionality Dilemma**: But how can innovation – a process characterized by true uncertainty – be harnessed to serve sustainability related solutions?

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Transformation approaches: a research program for complexity economics

- Beyond so-called tipping points complex systems lose their resilience and irreversible major pattern changes might occur.
- The famous planetary boundaries are tipping points in our ecological and climate systems. Surpassing them is not recommended.
- Our economic systems also have tipping points and surpassing them allows for paradigmatic changes to irreversibly overcome undesirable patterns.
- Example: The golden Age of Capitalism

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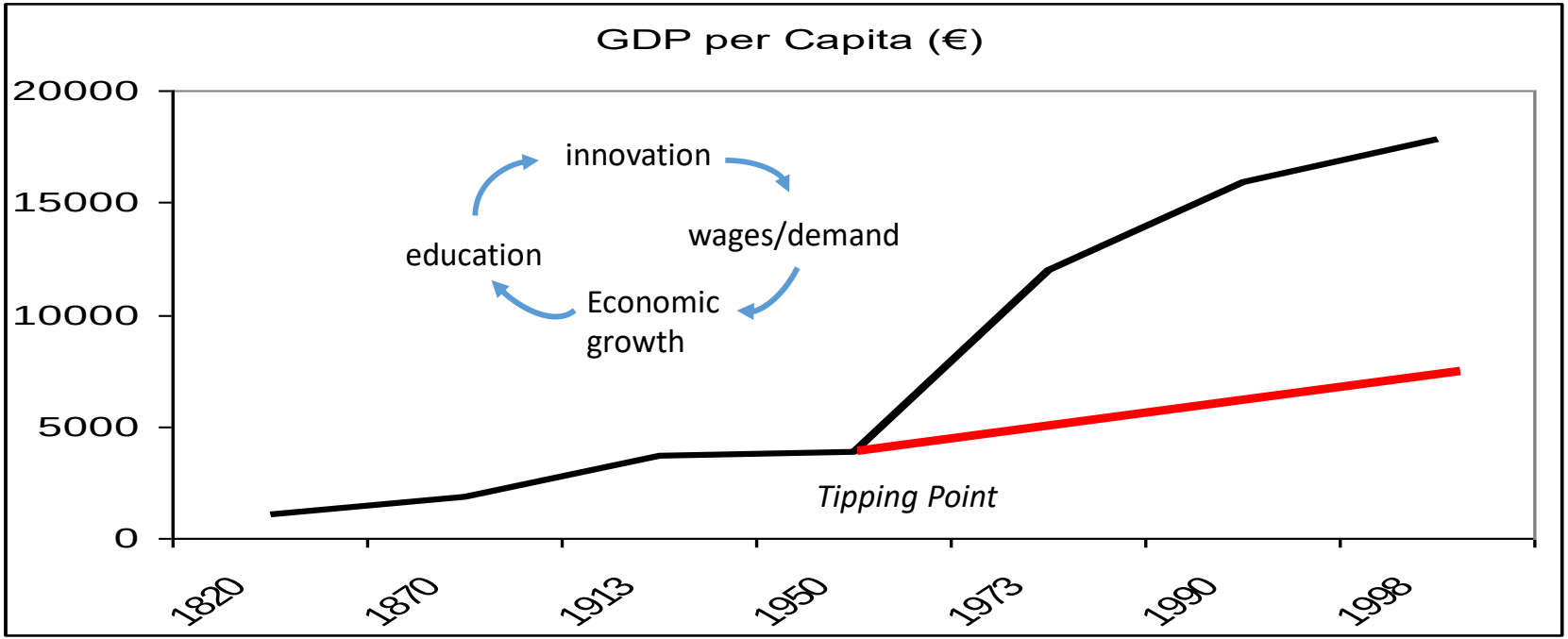
Virtuous Circle 1: The Golden Age of Capitalism



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Crossing economic and not planetary tipping points

- Earth scientists (Rockström et al. 2009; Steffen et al. 2015), leave no doubt that with each day business-as-usual is pursued, we are approaching several planetary thresholds beyond which we are at “substantial risk of destabilizing the Holocene state of the [Earth system] in which modern societies have evolved.”
- This collapse will not come gradually, but sudden. The nature of tipping points generally leaves little room for gradual adaptation.
- **Consequently, we must reach the tipping point towards economic behavioral change before the tipping point of the planetary system is reached.**

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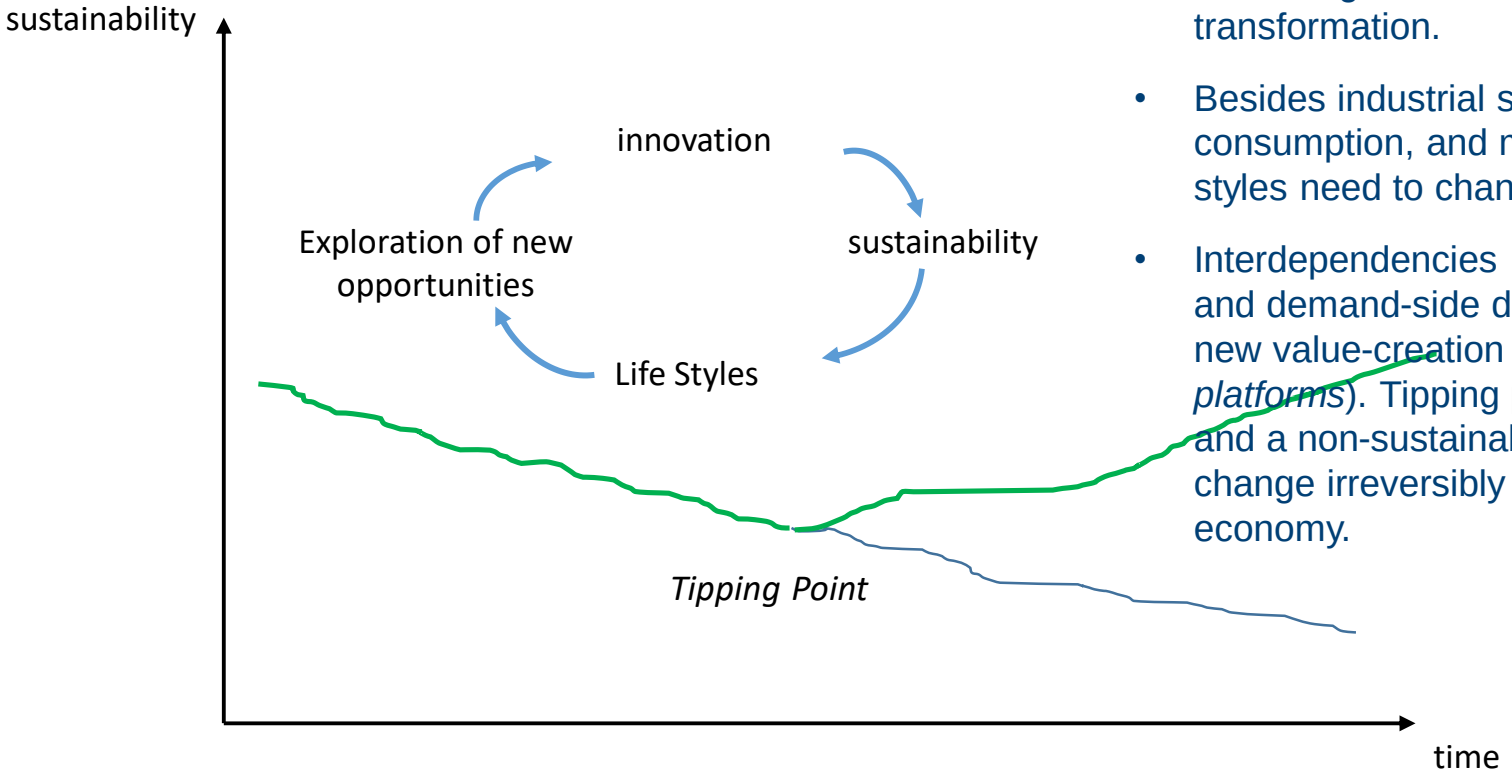
Transformation towards a sustainable bioeconomy

- Substitution and structural change are not enough for a sustainable transformation.
- Besides industrial structures also consumption, and more general, life styles need to change.
- Interdependencies between supply-side and demand-side developments lead to new value-creation networks (e.g. *green platforms*). Tipping points are surpassed and a non-sustainable economy might change irreversibly to a sustainable economy.

Virtuous Circle 2: The Return to Sustainability



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Transformation means paradigmatic change

Innovation systems for transformation need to trigger paradigmatic changes. So what can be considered to be the core of a technological paradigm?

- Paradigms shape the *general search heuristics*.
- General search heuristics are implicit and widely accepted meta-rules, applied in all kind of decision making.
- General search heuristics are in line with technological uncertainty and do not determine technological development.
- General search heuristics are compliant with prevailing social norms.

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Most popular 20th century general search heuristics

- *unlimited availability of fossil resources (e.g. energy, basic chemicals …)*
- *meat as the most desirable component in diet*
- *mass production to exploit economies of scale*
- *individual mobility as dominant traffic mode …*

→ meta-search heuristic of industrialization: **scaling-up** to realize economies of scale

→ prevailing norm: **increasing income per head**

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Alternatives emerging in the 21st century

- Concerning the meta search heuristic: Digitalization is questioning centralized and large scale solutions (*the industry paradigm*)
- Concerning prevailing norms: Sustainability thinking (economic, social and ecological) is challenging the increasing income postulate (*the neoliberal paradigm*).

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Conclusions for innovation systems

- Innovation systems need to be redesigned → **Dedicated Innovation Systems (DIS)**
- The dedication in DIS focusses on the development and implementation of new general search heuristics, which are suited to improve long-term sustainability performance (inter- and intra-generational justice, continuity of ecological systems, quality of life ….)
- This can only be achieved by involving a wide variety of stakeholders (democratization, participation, transparency, perceptibility, education ….).
- Established stakeholders suffer from not-invented-here syndromes and fear a replacement.
- Open space for creativity is needed.

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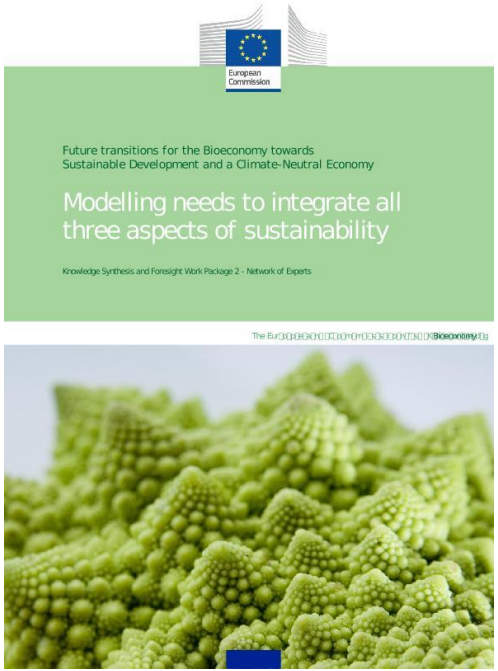
Conclusions for economic modelling in general



- Existing Models (DSGE) will not be useful to analyse the sustainability transformation.
- Complexity models in general and ABMs in particular offer the right framework to analyse systems composed of heterogeneous actors and important non-linearities.
- Big Data together with AI will support the design of interfaces between climate, ecological and economic models.
- New alliances between forecasting and modelling communities are promising.

https://publications.jrc.ec.europa.eu/repository/handle/JRC124579

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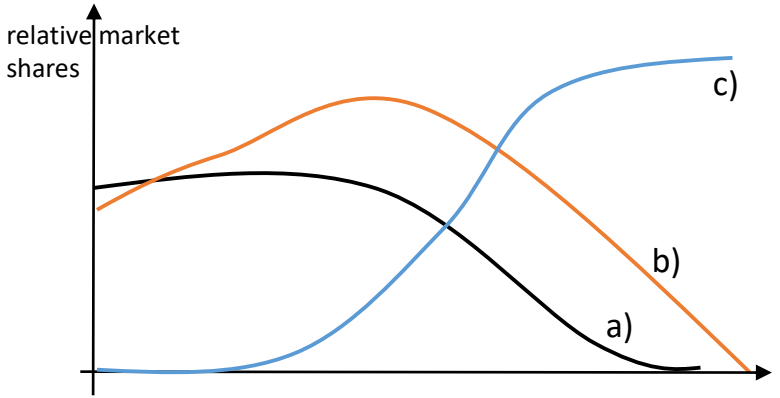
Time path of Sustainability Transformation:

a) a strong and absolute decline of carbon-based industries (e.g. combustion engines, synthetic materials…) → disrupting of unsustainable trajectories.

b) in the transition period ‘sailing ships’ (e.g. electric mobility …) with a strong motive to innovate in order to avoid being replaced and thereby contributing to a short run reduction of GHG emissions → integration of sustainability into existing innovation systems

c) the emergence of growing new sectors in the knowledge-based bioeconomy → establishing a DIS acknowledging for the uncertainties and complexities of technological and social innovation (*transformative knowledge*).

This particular combination allows for quantitative growth, qualitative development and transformation.



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Thank you for your attention!