Growth, Degrowth, or Green Growth?
In Search of a Better Paradigm

Belgian Royal Academy
Brussels, 4 May 2013

Prof. Dr. Ottmar Edenhofer
Dr. Michael Jakob / Dr. Jan Steckel
1. Is continued economic growth *feasible*?

2. Is continued economic growth *desirable*?

3. Commons as a new paradigm

4. Conclusion
Economic growth in perspective

Edenhofer et al. (2012)
No limits to economic growth?

Danger of overstepping “planetary boundaries”? 

Rockström et al. (2009)
What drives emissions?

Economic growth – particularly in newly industrializing countries – drives global emissions!
Green Growth to the rescue?

Can we keep up economic growth and still protect the environment?
What is Green Growth?

• “Green growth [...] is about fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies” (OECD 2011).

• “UNEP defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. [...] The key aim for a transition to a green economy is to eliminate the trade-offs between economic growth and investment and gains in environmental quality and social inclusiveness” (UNEP 2011).
Having your cake... ... and eating it, too!

This scenario results in a no-regret outcome, i.e. higher economic growth even if the environment wouldn’t matter.

Has been criticized for unrealistic assumption of additional investment that drives up growth (Victor and Jackson 2012). Having your cake...
Green Growth is not a sharply defined concept, and it lacks empirical verification...

... so maybe degrowth promises a more straightforward solution to reduce emissions?
“Degrowth“ is at least conceivable as a new post-materialistic lifestyle in industrialized countries...

... but how should degrowth be put into practice in poor countries?
Growth and poverty reduction

- People mired in absolute poverty: >1 billion.

- Without economic growth, chances to escape poverty are diminished.

\[ y = 1.185x - 0.0068 \]
\[ R^2 = 0.4935 \]

Dollar and Kray (2002)
What does degrowth mean for income distribution?

... and the US would have to degrow by about 80%

If global income were distributed equally...

... developing SSA could increase per-capita GDP seven-fold...

... LAM would remain at the current level...

US: 49'000

SSA: 14'000

LAM: 10'000

GDP per capita in current US$ (Source: WDI 2012)
High and low growth

Scenarios for global GDP development

Drivers of growth:
⇒ Population
⇒ Labour participation rates (age, gender, ...)
⇒ Human capital (schooling, ...)
⇒ Productivity growth
⇒ Capital accumulation

Kriegler et al. (2012b), RoSE project
450ppm-e with high and low growth

Higher **economic growth** has to be compensated by higher **energy & carbon** intensity improvements

Own calculations based on results from Kriegler et al. (2012)
Technology differences due to economic growth

Higher economic growth requires more efficiency improvements and renewables

Kriegler et al. (2012a), RoSE project
Luderer et al. (2012)
The current global energy system is dominated by fossil fuels.

Shares of energy sources in total global primary energy supply in 2008.

SRREN (IPCC, 2011)
The technical potential of renewable energies

---

**Global Technical Potential [EJ/yr, log scale]**

- **Electricity**
  - Geothermal Energy
  - Hydropower
  - Ocean Energy
  - Wind Energy
- **Heat**
  - Geothermal Energy
- **Primary Energy**
  - Biomass
  - Direct Solar Energy

**Range of Estimates of Global Technical Potentials**

<table>
<thead>
<tr>
<th></th>
<th>Max (in EJ/yr)</th>
<th>Min (in EJ/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geothermal Energy</td>
<td>1109</td>
<td>118</td>
</tr>
<tr>
<td>Hydropower</td>
<td>52</td>
<td>50</td>
</tr>
<tr>
<td>Ocean Energy</td>
<td>331</td>
<td>7</td>
</tr>
<tr>
<td>Wind Energy</td>
<td>580</td>
<td>85</td>
</tr>
<tr>
<td>Geothermal Energy</td>
<td>312</td>
<td>10</td>
</tr>
<tr>
<td>Biomass</td>
<td>500</td>
<td>50</td>
</tr>
<tr>
<td>Direct Solar Energy</td>
<td>49837</td>
<td>1575</td>
</tr>
</tbody>
</table>

---

**SRREN (IPCC, 2011)**
The costs of renewables are often still higher than those of non-renewables but...
Some technologies can already be competitive today

The lower end of the cost ranges represents favourable geographic and economic conditions.

Examples should not be misinterpreted to suggest a generally valid ordering of specific technologies from least to highest cost.
Learning-by-doing
Technologies and mitigation costs

Costs depend on:
- Stabilization target
- Use of biomass
- Availability of technologies, especially RE and CCS

IPCC 2011,
Edenhofer et al. 2010
With an annual rate of economic growth of 2%, limiting global warming to <2°C requires reducing carbon intensity of GDP (CO₂/US$) by ~4-7% per year.

Degrowth might reduce the needed annual reductions by the rate of economic growth, i.e. by 2%..

... but where should the other 2-5% come from?
Opportunity costs vs. risks

High Growth Scenario

- Nuclear
- CCS
- Biomass + CCS
- Renewables
- Energy Efficiency

Opportunity cost of foregoing mitigation option
A degrowth strategy would reduce these risks at best indirectly...

...and we have to distinguish the *ends* that a policy should achieve from its *means*. 
Policy Instruments

• Carbon pricing (e.g. carbon tax, emissions trading)

• Technology policies (e.g. feed-in tariffs, R&D subsidies)

• Insurance schemes

• Land-use management

If all environmental goals can be reached and technological risks addressed by appropriate policy instruments, why deliberately slow down economic growth?
Outline

1. Is continued economic growth *feasible*?

2. Is continued economic growth *desirable*?

3. Commons as a new paradigm

4. Conclusion
GDP is only partially related to well-being

However, this so-called Easterlin-Paradox is contested, as it suffers from data and measurement problems, does not take into account increases in life-expectancy, and might not be valid in cross-country studies.

In any case, growth cannot constitute a goal in itself, but it might help to attain things that increase well-being.
What are key factors of well-being?

For the individual, the most important correlates of happiness are:

- Family relationship
- Financial situation
- Work
- Community and friends
- Health
- Personal freedom
- Personal values

Layard (2005) from U.S. General Social Survey Data

80% of the differences in life satisfaction can be explained by:

- Divorce rate
- Unemployment rate
- Trust in other people
- Membership in voluntary organisation
- Quality of government
- Belief in God

Helliwell (2004) using World Values Survey Data
What *are* key factors of happiness?

For rich countries, inequality might be more important than absolute per-capita income

(Wilkinson and Pickett, 2009)
Hence, growth might not be desirable per se, but there is no reason to restrict economic growth directly...

... and we need to think about how we define social welfare in the first place instead!
What is the currently used welfare indicator?

• By „historical accident“ and a lot of positive feedback it is this:

\[ \text{GDP} = \text{C} + \text{I} \]

The monetary value of all the finished goods and services produced within a country's borders over a year's time.

• **GROWTH PARADIGM:** By the logic of many political actors, growth in GDP is a welfare improvement and the solution to social (and environmental?) problems.

• `Heterodox` Economists believe that this is inappropriate for affluent societies, although it may be correct for the developing world.
Social welfare as material well-being

Consider the most simple case (only physical capital)

• utility: $\int_0^\infty U(C_t)e^{-pt} dt$

• GDP is a function of the (physical) capital stock: $F(K_t)$

• capital dynamics with zero depreciation: $I = \dot{K}_t = F(K_t) - C_t$
Outline

1. Is continued economic growth *feasible*?

2. Is continued economic growth *desirable*?

3. Commons as a new paradigm

4. Conclusion
GDP alternatives: sustainability

Maximization of utility:
- Hamiltonian: $H = U(C_t) + \lambda (F(K_t) - C_t)$
- Assume linear utility: $U(C) = U_c C$
- Hamiltonian in terms of dollars: $H / U_c = C + I$

→ **NNP equals (approximately) the Hamiltonian**

- Definition of net national product in this case: $NNP = C + I$
- That is, in this special case $NNP = GDP$

→ If welfare only depends on consumption, GDP is a welfare measure
Net National Product - Public goods

Setup of the problem
• utility: $\int_0^\infty U(C, G)e^{-pt} \, dt$
• capital dynamics with zero depreciation: $I = \dot{K} = F(K) - C - G$

Maximization
• Hamiltonian: $H = U(C, G) + \lambda (F(K) - C - G)$

→ NNP includes public capital: $NNP = H/U_C = C + G + I$
Net National Product - Climate policy through a carbon budget

Setup of the problem

• utility: \( U(C) e^{-pt} dt \)
• investment with pollution as production input: \( I = F(K, P) - C - G(P) \)
• finite disposal space in the atmosphere \( S: \dot{S} = R = Q(S) - P \)

Maximization

• Hamiltonian: \( H = U(C) + \lambda (F(K, P) - C - G(P)) + \mu (Q(S) - P) \)

\( \rightarrow \) NNP includes changes in total pollution, weighted by marginal benefit of pollution: \( \frac{H}{U_C} = C + I + (F_P - G_P) \dot{S} \)
Where is the wealth of nations?

- World Bank introduced “Adjusted Net Savings”

- Correct gross investment \( (I_1) \) for:
  - Depreciation of physical capital \(-\delta K\)
  - Investment in education \( (I_2)\)
  - Depletion of natural resources \(-RF_p\)
  - Pollution damages \(-RG_p\)

\[
\text{NNP} = C + I_1 + I_2 - \delta K - RF_p - RG_p
\]

Central question for sustainable growth: can NNP be consumed in one period without undermining the ability to produce the same NNP in the future? (Hicks, 1946)
Are we consuming too much?

**Table 1**
Genuine Investment and Components as Percentage of GDP

<table>
<thead>
<tr>
<th>Country</th>
<th>Domestic net investment</th>
<th>Education expenditure</th>
<th>Damage from CO₂ emissions</th>
<th>Energy depletion</th>
<th>Mineral depletion</th>
<th>Net forest depletion</th>
<th>Genuine investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh 1973–2001</td>
<td>7.89</td>
<td>1.53</td>
<td>0.25</td>
<td>0.61</td>
<td>0.00</td>
<td>1.41</td>
<td>7.14</td>
</tr>
<tr>
<td>India 1970–2001</td>
<td>11.74</td>
<td>3.29</td>
<td>1.17</td>
<td>2.89</td>
<td>0.46</td>
<td>1.05</td>
<td>9.47</td>
</tr>
<tr>
<td>Nepal 1970–2001</td>
<td>14.82</td>
<td>2.65</td>
<td>0.20</td>
<td>0.00</td>
<td>0.30</td>
<td>3.67</td>
<td>13.31</td>
</tr>
<tr>
<td>Pakistan 1970–2001</td>
<td>10.92</td>
<td>2.02</td>
<td>0.75</td>
<td>2.60</td>
<td>0.00</td>
<td>0.84</td>
<td>8.75</td>
</tr>
<tr>
<td>China 1982–2001 (without 1994)</td>
<td>30.06</td>
<td>1.96</td>
<td>2.48</td>
<td>6.11</td>
<td>0.50</td>
<td>0.22</td>
<td>22.72</td>
</tr>
</tbody>
</table>

**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).*
The wealth of nations and the wealth of commons

The wealth of nations consists of:
- Privately Produced Capital (KP)
- Human Capital (KH)
- Social (Common) Capital (Ks), e.g. produced public capital
- Natural (Common) Capital (KN), e.g. land, exhaustible and renewable resources

Optimality: Pure rate of time preference equal to returns of risk-free asset, social, private, natural, and human capital

\[ \rho = r = F_{K_S}(K_S, K_P, K_H, K_N) - \delta K_S = F_{K_P}(K_S, K_P, K_H, K_N) - \delta K_P = \frac{l}{p} + \frac{p}{p} = h \]

Social rate of return equal for all forms of capital (i.e. “no arbitrage condition”), otherwise there is over- or under-investment.

Key question: Is there over- or underinvestment in any form of capital?
Social under-investment in infrastructure?

Highway construction in the USA (Gramlich 1994):
- maintenance projects: \( 35\% \)
- new urban construction projects: \( 15\% \)
- rural construction projects: (low)

Return on "ordinary" investments in USA (1926-2000): \( 8.8\% \)

Positive correlation between growth and infrastructure stocks (Calderon and Serven 2004):
- 0.15 for phones
- 0.13 for power generating capacity
- 0.21 for road length
Under-Investments in Human Capital and Health Care?

- Slow productivity growth in services (e.g. healthcare and education) compared to manufacturing
- As the economy grows, a higher share of GDP will be spent on these activities
- If there is an upper limit to expenditure (e.g. as % of GDP), underinvestment is likely to occur in the future
The Atmosphere as a Global Common

Atmosphere: Limited Sink up to ~1.300 Gt CO₂

Resource Extraction ~ 15.000 Gt CO₂
Scarcity of fossil fuels?

SRREN, Edenhofer et al. (2011)
Transformation of Resource Rent into Climate Rent

- Most coal reserves are left underground, but profit loss is limited
- Loss of fossil fuel rent is over-compensated by climate rent

(Bauer/Mouratiadou/Luderer/Baumstark/Brecha/Kriegler/Edenhofer subm.)
Why do social returns differ from private returns?

The central question for economic policy is not growth or degrowth, but welfare, for which common pool resources are a fundamental factor!
1. Is continued economic growth feasible?

2. Is continued economic growth desirable?

3. Commons as a new paradigm

4. Conclusion
Conclusions

• Continued economic growth seems feasible, at least from the perspective of climate change mitigation, provided that externalities are properly addressed.

• Economic growth cannot be a goal in itself. But it could help to attain desirable objects (i.e. happiness, prosperity...).

• Public policy should not primarily be concerned with growth, but with welfare.

• Different members of society do not necessarily have to agree on a definition of welfare. But they have to agree on how to manage common pool resources and common property regimes.
The central question for economic policy is not growth, green growth, or degrowth, but whether there is over- or underinvestment in common pool resources!