{% include JB/setup %}

# INTRO

* **Importance of economic dynamics for the earth system and global sustainability**
  + Human economic activitiy has a deciding role for the future of our planet. Yet some may argue that economics out of the three pillars of sustainability development - the social, the economic and the environmental - is the pillar least integrated in current approach to sustainability science.
  + The human economy is a driving factor of biodiversity loss and climate change. At the same time, global economic inequalities themselves can be viewed as one of the greatet barriers for addressing global environmental and socio-economic challenges.
  + At the same time Growth in human population and the economy are two trends that epitomizes the current environmental challenges of biodiversity loss and climate change and improvementes in living standards in many countries that have undergone economic growth in the 20th and 21st century. Associated with these trends is the dilemmas of global equity on a finite planet, including the question of whether countries with large economic prosperity need to consume less to allow the developing countries to achieve similar living standards.
  + In this context, understanding how the economy is linksed to the environment and to social aspects of society is of foundational importance for the science of global sustainability.
  + It is therefore concerning that scientific fields of the three pillars of sustainability are still only connected to a very limited extent. In particular, the field of economics and finance remains the pillar most poorly addressed by sustainability science [**REF**]. This is of great concern for the prospects of sustainable development guided by sound advice from the scientific community.
  + To address the need to integrate economics and finance better with sustainability science, in this Sustainability Science perspective we highlight two areas of importance:
    1. recent advances in integrating economics into sustainability-oriented sciences.
    2. major gaps for integrating economic into sustainability-oriented sciences.
* **A brief history of sustainability science - what concepts has been important for SS**
  + Sustainability science emerged as a unified discipline in the beginning of the 21st century (L. M. A. Bettencourt and Kaur 2011). Before and after its unification, contributions to sustainability science has mainly come from three broad fields, the social sciences, engineering and the biological sciences (L. M. A. Bettencourt and Kaur 2011).
  + Contributions from these fields have mainly come from a small number of disciplinary clusters. For example, contributions from engineering has mainly come from systems and complex engineering and research. Contributions from the biological sciences have mainly come from the field of ecology with contributions to bidodiversity and ecosystem services. Similarly in the social sciences, contributions have not been evenly distributed across the field.
  + *Maybe describe more here some of the important concepts of sustainability science - but may be too redundant for the type of article.*
  + The contribution of the social sciences has remained fairly constant over time, but increased slightly since the unification in 2003 (L. M. A. Bettencourt and Kaur 2011).
    - *Key papers*
      * Future challenges, Charles Perrings PNAS 2007
        + "Although both economics and ecology are still full of examples of disciplinary myopia, the integration of the disciplines through such ventures has generated more flexible and adaptive solution to both the management and the science of common-pool environmenta resources (12, 13). "
      * Evolution of sustainability science
      * Beyond panaceas
      * Science Magazine, Introduction, Sustainability Science paper, Kates and ...
      * William C. Clark and Nancy M. Dickson - Sustainability science: The emerging research program -PNAS 2003
* **History of economics and sustainability science - what generally characterizes the research questions that have been taken up?**
  + Sustainability science has been succesful in addressing a number of economic issues. These include the interactions between the natural resource base and human income, such as Sub-saharan African exceptionalism in world poverty and the role of deprived natural resources, ethnic diversity, inequality and institutions in keeping many people caught in a "poverty trap" (Kates and Dasgupta 2007). Another area of economics that have been advanced by sustainability science is the operationalization of ecosystem services (or natural capital) valuation (G. C. Daily and Matson 2008), both through national statistical accounting schemes [K.-G. Mäler, Aniyar, and Jansson (2008)}, now mandated by the OECD under the termninology of green accounts, and, through on-the-ground ecosystem service based governance through actions spanning from the community level (Cowling et al. 2008) to the national level (Liu et al. 2008).
  + The above two examples serve to illustrate that sustainability science' occupation with economics has mainly followed **two** pathways. (1) The role of disparity and central mode of human income and its interactions with the environmental system and the social effects it brings with though complex feedback loops. (2) Valuation of earths natural capital and operationalizing local and national governance schemes of these assets.
* **History of economic and sustainability science - what generally characterizes some of the research questions that hasn't been taken up?**
  + Other economics-related research questions have barely been addressed by sustainability science (\*at least when judging by the content published in the xxx number of articles under the sustainability science label in PNAS). Some of the most notable areas of omission appears to be the role of international licit and illicit financial capital flows and trade for sustainable development, and the role of financing and key-financial players in ensuring democractic or other political sustainablity transitions.
  + Is this because sustainability science is naive to the role of money in decision making?
    - We can not rule out this explanation, however sustainability science has dealt with issues of corruption in e.g. developing countries.
  + Is this because these branches of research are less well developed in economics and finance?
    - Doesn't seem likely since sustainability science has taken on other areas of research that have only recently emerged or been limited to small communities.
* **Recent history of decreasing diveristy of economics and relations to other disciplines in terms of sustainability related questions**
  + The fields of economics and finance research have changed over time. In particular, recent contributions document how the economical sciences during the 20th century underwent a continuing decrease in the diversity of research questions and methods being used (Colander 2005).
  + *What about the recent history of finance research? Find some references to document this.*
  + Recently, and partially fuelled by the financial crises of the 21st century. There has been a concerted effort to re-energize the field of economics with a return to a more diverse set of approaches and questions. It remains to be shown, however, if the recent changing dynamics of economics research will also lead to an uptake of sustainability related questions.
  + In recent decades many of the economical questions most pertinent for global sustainability have been addressed in communities that are only tangentially connected to the core fo economics research and in some cases arguably more closely connected to sustainability science. These include, the investigation of the material foundation and material limits to economic growth (club of rome ref, J. H. Brown et al. 2014; J. R. Burger et al. 2012; Burnside et al. 2012), the valuation of natural capital [Costanza and Daily refs], the global structure of the economy (Lenzen et al. 2012) , the impact of economic activies, such as trade, on the environment and vice versa [natural resources refs],**xxx**, **xxx**, **xxx**.
  + In the meantime, sustainability science must actively seek to integrate with those communities that address questions of economics and finance most pertinent to global sustainability.
  + \*Mention somewhere that the economical sciences have gone through a phase of decreasing diversity. A diversity that is now returning following the prolonged financial crises of the United States and Europe. Sustainability science can play an important role in maintaining this diversity by more fully integrating with some of the emerging branches of research.
* **Paragraph - summarizing intro and outlining content and purpose of the main body of the paper - EXAMINE BRIGHT SPOTS AND BLIND SPOTS**
* In the following we ... , ...

# RECENT ADVANCES

**National (greener) economic accounting**

Integrating measures of natural and social capital into national accounting systems

* Political attention to global sustainability and the unsustainable dynamics of current measurements of economic growth has facilitated international research progress on integrated measures of growth
  + E.g. Genuine progress measure (Nature paper by Costanza)
  + Green accounting mandated by OECD countries - what will happen next

**Socio-economic inequality and health and environmental quality**

* *Reference*
  + The Haves, the Have-Nots, and the Health of Everyone: The Relationship Between Social Inequality and Environmental Quality Annual Review of Public Health, 2014
  + Valuation of environmental and social goods.
  + Cost-effectivness of conservation actions (e.g. Jonathan Hoekstra, PNAS piece, 2012)
  + Economic change effects on land use change (", a recent doubling in commodity prices has created incentives for landowners to convert grassland to corn and soybean cropping") [Wright and Wimberley, PNAS 2013] and (Lybert et al. 2011 PNAS - booming markets for Moroccan argan benefits some rural househols but threatens endemic forests)
  + Inequality and biodiversity, environmental and health effects
  + Trade and emissions [e.g. China's international trade and air pollution in the United States, Lin et al. 2014 PNAS] and Lenzen and Wiedmann studies. [i.e. consumption based accounting of official trade statistics]
  + Poverty reduction [e.g. Hyden et al. 2007 PNAS]
    - Hyden even questions the application of mainstream economics assumptions of rationality etc.
  + Payments for ecosystem services [e.g. Kelsey Jack et al. 2008 PNAS]
  + Accounting for ecosystem services [e.g. Mähler et al. 2008 PNAS]
    - Karl-Göran Mäler, Sara Aniyar, and Åsa Jansson - Accounting for ecosystem services as a way to understand the requirements for sustainable development - PNAS 2008
  + A review of financial instruments to pay for predator conservation and encourage human-carnivore coexistence

**The impact of trade on the environment**

# AREAS THAT NEED ATTENTION

* ***Finance in politics, financial players an dynamcis***
  + **Role of finance in preventing democracy and implications sustainable transitions**
  + \*A study from 2014 have documented how the role of campaign financing in US politics may lead to in-validation of long held theories of political science, such as the median voter theorem (Gilens and Page 2014). Similar ongoing studies are documenting how the probability of getting elected is correlated with the amount of campaing funds raised [**Cite Tom Ferguson research**]. The regulated earns more than the regulator and this financial inequality may present some moral challenges for sound decision-making in regulators (Ferguson and Johnson 2010).
  + \*Such questions are of clear interested to sustainabliity science and research on global sustainablity. For example, what are the implications for the likelihood of sustainability transitions? If decision makers make choice in the interest of their financiers instead of in the interest of their electorate, may this either increase or decrease the likelihood and speed of sustainablity transitions wanted by the electorate?
  + **Impact of major financial corporations on global sustainability (key players)**
    - A recent study have documented that a small number of financial institutions play an important role in linking the global economy together (Vitali and Battiston 2013). What are the implications for global sustainability of such hyper connectivity?. Can the concepts of key-stone species, for example, be transferred to financial capital holders, and does this concept also apply to the socio-environmental effects of actions taking by the financial actors. Ongoing research are just starting to investigate such questions in the marine realm [*get Calle, JB and other SRC folks to fill in here*]. Similar research could be taken on in the agricultural and silvicultural realms with regard to land-use change etc.
  + **Financial market dynamics and impact on global sustainability**
    - The great recession of 2008 and the prolonged recession in Europe have been two of the most influential events on western hemisphere policy in the 21st century. Both recessions were partially caused by the influence of increasingly complex financial system on commodity prices such as housing prices and even national savings (Greece) [find articles on investment in the national savings of Greece, Italy and Spain **REFS**]. The impact of the following economic downturn on important environmental policies such as energy investments can be seen e.g. in many nations decision to explore options for liquified shale oil and natural gas and lowered ambitions in national and supra-national plans of transitioning to renewable energy sources [**REF**].
    - The integration of financial market dynamics and complexity with sustainability science seems an important agenda to ensure a more resilient and holistic response to such events.
    - Examples of remaining research questions with regard to the financial crisis are:
      * What have some of socio-environmental impacts been of the fincial crisis on other continents?
        + Can key trends in enviornmental and social degradation or improvement be traced to events relating to the financial crisis.
        + How do other actors respond to financial crisis. Do they e.g. learn to anticipate negative impacts from prolonge recessions caused by financial market complexity?
* ***International financial transactions and flows***
  + **Social and enviromental impact of financial transactions**
    - With increasing complexity of financial markets, impacts of capital flows are in a manner similar to impacts of production and consumption in globalized supply chains becoming harder to track. Are international financial transactions playing important roles in determining social and environmental outcomes in regions where they flow from, through and end-up. Are these outcomes positive or negative for global sustainablity?
  + **Social and enviornmental impact of illicit financial transaction**
    - While captial flows of the financial market may prove an important factor influencing the likelihood of sustainable transitions, much of international trade happens outside the market. For example, the international market for wildlife medicine largely occur through illicit financial transactions. Such markets and transactions may in some cases have more immediately obvious impact on socio-environemntal sustainablity. For example, the negative impact of such trading on threatened species, sometimes appearing on the brnk of extinction, is well-documented through declines in e.g. elephants and rhinos in Africa. Tragically, from trophy hunting it has been shown that increasing rarity of hunted species may only increase the exclusiveness, price and demand for their derived products - potentially leading to a self-reinforcing feedback loop toward further decline (Lucille Palazy et al. 2011; L. Palazy et al. 2012). In other cases, the effect of illicit international capital flows are much less well documented. **give examples** Thus, whether licit or illicit, untangling the teleconnected socio-environmental effects of international capital flows should be of priority to sustainability science.
  + Trade Policy and Public Health - Annual Review of Public Health - Vol. 36: 325-344 (Volume publication date March 2015) - First published online as a Review in Advance on December 10, 2014 - DOI: 10.1146/annurev-publhealth-031914-122739

# FUTURE PERSPECTIVES AND CONCLUSION

*Text to be added here.*

# Supporting notes

## Notes on integration

* Emphasis on need to fully integrate economics and finance into sustainability science.
* The current state of sustainability science or (environmental, social and economic sciences) is ripe with example of lack of integration.
  + Examples of lack of integration between ecological, social and economic perspectives:
  + Lack of integration of an explicitly ecological perspective into social sciences and socio-economic policy (J. H. Brown et al. 2014, Burnside et al. (2012))
    - With the implication of overlooking natural resource exploitation as an underlying trend for the "great recession" (J. H. Brown et al. 2014)

## Paper notes

* (J. H. Brown et al. 2014)
  + Malthusian vs. Darwinian dynamics (i.e. growth and resource limitation vs. organic and cultural selection for innovation to circumvent those)
  + Malthusians [population, resource limitation and conflict] vs. Cornucopians [technological innovation to facilitate eternal growth]
  + Read: Arrow et al. 1995, 2004 (Arrow et al. 1995, Arrow et al. (2004))
  + Economic growth, carrying capacity, and the environment, Science, 1995 (Arrow et al. 1995)
    - Outlines the origin and current evidence for the Environmental Kuznets Curve (EKC)
  + Are we consuming too much (Arrow et al. 2004)
* (Lenzen et al. 2012)
  + "Our findings clearly demonstrate that local trheats to species are driven by economic activity and consumer demand across the world."

## ***Older snippets***

### INTRO

The concept of capital is important to sustainability science and environmental conservation

* The concept of capital, a term borrowed from economics, is foundational for sustainability science. Natural, social and financial capital distinguishes between the assets possess in currencies of environmental, societal and monetary value. This is one example of an important interplay between sustainability science and economics where sustainability science has adopted central concepts of economics. Sustainability science is addressing some research areas of economics
* Sustainability science has begun to address the interplay between economic dynamics/sustainability and socio-environmental sustainability. Examples include, (1) the influence of economic inequality on environmental sustainability, (2) the measurement of economic growth integrating measures of financial capital with social and natural capital.

Sustainability science has been slower to pick up other central lines of economic research \* However, many central areas of economics has yet to make into integrated sustainability research. These include, (1) the influence of money in politics and how they influence democratic transitions toward sustainability, (2) how international monetary transactions and illicit capital flows influence social and environmental outcomes at their destinations and to what extent this tele-couples econo-socio-environmental dynamics in areas fare apart.

### Main body

* Green accounting (progress, next steps)
* Inequality and environmental, social and financial sustainability
* The role of money in facilitating or slowing down democratic transformations toward sustainability

Perspective \* From green accounting to national accounts revisions

## ***Even older snippets***

### Title:

*Blind spots: Gaps and recent progress in linking real world economics and sustainability science*

### Tenet:

Sustainability science has made good progress in showing the environmental and social effects and limits to current resource use. Yet, the field has had what can best be described as a "blind spot" to the impacts of capital and so-called real world economics on the environmental and social aspects of sustainability.

### Format suggestions:

A comment or perspective piece, e.g. for PNAS sustainability science section, or some more realistic target journal. The piece would comment on and highlight recent progress and future potential for stronger integration of real world economics into sustainability science.

Four topics to highlight as gaps or areas of recent progress Remaining gaps

* The influence of capital in governance on environmental issues
* International financial flows and consequences for democracy and the environment Areas of recent progress?
* The environmental and social sustainability of income distributions (an area of progress?)

' Macroeconomic indicators (an area of progress?)

**The influence of finance in environmental decision making**

Main argument: Democracy as a cornerstone in a future Anthropocene that is just, fair and sustainable.

Research questions: Do elected representatives represent the electorate and the environment? What is the role of vested interest in environmental policy?

Research needs: Studies looking at voting behaviour of elected representatives on environmental issues in relation to campaign financing and total amounts of raised capital and public opinion etc.

*Resources:*

Tom Ferguson analysis of votes and campaign finance in congress elections (in prep)

Analysis of elected representatives' behavior on 1700 policy issues in relation to vested interest and public opinion (Garry has reference that cites Ferguson).

**Illicit financial flows - hidden connections to democracy and the environment?**

Research questions: What is the role of financial flows in and out of countries in affecting foundational aspects of a sustainable future?

1. Do international investment/money laundering affect aspects of democracy and thus opportunities for sustainability?
2. What are the direct and indirect impacts of international financial flows? Are they captured by analysis of commodity flows and supply chain/life cycle analysis?

*Resources:*

* Biocapacity exports and imports (Lenzen, political ecology)
* Lenzen, M., Moran, D., Kanemoto, K., Foran, B., Lobefaro, L., & Geschke, A. (2012). International trade drives biodiversity threats in developing nations. Nature, 486(7401), 109-112. <doi:10.1038/nature11145>
* Lenzen, M., Kanemoto, K., Moran, D., & Geschke, A. (2012). Mapping the structure of the world economy. Environmental Science & Technology, 46(15), 8374-81. <doi:10.1021/es300171x>
* Datasets on financial flows (illicit financial flows report/database, Garry has database )

**Sustainable income distributions (an area of recent progress?)**

*Research question:*

Which (post-transfer) income distributions are most sustainable in terms of environment (and other aspects of human wellbeing)?

Recent progress:

Happiness and inequality studies?

GDP growth and inequality studies (does GDP growth increase inequality while decreasing ecosystem and human well-being?)

What are unaddressed gaps here?

*Resources:*

Garry Peterson publications in PLoS One and Conservation Biology.

What are other important resources Garry?

**The sustainability of macroeconomic indicators (an area of progress?)**

Aim of section: Highlighting progress in reforming macroeconomic indicators of growth to include ecoysytem services and human well-being. Research question: I'm not sure what the area for sustainability science is her

Basically I guess this section could be a description of the many known undesirable environmental and societal effects of a pure GDP growth based focus and an analysis of science' role in current progress in changing the policy agenda.

*Resources:*

Costanza, R., Kubiszewski, I., Giovannini, E., Lovins, H., McGlade, J., Pickett, K. E., . Wilkinson, R. (2014). Time to leave GDP behind. Nature, 505, 283-285.

And Ida's ecological economics paper and global environmental change paper

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