DELIVERING SUSTAINABILITY: AN ECONOMIC PERSPECTIVE.

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Warning!

- As an economist, I will not be including many (any?) pretty pictures in my presentation.

outline

1. What does sustainable development mean to economists?
2. How can we measure sustainability?
3. What aspects of “nature” are included in such measures?
4. How are these aspects of nature valued?
5. Problems with this approach
6. Do economic indicators or sustainability do a good job of predicting future well-being?
7. What does all this mean for “sustainable agriculture”?
8. Research priorities?

What does "sustainable development" mean to an economist?

- Two approaches to defining this: the outcome approach, and the capabilities approach (strong theoretical links exist between these)
- Outcome-based: Sustainable Development (SD) means non-declining per capita utility over time
- Capabilities-based: Sustainable Development means a non-declining capital stock.

a non-declining capital stock?

- Capital (K) here includes produced K, human K, social K and natural K.
- All are sources of future well-being
- Weak versus strong sustainability: how easy is it to substitute these different types of capital for each other?
- Weak sustainability paradigm: all that matters is total K, since substitution is fairly perfect in terms of maintaining future well-being
- Strong sustainability: need to maintain certain level of individual stocks, since substitution possibilities are very limited

Recent initiatives on SD indicators

- Nagoya, Japan, 2010: 193 countries agree to incorporate biodiversity values into national accounting systems
- Stiglitz report for President Sarkozy 2009
- TEEB report (2010) and UK National Ecosystem Assessment (2011)
- World bank (2012) “Beyond GDP” – importance of wider wealth accounts including K_n alongside conventional accounts.
- World Bank “WAVES” initiative – Wealth Accounting and Valuation of Ecosystem Services
- United Nations “Inclusive Wealth” report, 2012
- Continued development of SEEA “experimental ecosystem accounts” – position paper in 2011(System of Environmental-Economic Accounts)
- Scottish Natural Heritage “Natural Capital Asset index”

How do economists measure sustainability?

- Main approach now in economics is the concept of Genuine Savings (Hamilton, Atkinson, Pearce), also known as comprehensive investment or ANS.
- This tracks *changes*, year on year, in the total stock of K in a country
- Sum of gains and losses of each element of the total capital stock, valued according to certain principles derived from theory.
- These gains and losses are all in £, $ etc.
- If GS is < 0, this is a signal of unsustainable development: country is running down its wealth (capacity to generate future well-being).

- Concept of GS derives from the “Hartwick rule” for sustaining consumption over time for an economy exploiting a non-renewable resource.
- GS can be adjusted to include effects of technological change (Pezzey, 2004), changes in resource prices (Asheim), and changing population (Arrow et al, 2012).
- Big empirical problems in actually measuring these changes in Kp, Kh, and we have little idea how to measure social capital in ££s.
- But what about Natural Capital?

Natural capital

- "Nature has provided ecosystems *and their benefits to us* for free. On the other hand, perhaps because this capital has been provided freely to us, we humans have tended to view it as limitless, abundant and always available for our use and exploitation… The concept of ecosystems as natural capital can (allow us to) find better ways to manage and enhance what is left of our natural endowment".

  E.B.Barbier (2011) Capitalizing on Nature.

What gets included in “natural capital”?

Currently, most empirical exercises in sustainability accounting include:

- Mineral and energy resources
- Renewable resources such as fisheries and forests
- Agricultural land
- Some pollution stocks

SO: omits many ecosystem assets

A very partial accounting for the “gifts of nature” which make up the stock of natural capital at any point in time.

How are these elements of Kn treated?

- For Genuine Savings, we want to know the *change* in the stock of each part of Kn year-on-year
- Eg using up of oil , loss of forests, changes in fish biomass, extra tonnes of CO2-eq. emitted or sequestered
- These physical flows are converted in £ terms using a general principle of "rents" – price minus marginal costs, showing the net benefit of one more unit of capital. Or can use PV of future flows of net benefit over, say, 30 years.
- CO2 valued using shadow price of carbon

- These monetary values of gains and losses in natural capital in any year are then combined with gains/losses in produced capital (net investment) and human capital (eg spending on education and training) to produce overall net effect on total capital stock in the year
- If GS >0, this is a “sustainability signal”.
- If GS<0, this is an un-sustainability signal – we are running down our capital faster than we are replacing it. Implication is that future well-being will thus decline.

Some results for national genuine savings

- Sources: World bank 2006; 2011.

Genuine savings estimates for selected countries

	Gross national saving	CFC	Education investments	Energy depl.	Mineral depl.	Net forest depl.	PM damage	CO2 damage	Genuine Savings
New Zealand	17.7	10.9	6.9	1.3	0.1	0.0	0.0	0.4	+11.8
Nicaragua	17.3	9.1	3.7	0	0.1	0.9	0	0.6	+10.3
Niger	2.6	6.7	2.3	0	0	4.1	0.4	0.4	-6.7
Nigeria	25.7	8.4	0.9	50.8	0	0	0.8	0.6	-33.9
Norway	36.9	16.2	6.1	8.0	0	0	0.1	0.2	+18.5
Pakistan	19.9	7.8	2.3	3.1	0	0.8	1.0	0.9	+8.6
Poland	18.8	11.0	6.3	0.5	0.1	0.0	0.7	1.1	+11.7
Saudi Arabia	29.4	10	7.2	51	0	0	1.0	1.2	-26.5

Notes: CFC = depreciation of produced capital. “depl.” is depletion of energy and mineral reserves and of forest stocks. PM is particulate matter (PM10). Source: World Bank, 2006.

As countries become richer, the share of natural capital in total wealth declines…

	Natural capital share	Produced capital share	Intangible capital share
Low income countries	26%	16%	59%
Middle income countries	13%	19%	68%
High income countries	2%	17%	80%

What are the problems in calculating genuine savings?

- Getting the prices right – the numbers we use will not be those which theory says we should
- How to price CO2-eq. over time is particularly problematic
- For many aspects of natural capital, we have no market prices anyway to value service flows (➔ non-market valuation needed, but on a massive scale)
- Threshold effects are not really accounted for. Cumulative impacts on functioning also not included.

- *Also note that what counts as part of a country's natural capital stock at any point in time is partly determined by prices and technology:*
- *shale oil? Deep sea minerals? Rare earths? Deep sea fish species?*

Could we include values of changes in the "stock" of biodiversity in Kn?

- Mace et al (TREE, 2012): biodiversity fits into the ecosystem services framework in three ways:
  1. as an input to functioning
  2. as a final ES flow
  3. as a direct benefit to people
- We would find it unbelievably challenging to quantify the changes in these inputs/outputs year-on-year (esp. for (1) and (2)) AND to then attach £ values to them.
- So hard to see how biodiversity could be included, practically, in natural capital accounts

Does Genuine Savings predict future well-being?

- Theory says yes, under a specific set of conditions.
- Hamilton and Withagen: if GS >0, then future consumption will be non-declining.
- Pezzey et al (2006) – only a one-sided test.

- Empirically, the only tests of the link between GS and future well-being have used rather short run, cross-country (ie panel) data sets.
- Ferreira and Vincent (2005); Ferreira, Hamilton and Vincent (2008)

- They test $\Delta_{it} = \beta_0 + \beta_1 S + \varepsilon_{it}$, where Δ_{it} is the change in future consumption and S is genuine savings
- Strict version of theory says $\beta_0 = 0$ and $\beta_1 = 1$.
- They reject this
- However, they do find $\beta_1 > 0$, and that the value of β_1 increases as GS is made more comprehensive.
- This shows that positive genuine savings leads to higher future consumption (= well-being in their model).

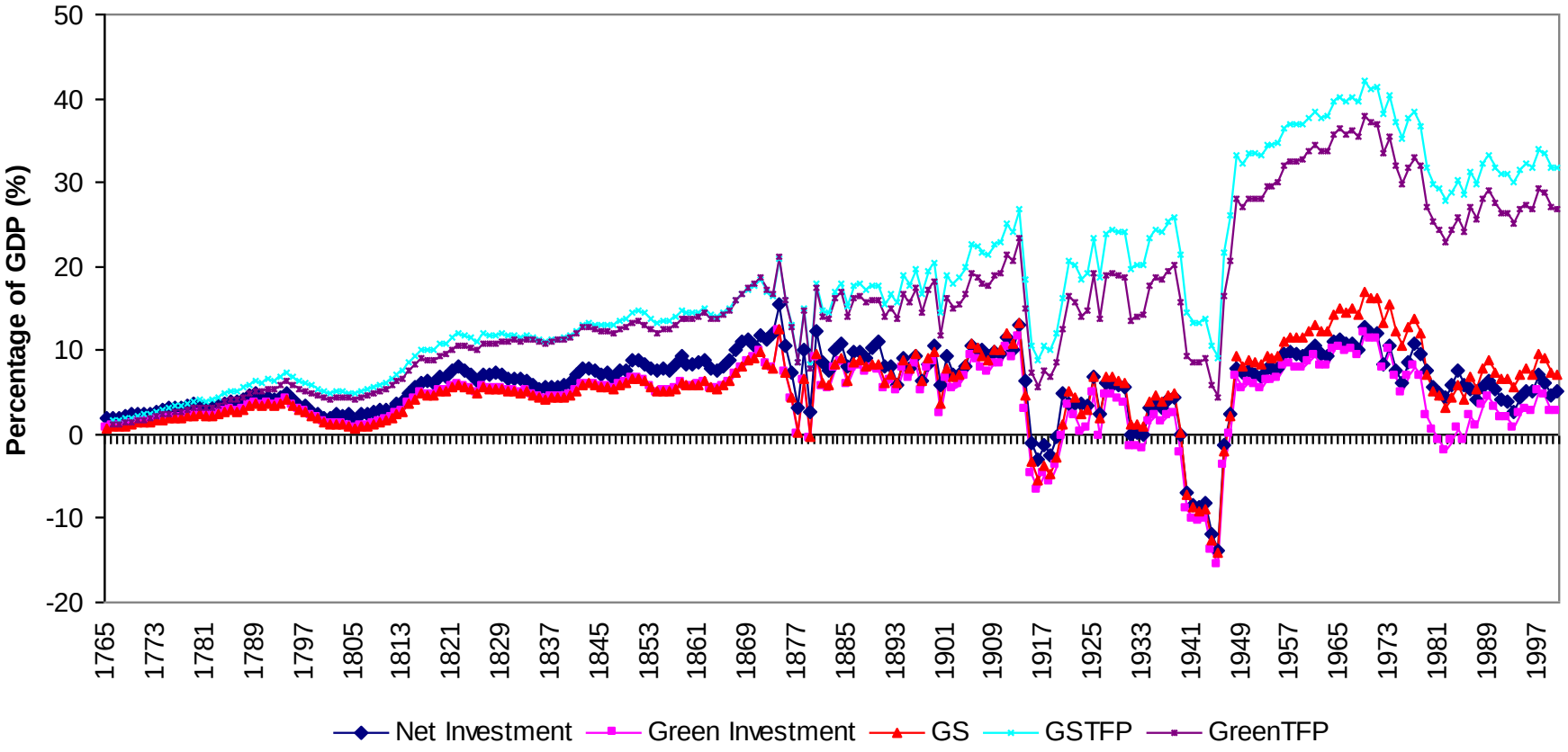
- However, they really only use 30 years of data: sustainability is a longer term concern than this?

A new test of GS over the long run

- Greasley et al (2012) construct genuine savings estimates for the UK back to 1750, including estimates of changes in natural capital over this time period
- The only elements of Kn they include are coal, minerals, oil and gas, and forestry
- The industrial revolution sees a running down of physical coal reserves, but also technological progress which increases the economic reserve by driving down costs
- Human capital changes are proxied by spending on education
- Technological progress is included using estimates of "total factor productivity" changes.

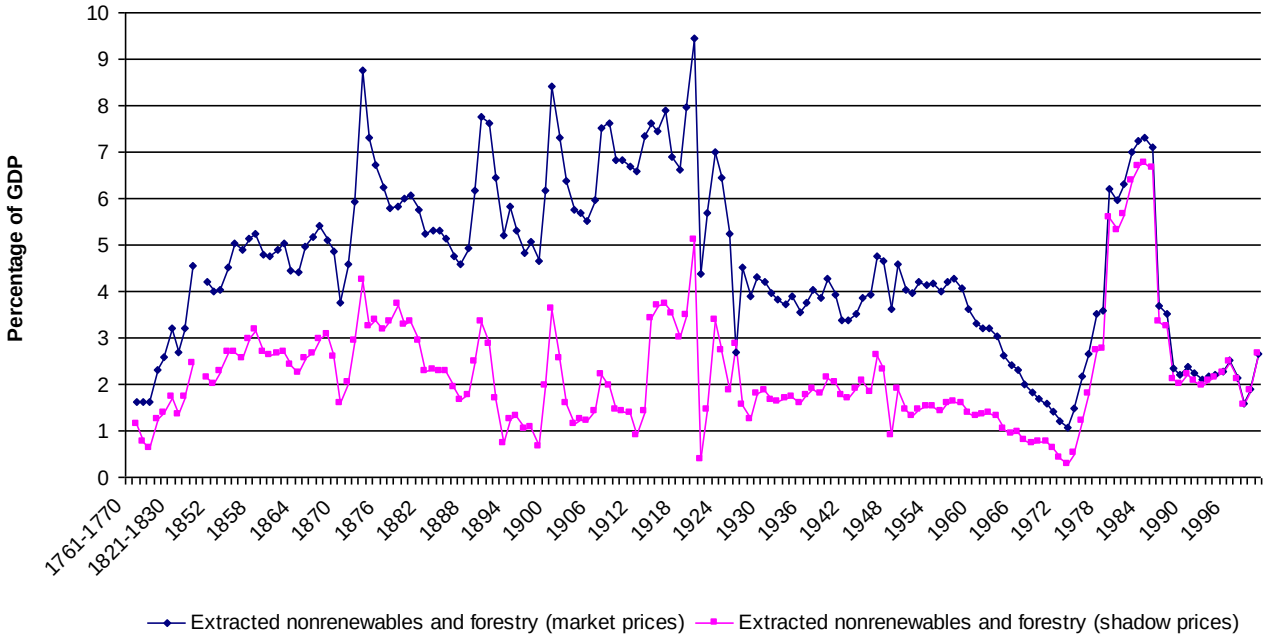
- The authors then use time series econometrics to test whether GS can predict either consumption or real wages (2 measures of well-being) 20, 50 and 100 years into the future, testing for “cointegration” between GS and the two well-being measures.
- Results: GS turns out to predict future well-being reasonably well up to 100 years into the future, although (i) whether include technological progress has an effect (ii) predictions generally better for +50 years than +100 years.
- But our measures of Kn and well-being are both rather basic.

Genuine Savings and other measures of “net investment” over time for the UK



Source: Greasley et al, 2012.

Figure 2 Extraction of non-renewables (including coal) and forestry as a percentage of GDP, 1761-2000

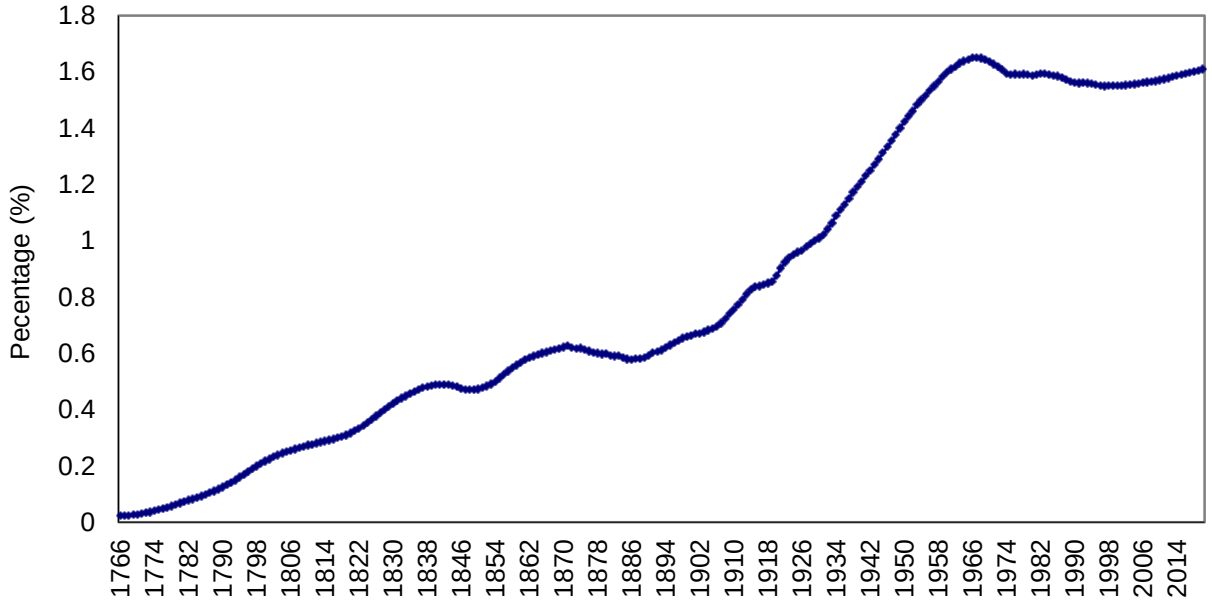


the “natural capital adjustment” is never more than 7% -9% of GDP. However, we note that our measure of natural capital excludes many of the ecosystem service flows which we would ideally like to capture.

What about technological progress?

- This increases our ability to generate well-being from a given set of resources
- It is a major driver of economic growth
- But hard to measure, and conflicts over how to incorporate in sustainability measures
- Our approach was to use changes in “total factor productivity” – but as economists know, this measure has its problems.

Figure 2 Trend TFP growth rate, 1766-2020



Notes: For the TFP calculations, data for real gross capital stock was taken from Feinstein [27], Feinstein [29], O'Mahony [34]. Data on labour, measured in labour hours, was attained from Crafts [35], Voth [36], Wrigley [37], Flinn [38], Feinstein [27], O'Mahony [34], and real GDP data was obtained from Broadberry [26], Feinstein [27], ONS [28

So what does all this mean for agriculture?

- The sector forms part of our national wealth account: in terms of all types of capital.
- Although its measured contribution is now small
- Flow of ecosystem services clearly depends on how farmland is managed, and on changes in area of farmland ➔ implications for value of natural capital of these ecosystem assets (lowland arable, upland farmland, grazing marshes etc).
- As Allan Buckwell will point out, few of these ecosystem services are rewarded by the market, although increasingly more are rewarded by the CAP (and, to a tiny degree, by markets for ES)
- Also, we know rather little about how the value of these ecosystem assets has changed over time, or how they might change under future scenarios (although some work has been done on elements of this) ➔ role of Natural Capital Asset Check.
- But what "sustainability rules" might we wish to impose on agriculture?

Sustainability rules?

- Note that these have mainly been developed in the context of national sustainability. Not much sense, from an economic viewpoint, in prioritising the sustainability of a single sector.
- Which rules to suggest depends on whether we believe in weak or strong sustainability.
- Hartwick-type rules govern re-investment when assets are depleted. Can be into any form of capital. But do not have to be in the same sector. So not obvious that they would apply to agriculture on its own.
- Strong sustainability rules: prevent decline in natural capital. But in value terms or physical units? What are the costs of either approach? How could such rules be implemented?

Rules? (continued)

- A variant: avoid crossing thresh-holds past which the supply of ecosystem services falls discontinuously. But do we know what these thresh-holds are? One example might be the supply of pollination services, although substuitution possibilities exist for wild pollinators
- Maintain capacity to produce food? Of a particular value? But this prioritises one ES over all others. Are we confident about trends in relative values of different (competing) ES over the medium term?

So what are the research priorities?

- Shadow pricing of ecosystem services from agricultural ecosystems, and quantifying how these might change

  ➔ determination of ecosystem asset values
- Measuring human and social capital associated with these ecosystems
- Developing theory of how to deal with thresh-holds, critical stocks and irreversibilities
- Identifying complementarities and trade-offs in the supply of different ES from agriculture
- Value of stock of biodiversity in these ecosystems?

thanks

- The Leverhulme Trust
- David Greasley, Les Oxley, Paul Warde, Eoin MacLaughlin, Jan Kunnas

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