Tracing sustainability in the long run

Genuine Savings estimates 1850 – 2018

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Beyond GDP: Genuine Savings as an alternative indicator

- Genuine savings: current indicator of future prospects
  - Negative genuine savings is a signal of unsustainability (Hamilton and Clemens 1999)
  - Positive genuine savings needs to be interpreted with a little more care
- “Early” empirical insights now augmented by substantial theoretical interrogation

Our contribution

- Project
  - Global database of sustainability indicators for 40(+) countries
  - Create a long-run basis of Genuine Savings
    - Building on earlier work by Rubio (2004), Lindmark & Acar (2013), & Greasley et al. (2014)
  - Bring debates about sustainability into mainstream economic history
    - Address strengths and weakness of alternative measures
  - **Aim**: A global measure of historical sustainable development

- Paper
  - Contextualise modern work (i.e. what happened before 1990)
  - Genuine Savings as comprehensive measure of progress in a national accounts framework
  - **Complement existing long-run estimates of GDP**
    - Comparable across time & space
    - Comparable with widely used Maddison Database (Bolt & Van Zanden 2014, 2020)

Rules for SD: Hartwick Rule & Genuine Savings

- A basic measure is 'saving' – how much of production is saved for the future, rather than being consumed now
- 'Genuine saving' is a comprehensive measure of saving, which includes depletion of environmental resources
  - ΔWealth: *genuine savings*/ 'comprehensive investment'
- Based on the Hartwick Rule (John Hartwick, AER, 1977):
  - " the investment of current exhaustible resource returns in reproducible capital implies per capita consumption constant"

Economic History Research on wealth of nations

- Modern national accounting dates from 1930s (Coyle 2015; Field 2019)
- Since 1960s has focused on quantifying long-run economic growth by estimating GDP (Maddison 2004; Bolt & Van Zanden 2014)
- Historical data used to contextualise modern and historic development (Arndt 1987)
- GDP estimates used to explain drivers of growth (Crafts 2009; Crafts & Woltjer 2021)

Genuine savings calculations

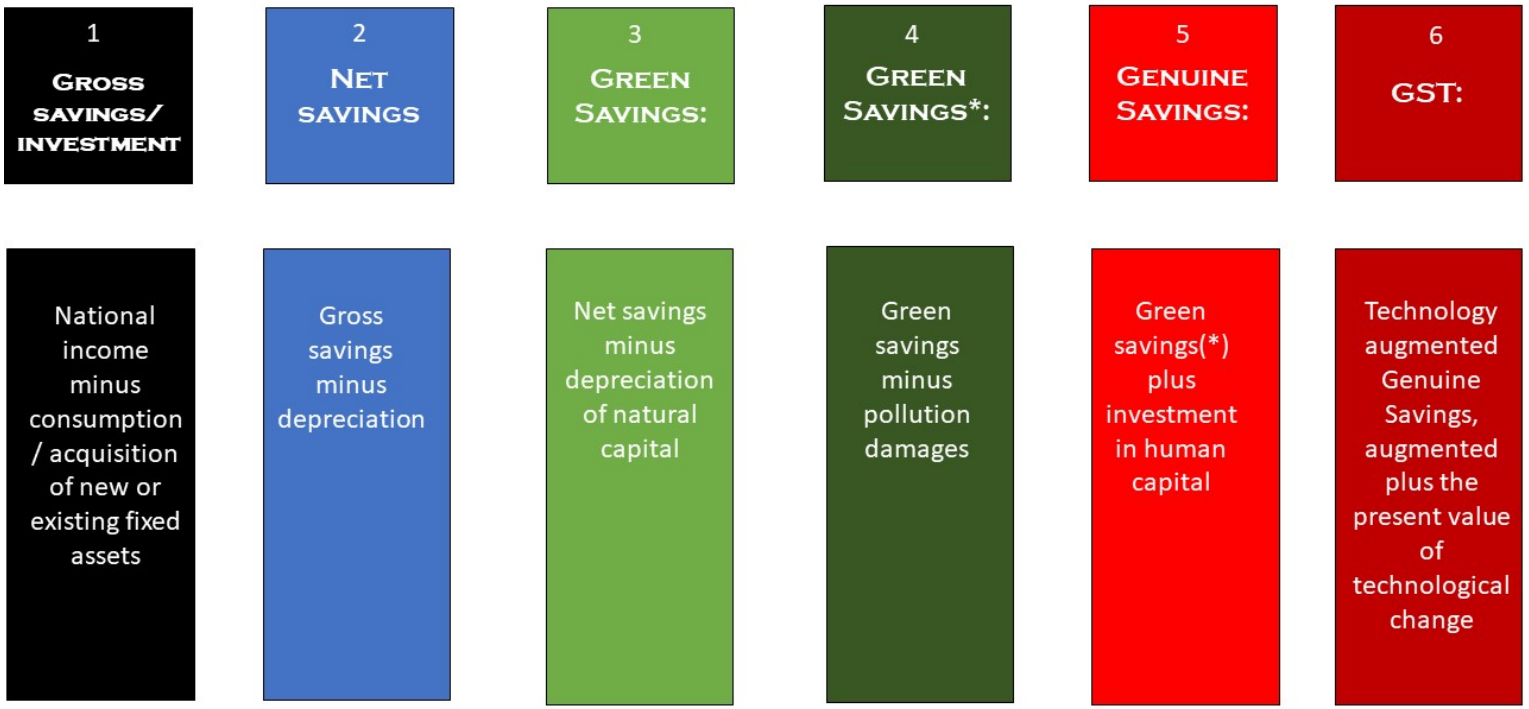


Figure: Genuine Savings Calculations

GS Methodology

- Following Hamilton & Clemens (1999) and World Bank (2006, 2011), we use the following formula for calculating our baseline GS:

$$\mathbf{GS} = [I - \delta K] - [n] - [\sigma(e)] + [m] \tag{1}$$

- Where:
  - I = Investment
  - δK = depreciation of fixed capital
  - n = resource rents, where $n = \sum q_r(p_r - c_r)$
  - $\sigma(e)$ = damage costs from pollution
  - m = $ spending on human capital

GS Extensions

- Technological progress and the value of time is an important concept in theoretical literature
  (Weitzman 1997, 1999; Ulph & Pemberton 2001; Arrow et al. 2004, 2012)
  - Changes in TFP as an indicator of technological progress
  - Weitzman (1997) TFP adjustment may be in the region of 40% of net national product
  - Net present value of TFP contribution to future GDP growth (Pezzey et al. 2006; Mota and Domingos 2013; Greasley et al. 2014)

Global pollutants

- Incorporate carbon dioxide emissions in our *global* estimates (Pezzey & Bourke 2014)
  - Use marginal damage costs from existing literature (e.g., DICE models)
  - Current view is that DICE models are biased downwards (Stern 2022)
  - Use a variety of prices to reflect low, medium, & high scenarios
  - Prices discounted (2%) (Kunnas et al. 2014; Rennert et al. 2022)

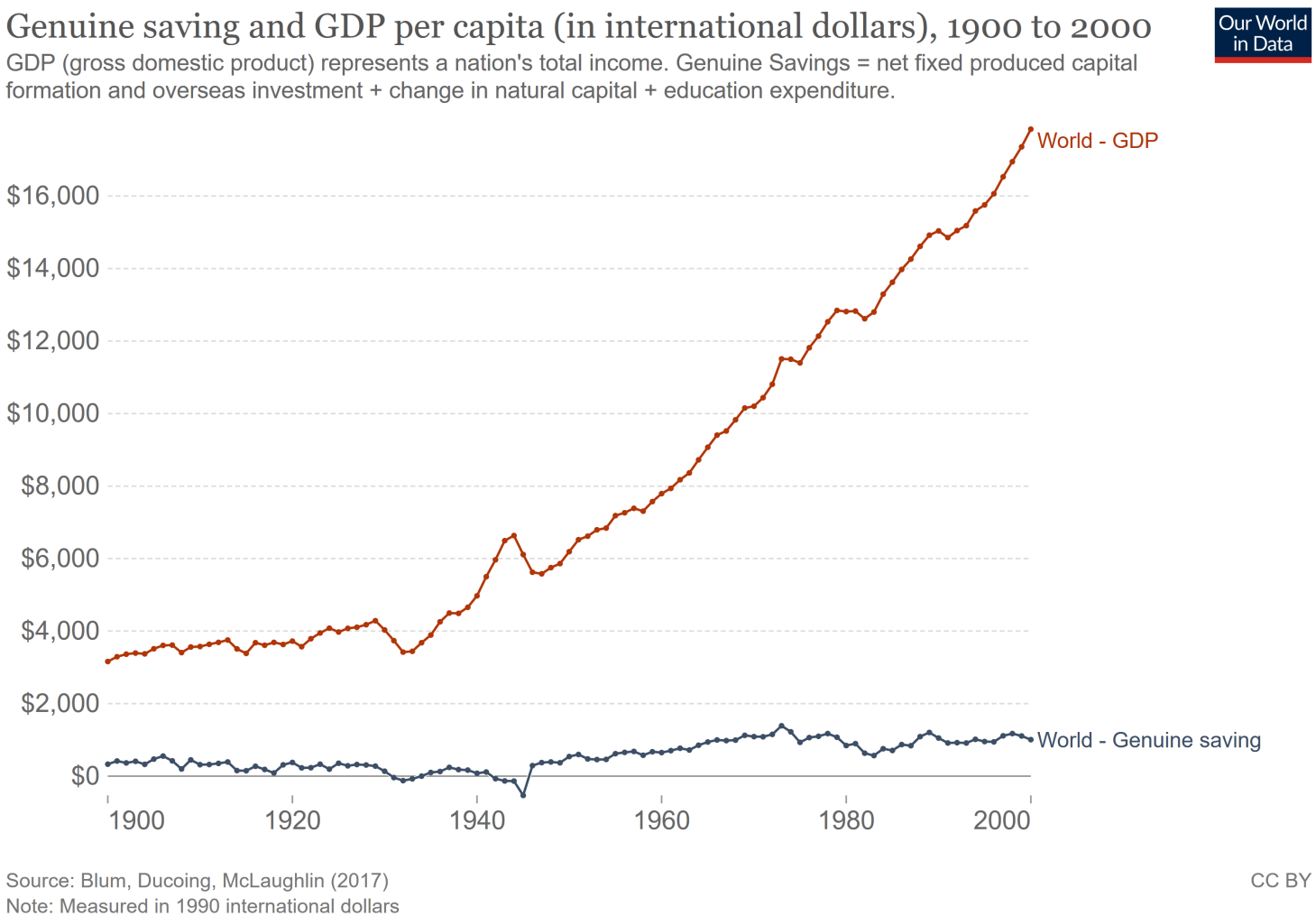
Limitations

- Only quantifying indicators that can be approximately expressed in monetary units
- Omissions:
  - Fisheries
  - Biodiversity/ Ecosystem services
- Overlooking *local* pollutants
  - SO_2 and NOx
  - Water pollution

Modern studies

Country	Period	Source
17 countries	1990	Pearce & Atkinson (1993)
c. 50 countries	1970* - 2000	Hamilton & Clemens (1999)
Latin American	1973-1986	Vincent (2001)
Scotland	1990 - 2000	Pezzey et al. (2006)
c. 176 countries	1970-2003	World Bank (2006)
Ireland	1991-2005	Ferreira & Moro (2011)
c. 176 countries	1975-2008	World Bank (2011)
Portugal	1991-2005	Mota & Domingos (2013)
Global	2005	Pezzey & Burke (2014)

Our previous work (as featured on Our World in Data)

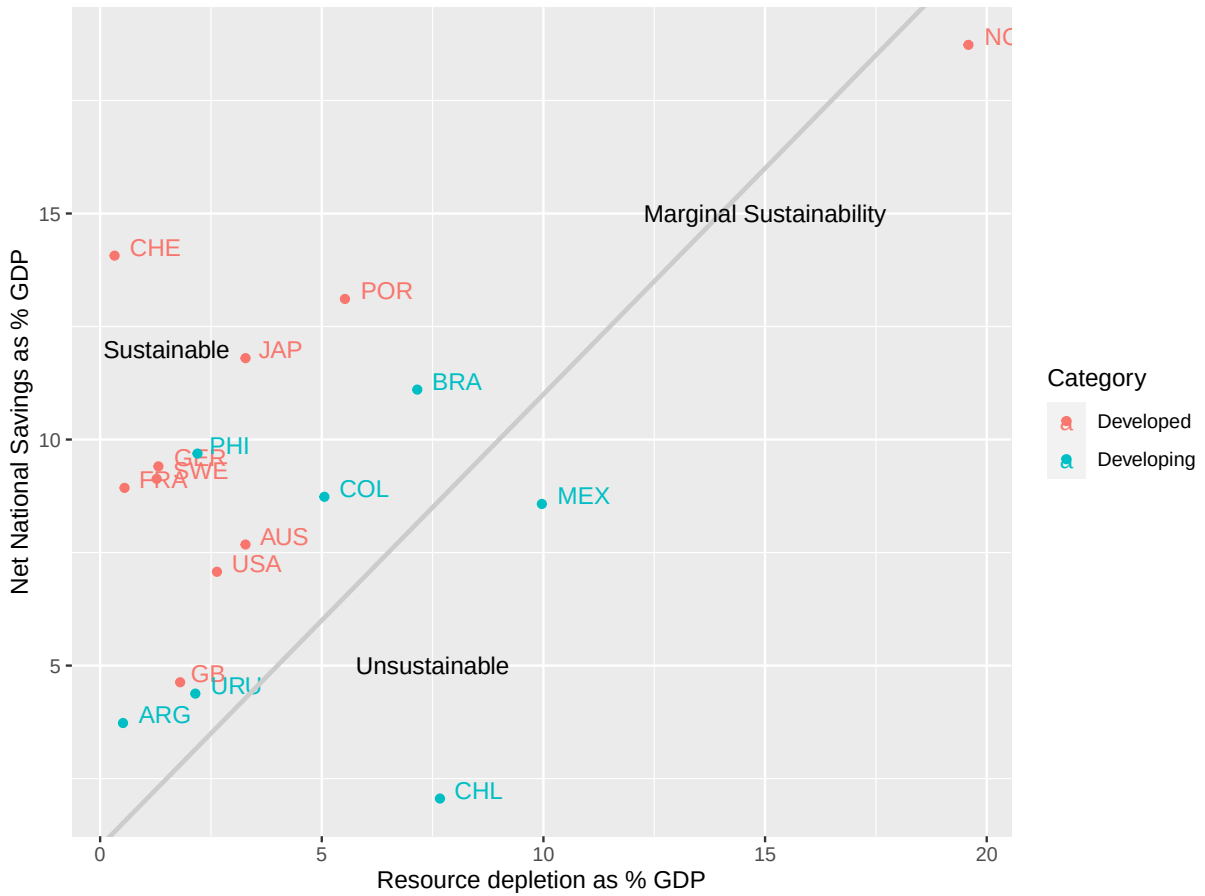


Data coverage

Country	Period	Source
Argentina	1900 - 2000	Blum et al. (2017)
Australia	1870 - 2018	Greasley et al. (2017)
Brazil	1880 - 2018	Blum et al. (2017)
Cambodia	1970-2010	This paper
Chile	1880 - 2000	Blum et al. (2017)
Colombia	1900-2000	This paper
Costa Rica	1950-2000	This paper
France	1900 - 2000	Blum et al. (2017)
Germany	1850 - 2010	Blum et al. (2019)
Japan	1880 - 2010	This paper
Mexico	1900-2000	Rubio (2004)
New Zealand	1950 - 2000	Qasim et al. (2020)
Norway	1870 - 2000	Fink & Ducoing (2021)
Philippines	1902-2000	This paper
Portugal	1900 - 2000	This paper
Spain	1950 - 2010	Iriarte
Sweden	1850 - 2010	Lindmark & Acar (2013)
Switzerland	1900 - 2000	Blum et al. (2017)
Venezuela	1935 - 1985	Rubio (2004)
United Kingdom	1760-2000	Greasley et al (2014)
United States of America	1870 - 2015	Hanley et al. (2015)
Uruguay	1875 - 2015	Labat et al. (2019)

‘Useful new information’?

Figure: Scatter plot of Resource Depletion and Net Savings rates, 1900-2000



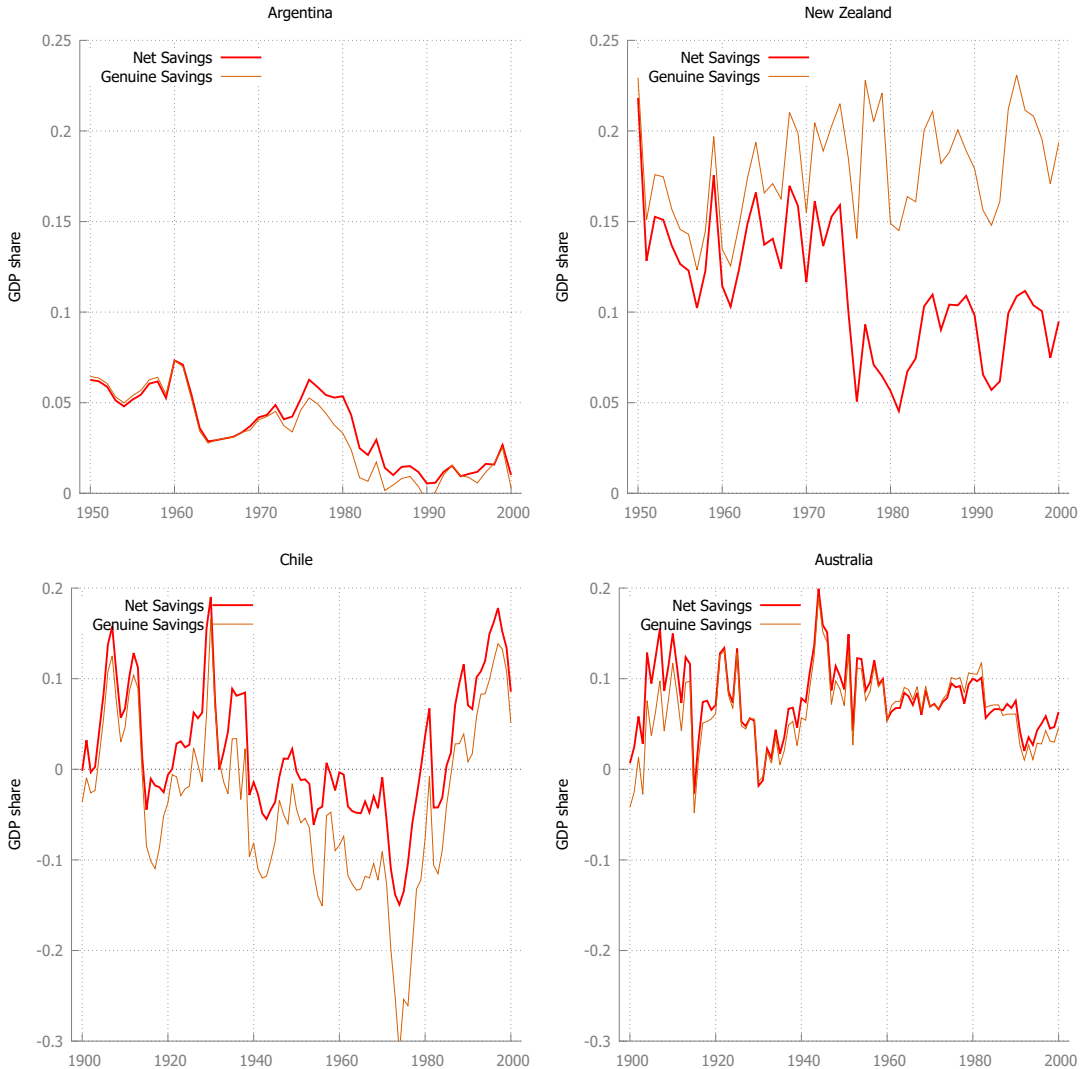
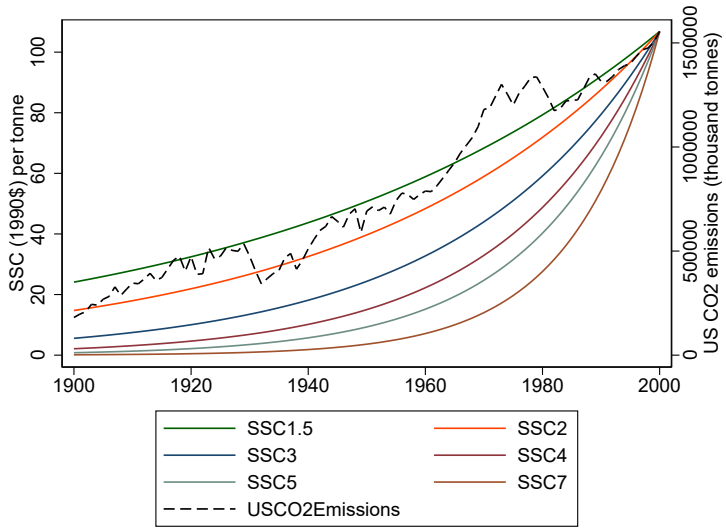


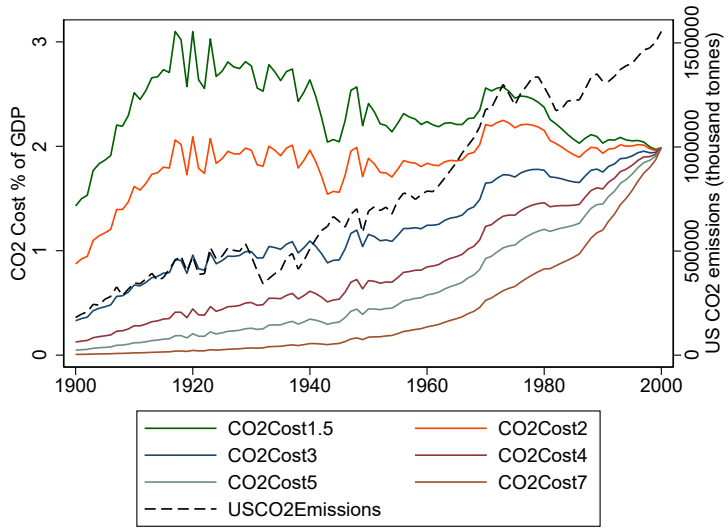
Figure: Net National Savings and Genuine Savings in Argentina, New Zealand, Chile and Australia. 1900 - 2000

Social Cost of Carbon

(a) SCC

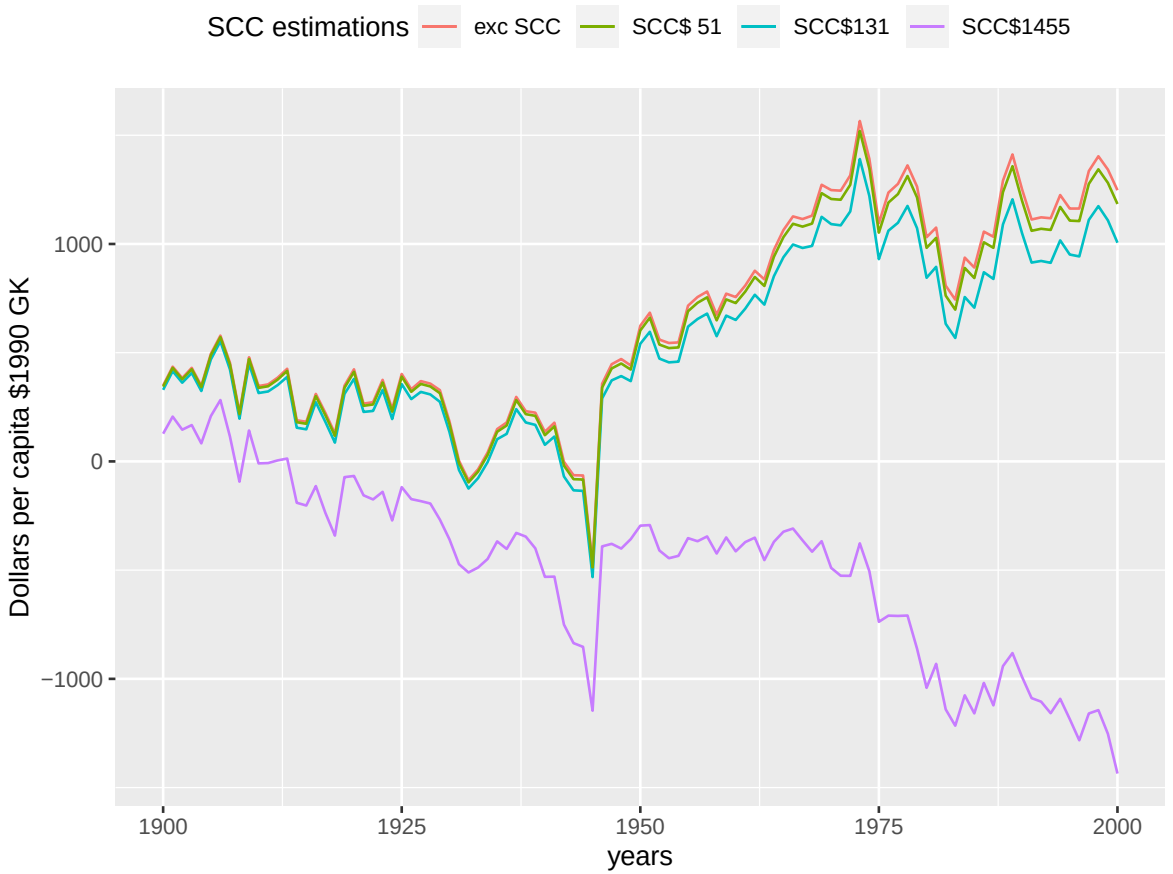


(b) Carbon costs % of GDP



Aggregate GS - including and excluding CO_2

Global estimates GS including SSC $0, $51, $131, and $1455



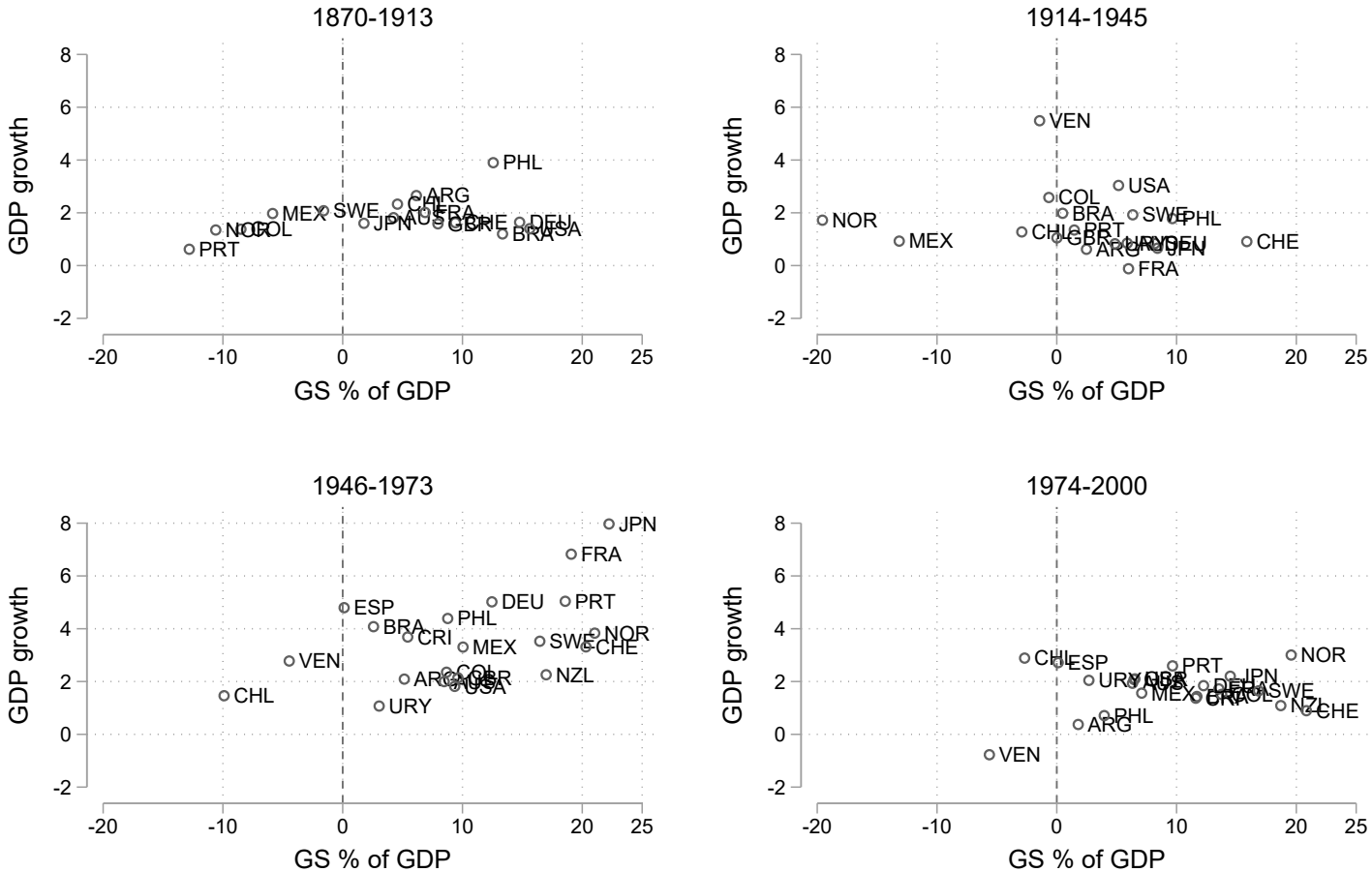


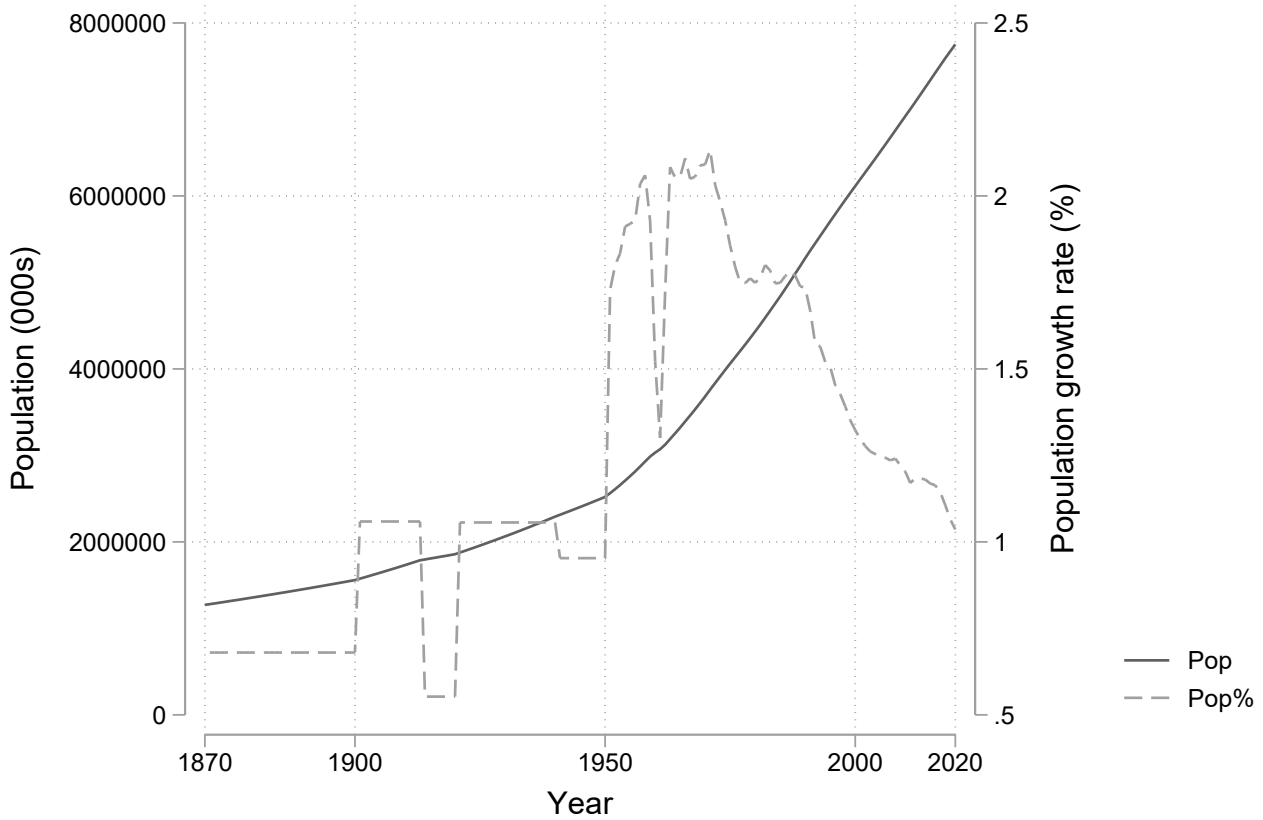
Figure: GDP growth and GS rates. 1870 - 2000

Future Questions

- Is there “one” indicator or we should use several indexes?
- Can we push for a GDP replacement?
- Are we correctly valuing our natural resources?
- How should we incorporate technological progress?
- What (& how) pollutants should be included?
- How do we incorporate international sector more robustly?

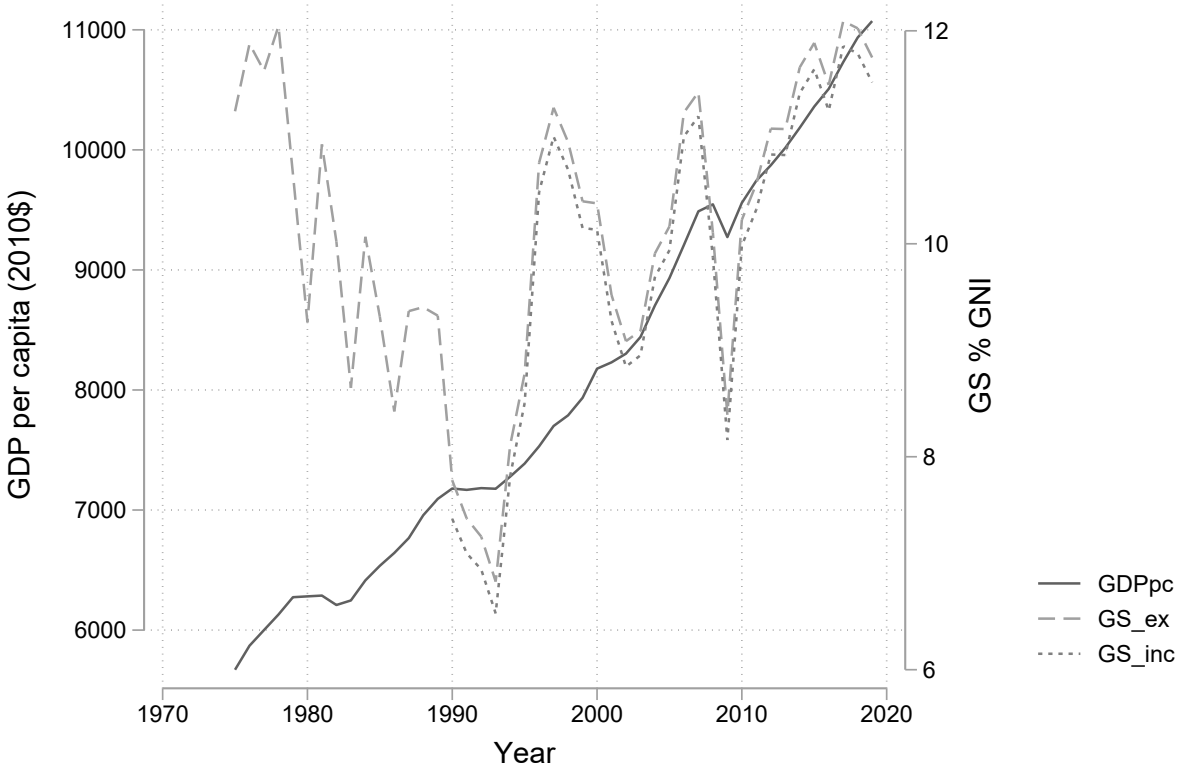
Some issues: Wealth dilution

Population levels and population growth 1870-2020



Link our database with World Bank database

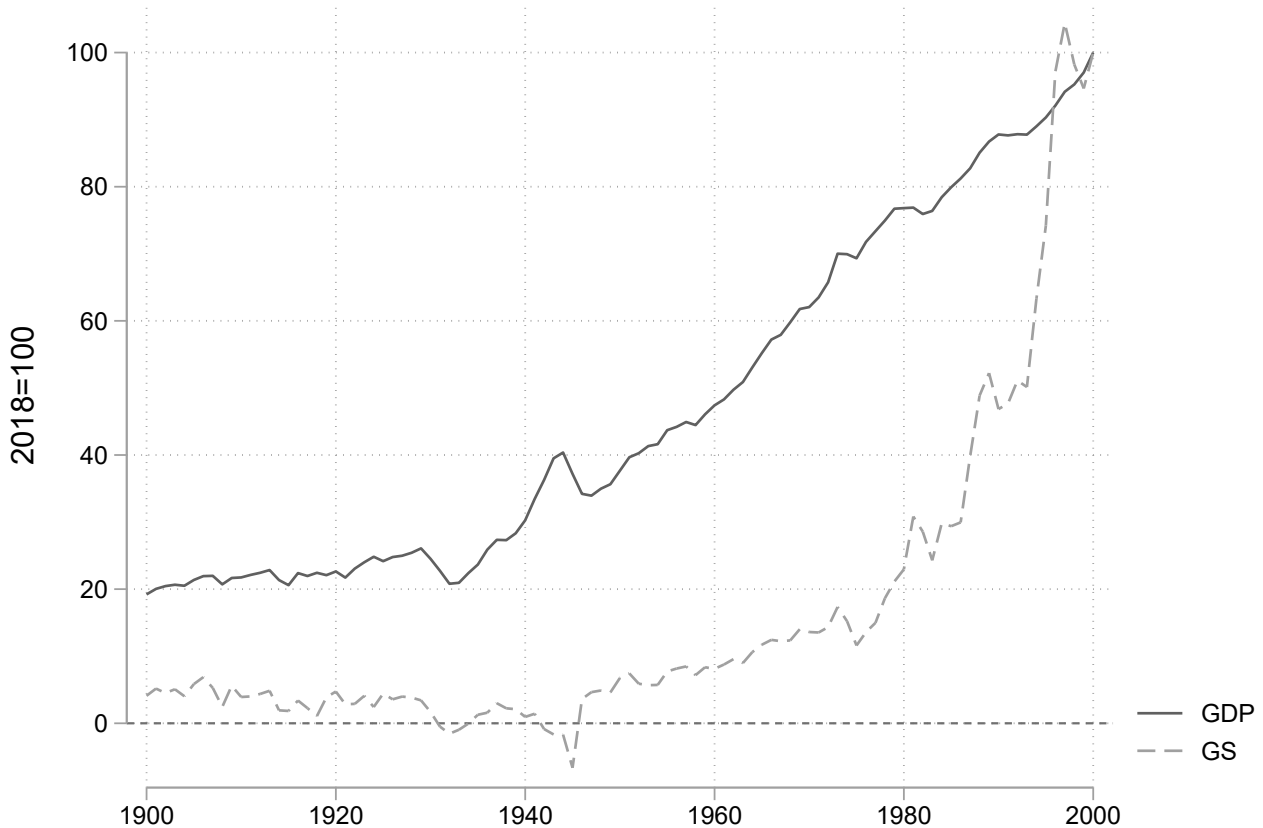
Figure: Global Savings Rates



Source: World Development Indicators and author calculations

Long run “World” GDP and GS preliminary trends

GDP and GS per capita, 1900-2020



Spliced index based on our database and World Bank data