Can Today's and Tomorrow's World Uniformly Gain from Carbon Taxation?

Kotlikoff, Kubler, Polbin, & Scheidegger

Discussion at "Climate and the Business Cycle" Workshop

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Questions

- Q: Can we design a system of intergenerational transfers along with carbon taxation to *uniformly* increase welfare of all generations?

Build on "MAKING CARBON TAXATION A GENERATIONAL WIN WIN" (2021)

X 18 regions in an open economy

Climate Macro General Equilibrium Model

- OLG model (begin at age 20 and max age of 100)
  - Feed in UN population projections (fertility, mortality, migration)
  - Fair annuity market hedges mortality risk
- Final consumption good with capital, labor, and energy
- Energy: clean (produced with land, K, L) or dirty (produced with fossils)
  - Baseline: perfect substitutes (allow for gradual increase in substitutability)
- Dirty energy: coal, oil, natural gas (Golosov Hassler Krusell Smith, 2014)
  - Increasing resource extraction costs on finite world resources
  - **<u>Carbon taxes</u>** per unit of dirty energy
 - Perfectly competitive energy producers

Macro Structure

- Single consumption good in the world (no home bias/trade costs)

- Perfect capital mobility – unique world real interest rate

- Labor market region specific.
  - Countries differ in their energy share, and TFP
  - Labor immobile

- Energy intensity region-specific
  - Clean energy non-tradeable. But oil, gas, coal freely tradeable.

- homogenous ownership of all assets (fossils, land, capital, debt)

Climate meets Macro block

- Dirty energy ⟶ Emissions ⟶ Temperature ⟶ Damage
  - (Nordhaus + advances in climate science Follini, Kubler, Malova & Scheidegger 2021)
- Production of fossils feed into carbon (Atmospheric & Oceanic)
- Carbon concentration ⟶ radiative forcing ⟶ temperature
- Translate the global temperature into GDP weighted local temperature
- Local temperature affects local TFP (good for cold countries)

Schematic for Bill Phillips' MONIAC: Monetary National Income Analogue Computer
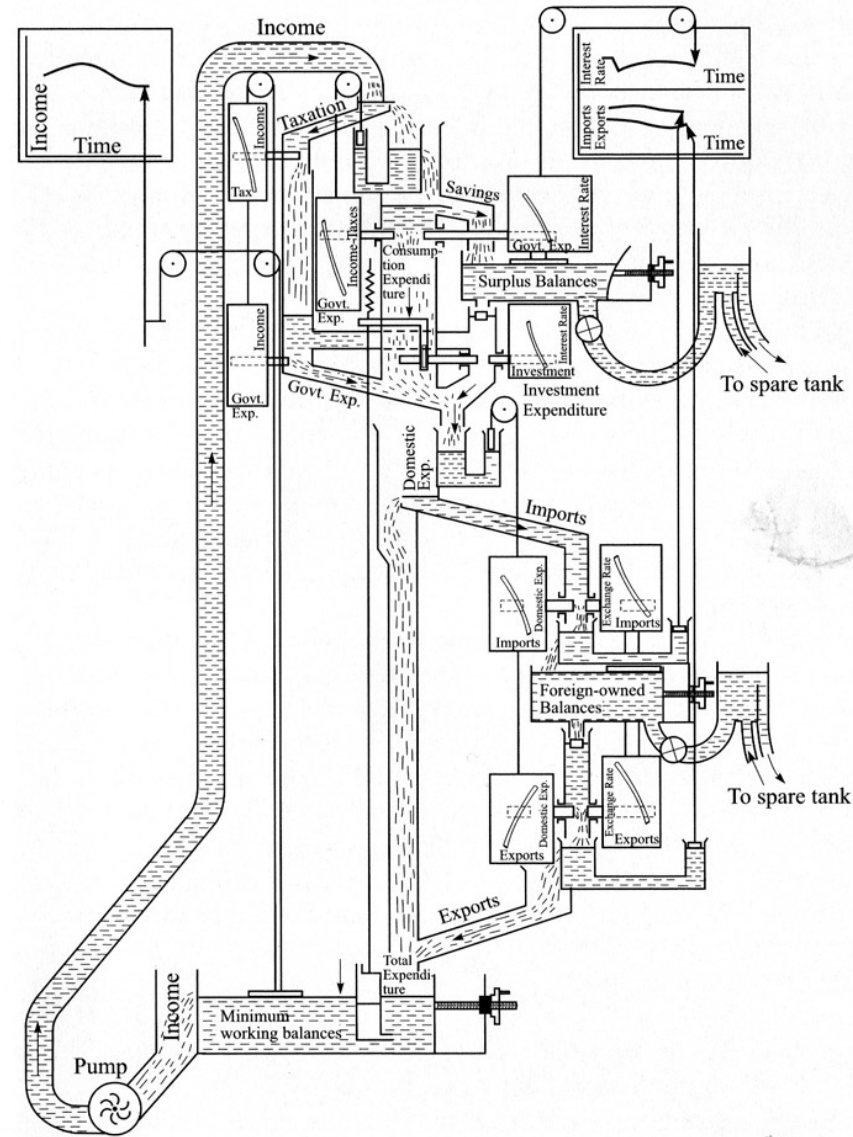
Carbon Policy Instruments

- Sequence of carbon taxes
    - Initial carbon tax
    - Growth rate of carbon taxes
- Transfers to current generations at date 0
- Transfers to unborn generations in their first year
- Debt issued by IMF to finance carbon policy

Uniform Welfare Improvement (UWI)

- OLG framework to think about carbon taxation
  - Intergenerational externality from carbon emissions
  - Single infinitely lived agents: how do you choose a discount factor? Ethics? Intergenerational altruism?
  - Their solution: UWI. With caveat that we get to leave debt burden on *unborn* generations.

- Optimal Carbon Policy
  - An initial carbon tax, a carbon tax growth rate, and generation-specific net transfers
  - To uniformly maximize the welfare-gain of all generations (UWI)
  - the largest uniform (across all current and future generations) welfare increasing (UWI) carbon tax
  - Welfare changes = compensating consumption differentials relative to business-as-usual (BAU) scenario

How it is being computed?

1. Find optimal carbon tax path based on social cost of carbon in business as usual

2. For this tax path, compute the solution to UWI redistribution policy

3. Calculate new equilibrium social cost of carbon. Update the carbon tax.

4. Iterate until convergence

What is being computed

- Time paths of
  - aggregate capital stock,
  - oil, coal, gas reserves
  - global emissions,
  - TFP, and,
  - carbon tax

  over a millennium to determine yearly
  - Prices: coal, oil, gas, land, labor, capital,..
  - Quantities: consumption, temperature, damages…

(some of the) Quantitative Results

Business as Usual
- Avg temperature increase is 3.7℃ by 2200
- "Good" for Canada and Russia, "Bad" for India, Africa, the Middle East

Optimal UWI policy
- Dirty energy usage ends in 2103, limits rise in temperature to 2.1℃

Good news: carbon taxation works! Consumption increase of 4.3% for all under business as usual to be *indifferent* to UWI scenario.

Bad news: we may be too late! Optimal policy limits *absolute* economic damages by 44% relative to business as usual.

What do the UWI transfers look like?

The Redistribution Authority (IMF) makes transfers

- Positive (near-term) to Russia, Eastern Europe and Former Soviet
  - to offset their rising costs as they use fossils heavily in production
  - About 15% of lifetime consumption
- Negative (after 2200) to India
  - Most exposed to climate change under business-as-usual
  - About 40 percent of lifetime consumption

Time-consistent policy

- UWI is not time-consistent. Future generations once climate change is resolved may decline to honor the taxation burden

- Alternate policy: UWIF.
  - Restrict current generation utility to business as usual
  - Impose a flat 10% tax on future generations
  - Future generations are better off than UWI (not paying as high taxes)
  - India still faces highest carbon taxes in the future
  - They restrict future net tax cap to 10 percent in another UWIL policy
- Like the exercises they do, but somewhat unconvinced that UWIL is politically feasible.

Coalitions: convergence and compliance

If China does not agree to the optimal carbon policy,

- Can achieve only 60% of the Consensus gains

- Gains from coordination with China are very large

- I think it relies on an assumption of convergence in income between EU and China

- Nordhaus (2015): Climate Clubs with import sanctions on non-participants? Can import sanctions on non-compliant countries work?

- Trade wars to deal with climate compliance? Nordhaus (2021)

Climate Clubs: political feasibility

- Coalition consensus is hard to build for many reasons
  - Winners and Losers are separate entities.
  - Consume different goods, different political appetite for sanctions
  - What if only the losers built a coalition?

  - Interaction of Demographics with climate coalition/clubs

  - Climate coalitions with heterogenous ownership of fossils

Somewhat surprising answers

- Distribution of global GDP unaffected under UWI
  - Despite nonlinear climate damage functions
- US and China have similar temperatures today. Damage proportional to temperature. So, climate change does not affect distribution of income materially

- allow for spillovers in climate damages (input-output networks)?

I would like to understand a little better

- The projection on real interest rate

Current calibration is 4% per year.

Under BAU, projected to fall to 2.9%. Under UWI, between 3.4% – 4.2%

    Would be useful to see how carbon taxation interacts with aging

    Interaction with growth assumptions (Benzel et al. 2023)

Could make a connection to misallocation of capital (Hsieh and Klenow) to interact with carbon policy?

    Productivity damages should push down r*

    How would MPK heterogeneity interact with carbon policy?

I liked this paper a lot

- Structural approach
- Obviously comes with a lot of assumptions but most of these are very transparent
- Non-trivial computational artillery
- There is a lot of admiration for the work in this paper
- I learnt a great deal!
- Recommend reading it!

Thank you!