International Cooperation on Trade and Green Industrial Policy

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Plan

Motivation

1. Governments need to use green subsidies for climate objectives + political economy.
2. Green subsidies have international externalities: profit shifting and relocation.
3. Therefore, they can produce subsidy races.
4. And they interact with trade policy, possibly violating trade agreements.

Questions

1. How do subsidy races work and what is their impact?
2. How would international cooperation look like in a world in which governments need to use green subsidies if they decide to reduce carbon emissions due to domestic political economy constraints?

Approach

Combine a simple new trade model of relocation externalities (Ossa 2011 JPE) with a simple model of climate policymaking with political economy (my JMP).

Motivation 1

Governments need to use green subsidies.

Policy sequencing toward decarbonization

Jonas Meckling[1*], Thomas Sterner[2] and Gernot Wagner[3,4*]

Many economists have long held that carbon pricing—either through a carbon tax or cap-and-trade—is the most cost-effective way to decarbonize energy systems, along with subsidies for basic research and development. Meanwhile, green innovation and industrial policies aimed at fostering low-carbon energy technologies have proliferated widely. Most of these predate direct carbon pricing. Low-carbon leaders such as California and the European Union (EU) have followed a distinct policy sequence that helps overcome some of the political challenges facing low-carbon policy by building economic interest groups in support of decarbonization and reducing the cost of technologies required for emissions reductions. However, while politically effective, this policy pathway faces significant challenges to environmental and cost effectiveness, including excess rent capture and lock-in. Here we discuss options for addressing these challenges under political constraints. As countries move toward deeper emissions cuts, combining and sequencing policies will prove critical to avoid environmental, economic, and political dead-ends in decarbonizing energy systems.

Motivation 2

Green subsidies have international spillovers: profit shifting and relocation.

THE EFFECTS OF "BUY AMERICAN":
ELECTRIC VEHICLES AND THE INFLATION REDUCTION ACT

Hunt Allcott
Reigner Kane
Maximilian S. Maydanchik
Joseph S. Shapiro
Felix Tintelnot

Working Paper 33032
http://www.nber.org/papers/w33032

Motivation 3

Non-cooperative policies can involve subsidy races.

Motivation 4

Subsidies can violate trade agreements.

- Japan and the EU filed complaints at the WTO against Ontario's Feed-in Tariff in 2010. They partially won. (See Charnovitz and Fischer, 2015.)
  - Canada violated GATT Article III:4 (no discrimination) and TRIMs Article 2.1 (no local content requirements) do to LCR on RE generation components.
  - But the Appellate Body could not conclude whether the FIT was a prohibited subsidy under the Agreement on Subsidies and Countervailing Measures (ASCM).
- The US filed a complaint at the WTO on 6 February 2013 against India's domestic content requirements under the Jawaharlal Nehru National Solar Mission ("NSM") for solar cells and solar modules.
- China filed a formal complaint at the WTO on March 2024 against the US against several IRA tax credits.

Broad Theoretical Questions

1. How do subsidy races work and what is their impact?
   - Are they good for the environment?
2. Does international cooperation help? How?
   - Without the climate externality, is banning discriminatory subsidies a good idea?
   - With the climate externality, does it make sense to "allow" the race?
3. What if climate policy requires subsidies due to political constraints?
   - What if two governments are simultaneously playing the game with their domestic industries (described in my JMP), and there are relocation externalities?

Literature

Obviously I'm not the only person thinking about this.

1. **Kotchen and Maggi (2024).** Very similar question, but different enough approach. They fix trade policy and find equilibrium climate policy with and without lobbying. No relocation, and no dynamics. Insight: in a non-cooperative equilibrium subsidies are good because they have a "reverse leakage" effect. A perfect agreement removes subsidies, but if there is a "speed limit" subsidies initially increase and then go to zero. Green lobbies may be good in a non-cooperative equilibrium.

2. **Papers that look at interaction between carbon taxes and trade (policy).** Nordhaus (2015), Böhringer et al (2016), Shapiro (2021), Le Moigne et al (2024), Farrokhi & Lashkaripour (2025).
   Several econ JMPs: Baek (UC Davis), Bourany (Chicago), Hong (Penn State), Hsiao (MIT), Xiang (Yale). Relevant but I care about subsidies.

3. **Think Pieces.** Charnovitz (2014), Charnovitz & Fischer (2015), Clausing & Wolfram (2023), Mehling (2024), ...

The Model

I start with a version of Krugman (1980) that incorporates green vs polluting production.

There is a set of locations $i \in [0,1]$. Each location produces a unique product with two technologies given by their cost function $c_i \in \{c^g, c^b\}$.

- $c^g(q) = f + cq$, $c^b(q) = q$, with $f > 0$, $c < 1$.
- **The green technology has increasing returns to scale.**

Consumers have CES preferences $U = \left(\int_0^1 q_i^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}$ with $\sigma > 1$. Demand is $q_i \propto p_i^{-\sigma}$.

Producing q_i units has labor costs $c_i(q_i)$. Producers choose prices p_i to maximize profits $\pi_i = p_i q_i - c_i(q_i)$. There are L units of labor supplied inelastically.

Monopolistic competition, so $p_i = \frac{\sigma}{\sigma-1} c_i'(q_i)$ and $\pi_i = \frac{1}{\sigma-1} c_i q_i - f_i$. In equilibrium profits using each technology are the same. Locations $[0, g]$ use c^g and $(g, 1]$ use c^b.

Proposition
The equilibrium is socially optimal, i.e., maximizes aggregate welfare.

Adding Climate Damages

Suppose that polluting technology releases q_i units of GHGs that reduce labor by γq_i.

Consider a carbon tax τ on carbon emissions, i.e., polluting firms pay τq_i.

Proposition
The social optimum can be implemented with carbon taxes $\tau = \gamma$.

Carbon taxes raise the price of products using polluting technology and reduce the number of firms using the polluting technology.

Adding Political Economy

Suppose that implementing policy requires agreement by n locations (e.g., $n = \frac{1}{2}$).

Each location has income $Y_i = L + \pi_i + T$, where T is a lump-sum transfer. Welfare is $W_i = Y_i/P$, where $P = \left(\int_0^1 p_i^{1-\sigma}\, di\right)^{\frac{1}{1-\sigma}}$ is the price index.

Timing:

1. Government chooses a green subsidy s.
2. Locations choose technology.
3. Government chooses a carbon tax τ.
4. Producers choose prices, consumers choose quantities, and government chooses lump-sum transfers to balance the budget.

Proposition

Under some conditions the government uses the green subsidy to build a coalition of green locations, and a carbon tax $\tau = \gamma$.

Adding Trade

We add an equal country, add their emissions as climate damages, and allow trade in products with iceberg costs $\theta > 1$.

Proposition
The global optimum can be implemented with free trade and a carbon tax $\tau = 2\gamma$.

Optimal Unilateral Policy

Proposition
The unilateral optimal allocation can be implemented using a combination of tariffs, green subsidies and carbon taxes.

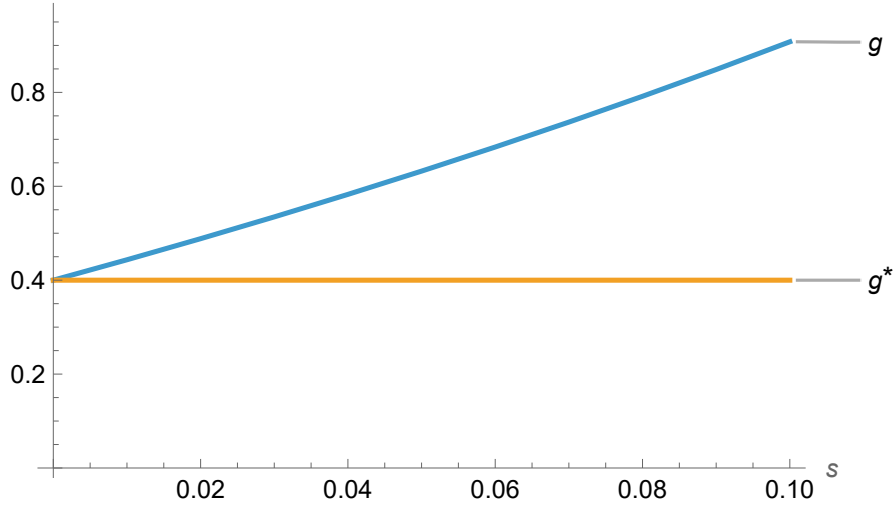
In these models there is a welfare rationale for unilateral tariffs.

In the absence of tariffs, even if there are no climate damages, there is a welfare rationale for green subsidies.

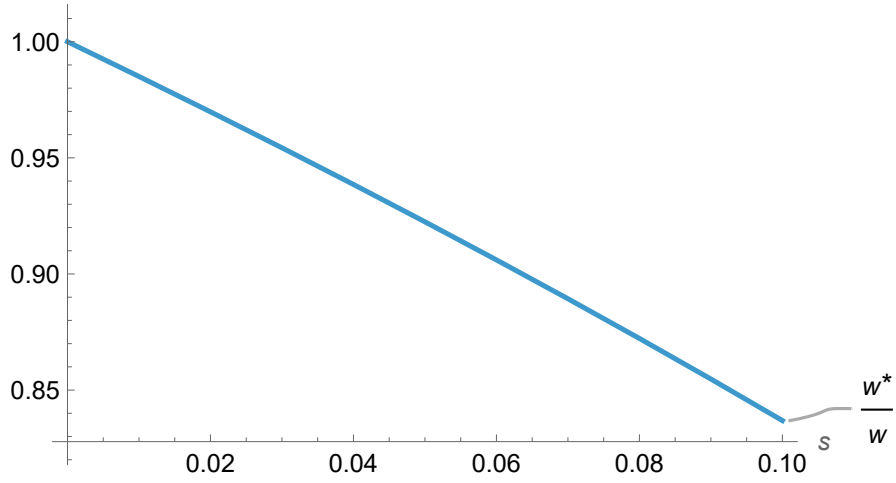
Equilibrium

$$(cw)^\sigma x_g = ((1+\tau)w)^\sigma x_b = (c\theta_g w^*)^\sigma m_g = (\theta_b w^*)^\sigma m_b,$$
$$(cw^*)^\sigma x_g^* = ((1+\tau^*)w^*)^\sigma x_b^* = (c\theta_g^* w)^\sigma m_g^* = (\theta_b^* w)^\sigma m_b^*,$$
$$g(cq_g + f) + (1-g)(1+\gamma)q_b + \gamma(1-g^*)q_b^* = L,$$
$$g^*(cq_g^* + f) + (1-g^*)(1+\gamma)q_b^* + \gamma(1-g)q_b = L,$$
$$q_g = x_g + \theta_g^* m_g^*, \quad q_b = x_b + \theta_b^* m_b^*,$$
$$q_g^* = x_g^* + \theta_g m_g, \quad q_b^* = x_b^* + \theta_b m_b,$$
$$\pi = \frac{1}{\sigma-1} cq_g - f + s = \frac{1}{\sigma-1}(1+\tau)q_b,$$
$$\pi^* = \frac{1}{\sigma-1} cq_g^* - f + s^* = \frac{1}{\sigma-1}(1+\tau^*)q_b^*,$$
$$(c\theta_g m_g + \theta_b m_b)w^* = (c\theta_g^* m_g^* + \theta_b^* m_b^*)w.$$

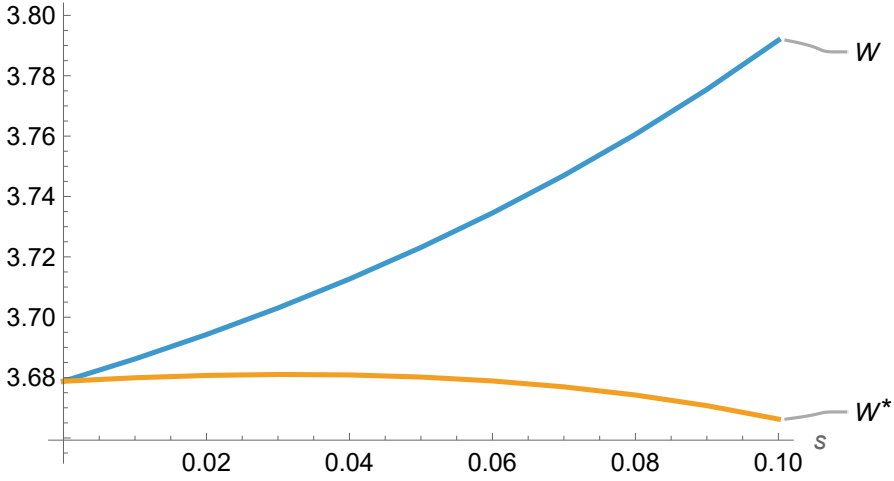
Effect of Subsidy on Green Investment



Effect on Exchange Rate



Effect on Welfare



Results I expect

With only one country this is essentially my JMP, and what happens is that if polluters are a majority initially, governments need to use the subsidy today to "build a coalition" for a carbon tax tomorrow.

With two countries I expect that the subsidy increases the number of green varieties in the home country, but decreases the number of green varieties in the foreign country.

We could get a subsidy race, or "specialization:" one country uses subsidies and then carbon taxes, and the other one doesn't use any climate policy.

Conceptual point: subsidies can make the politics of climate policy easier in the home country, but can make it harder in other countries. Political spillovers.

Can a climate agreement without dynamic commitment help? (I suspect yes.)

What happens if governments can use trade policies? What if they can sign an agreement on climate and trade policies?