Inefficient Policies in the Green Transition

Juan Dodyk

Washington University in St. Louis

Two Approaches to Climate Policy

Taxing Pollution

Subsidizing Green Technologies

Two Approaches to Climate Policy

Taxing Pollution

Subsidizing Green Technologies

Two Approaches to Climate Policy

Economists recommend taxing pollution

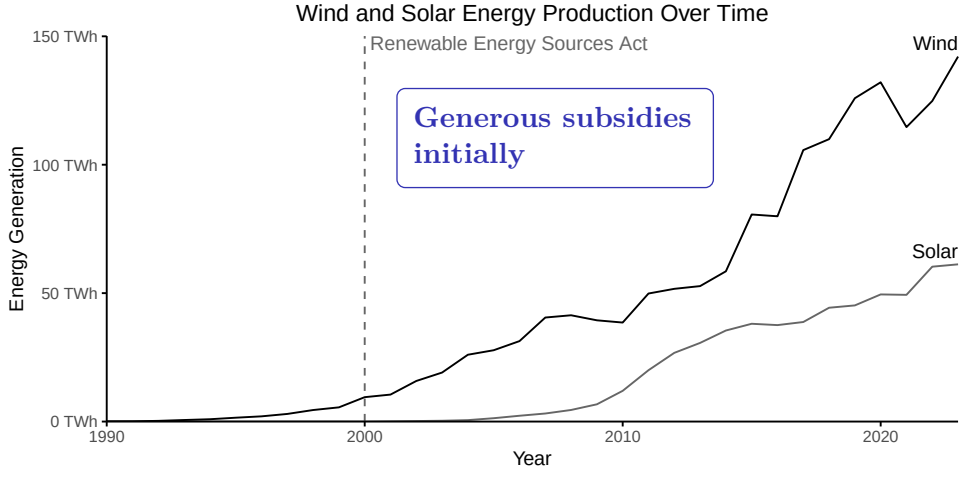
- Statically, it reduces emissions cost-effectively
- Dynamically, it encourages economic actors to invest in clean technologies if the environmental harms justify paying the cost of transition

Reality: only 1% of global emissions are taxed at the recommended level (World Bank)

Variation across countries, and **within countries over time**.

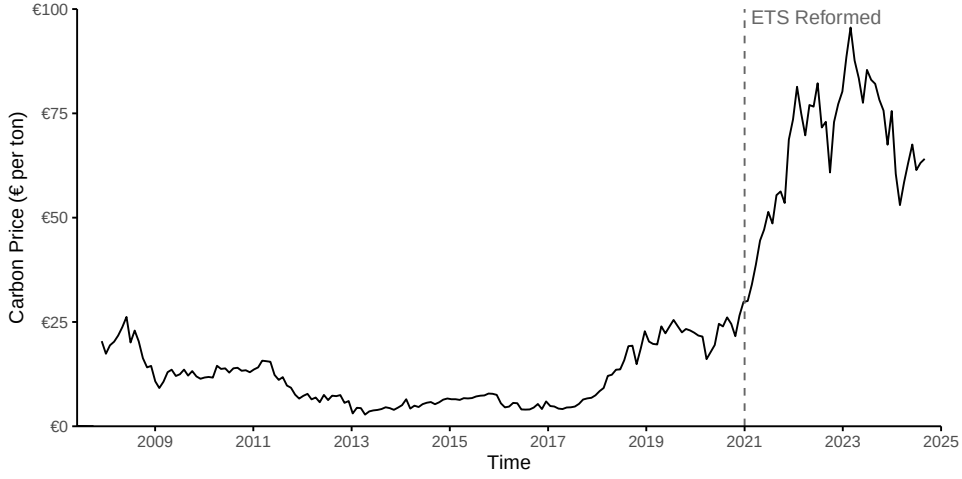
Pattern: subsidies + low taxes initially → high taxes later.

Germany – Renewable Energy Sources Act (2000)



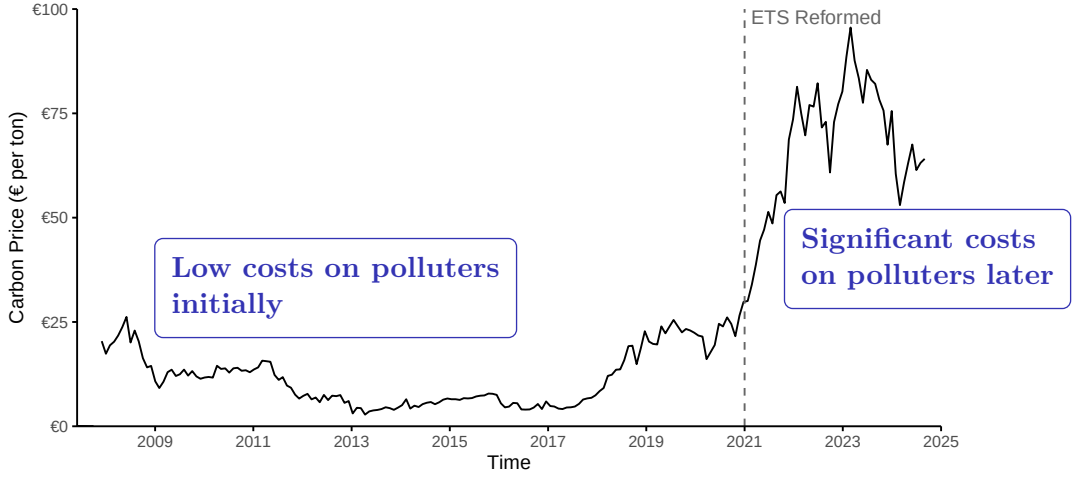
EU Emissions Trading System (ETS) starts in 2005, reformed in 2021

Germany prices carbon in the heating and transportation sectors in 2021



EU Emissions Trading System (ETS) starts in 2005, reformed in 2021

Germany prices carbon in the heating and transportation sectors in 2021



Canada – Project Green (2005)

Subsidies + low costs on polluters initially

Burning Our Money to Warm the Planet

Canada's Ineffective Efforts to Reduce Greenhouse Gas Emissions

Mark Jaccard, Nic Rivers,
Christopher Bataille,
Rose Murphy, John Nyboer and
Bryn Sadownik

Canada – Federal Carbon Price (2018)

Significant costs on polluters later

Canada passed a carbon tax that will give most Canadians more money

By rebating the revenue to households, disposable income rises, which can be a boon for the Canadian economy

Prime Minister Justin Trudeau answers a question on Parliament Hill in Ottawa on Thursday, Oct. 25, 2018. Photograph: Canadian Press/REX/Shutterstock

Questions

Puzzle: generous subsidies + low carbon taxes are hard to reconcile with the theory of optimal environmental policy.

Policy sequencing argument: subsidies serve to **build a coalition** today, and relax political opposition to carbon pricing tomorrow (Meckling et al 2015, 2017; World Bank 2024).

> "We need to **disrupt the political power of carbon polluters before** we can meaningfully reshape economic incentives" (Mildenberger and Stokes 2020).

What we do not know:

1. Under what conditions the policy sequencing strategy is feasible.
2. How do subsidies work? How should they be designed?
3. Can this logic explain the empirical pattern?

This Paper

Dynamic political economy framework to address the following questions:

1. Under what conditions is the policy sequencing strategy even feasible?
   - How do political and economic conditions, such as political turnover and the productivity of green technologies, affect the feasibility of the strategy?
2. Can it help us rationalize the dynamic path of pollution taxation?

This is the **first paper** to develop a **dynamic model of climate policymaking** in which policy **reshapes the distribution of political power** among economic sectors.

My Approach

Two policies: a carbon tax and a subsidy for green investments.

Policy requires approval by a legislature.

Legislators represent constituencies that differ in how "easy to decarbonize" they are.

Polluter districts are initially a majority.

Two periods. Risk of turnover: the policymaker can be replaced by an environmentally unfriendly politician in the future.

Key Tension

Distributive conflict creates a **tension**:

The proposer needs to win over pivotal polluting constituencies...

... without alienating existing green constituencies.

Why?

Subsidies help to get approval by pivotal polluting constituencies.

But they raise fiscal costs and shrink the base of pollution taxes. Green districts are eventually forced to pay for these subsidies that go to polluting districts.

Preview of Results

1. Whenever the sequencing strategy is feasible, it generates the empirical pattern:

   subsidies + low taxes initially $\rightarrow$ high taxes later.

2. Policy sequencing is feasible only if:

   green technologies are sufficiently advanced and investment costs are sufficiently low,

   and marginal environmental damage is neither too low nor too high.

   The effect of political turnover is ambiguous. Under some conditions it can help implement climate policy.

Literature

Comparative political economy of climate policy (Harrison 2010; Breetz et al 2018; Mildenberger 2020; Finnegan 2022; Besley and Persson 2023; Allan and Nahm 2024)

Politics of instrument choice (Buchanan and Tullock 1975; Aidt and Dutta 2004; Schmitt 2014; Hughes and Urpelainen 2015; Meckling and Jenner 2016; Cullenward and Victor 2020; Harstad 2020; Behmer 2023; Konisky 2024)

Policy feedback effects of climate policies (Baldursson and von der Fehr 2007; Aklin and Urpelainen 2013; Meckling et al 2015, 2017; Stokes 2020; Anderson et al 2023; Alberdi 2024)

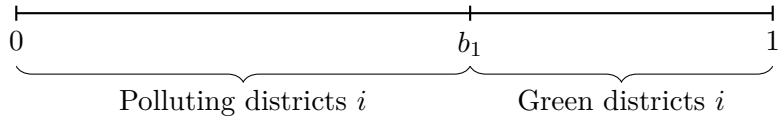
Dynamic models of policymaking (Persson and Svensson 1989; Besley and Coate 1998; Alesina and Tabellini 1990; Prato 2017) with an endogenous status quo (Buisseret and Bernhardt 2017; Dziuda and Loeper 2018; Austen-Smith et al 2019)

Roadmap

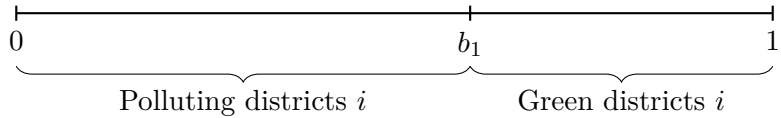
1. The Model
2. Results
3. Robustness
4. Extensions and Conclusions

The Model

The Model – Economy



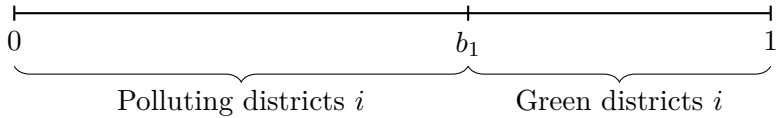
The Model – Economy



Production function is Cobb-Douglas with $\alpha = \frac{1}{2}$ using numéraire good and capital.

- Polluting technology produces y at cost $\frac{1}{2}y^2$.
- Green technology in district i produces $\boldsymbol{Ai}y$ at cost $\frac{1}{2}y^2$.
- $A > 1$ measures the productivity of green technology.

The Model – Economy



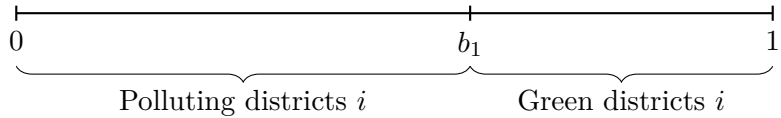
Production function is Cobb-Douglas with $\alpha = \frac{1}{2}$ using numéraire good and capital.

- Polluting technology produces y at cost $\frac{1}{2}y^2$.
- Green technology in district i produces $\boldsymbol{Ai}y$ at cost $\frac{1}{2}y^2$.
- $A > 1$ measures the productivity of green technology.

Polluting district i can invest in green capital and transition at cost $c \geqslant 0$.

The marginal district b_1 is indifferent between investing in green technology or not.

The Model – Economy



Production function is Cobb-Douglas with $\alpha = \frac{1}{2}$ using numéraire good and capital.

- Polluting technology produces y at cost $\frac{1}{2}y^2$.
- Green technology in district i produces $\boldsymbol{Aiy}$ at cost $\frac{1}{2}y^2$.
- $A > 1$ measures the productivity of green technology.

Polluting district i can invest in green capital and transition at cost $c \geqslant 0$.

The marginal district b_1 is indifferent between investing in green technology or not.

Polluting production generates carbon emissions: producing y units $\rightarrow$ emitting y tons.

The Model – Policies

Carbon tax $\tau \in [0, 1]$.

- Polluting districts pay τy.
- Green districts are not affected.

Investment subsidy $s \geqslant 0$.

Uniform lump-sum tax or transfer T.

- Used to balance the budget across the two periods.

The Model – Policies

Let b_2 be the marginal polluting district in the second period.

Income of district i:

Polluting: $\underbrace{(1-\tau_1)y_1 - \frac{1}{2}y_1^2}_{\text{Period-1 Income}} + \underbrace{\delta}_{\substack{\text{Discount}\\ \text{Factor}}} \times \underbrace{\left[(1-\tau_2)y_2 - \frac{1}{2}y_2^2\right]}_{\text{Period-2 Income}} + \text{Transfer}$

The Model – Policies

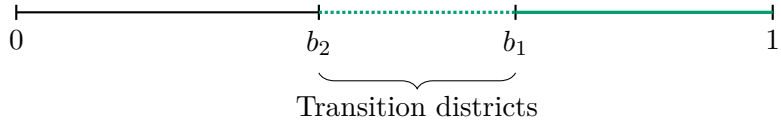
Let b_2 be the marginal polluting district in the second period.

Income of district i:

Polluting: $$\frac{1}{2}(1-\tau_1)^2+\frac{\delta}{2}(1-\tau_2)^2+T,$$

The Model – Policies

Let b_2 be the marginal polluting district in the second period.



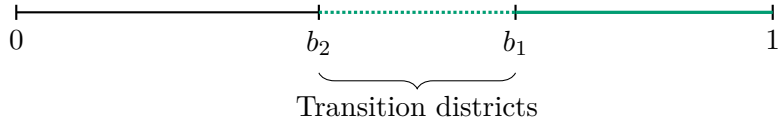
Income of district i:

Polluting: $\frac{1}{2}(1-\tau_1)^2 + \frac{\delta}{2}(1-\tau_2)^2 + T,$

Transition: $\frac{1}{2}(1-\tau_1)^2 + \text{Subsidy} - \text{Capital Cost}$
$+ \text{Period-2 Income using Green Technology} + T$

The Model – Policies

Let b_2 be the marginal polluting district in the second period.



Income of district i:

Polluting: $\frac{1}{2}(1-\tau_1)^2+\frac{\delta}{2}(1-\tau_2)^2+T,$

Transition: $\frac{1}{2}(1-\tau_1)^2+s-c+\frac{\delta A}{2}i+T,$

The Model – Policies

Let b_2 be the marginal polluting district in the second period.

Income of district i:

Polluting: $\frac{1}{2}(1-\tau_1)^2+\frac{\delta}{2}(1-\tau_2)^2+T$,

Transition: $\frac{1}{2}(1-\tau_1)^2+s-c+\frac{\delta A}{2}i+T$,

Green: Period-1 Income + Period-2 Income + Transfer.

The Model – Policies

Let b_2 be the marginal polluting district in the second period.

Income of district i:

Polluting: $\frac{1}{2}(1-\tau_1)^2+\frac{\delta}{2}(1-\tau_2)^2+T,$

Transition: $\frac{1}{2}(1-\tau_1)^2+s-c+\frac{\delta A}{2}i+T,$

Green: $\frac{A}{2}i+\frac{\delta A}{2}i+T.$

The Model – Politics

There are two proposers: G and B.

Initially taxes and subsidies are zero, and G is the agenda-setter.

In each period $t = 1, 2$:

1. Proposer chooses a carbon tax τ_t; in the first period, also a subsidy s.
2. If a majority of districts prefer it to the status quo, it is implemented, and becomes the new status quo.
3. Districts make production and investment decisions.
4. The next period proposer is determined: with probability ρ the current proposer is replaced by B.

In the second period T is automatically determined to balance the budget.

Equilibrium selection. If the first-period policy is blocked then districts expect zero taxes in the second period.

The Model – Preferences

Agents maximize discounted expected utility with discount factor δ.

Legislators only care about consumption π_{it}.

Proposer P's payoff in period t is

$$W_P = \text{Aggregate Consumption} - \text{Environmental Damages}.$$

The Model – Preferences

Agents maximize discounted expected utility with discount factor δ.

Legislators only care about consumption π_{it}.

Proposer P's payoff in period t is

$$W_P = \underbrace{\int_0^1 \pi_{it}\, di}_{\substack{\text{Aggregate} \\ \text{Consumption}}} - 1_{P=G}\boldsymbol{\lambda} \underbrace{\int_0^{b_t} y_{it}\, di}_{\text{Emissions}}.$$

$\boldsymbol{\lambda}$ is the (subjective) **social cost of carbon**.

Results

Policy without Politics

Proposition
If the proposer is a dictator in both periods then carbon taxes equal the social cost of carbon and the subsidy is not used.

Why? Setting the carbon tax equal to the social cost of carbon

- Statically, it reduces emissions cost-effectively
- Dynamically, it encourages firms to invest if the social cost of carbon justifies paying the cost of transition

Subsidies are an **inefficient** instrument for reducing carbon emissions.

Analysis of the Full Model

1. Second Period Policies
2. Investment Decisions
3. First Period Policies

Second Period Policies

Two cases:

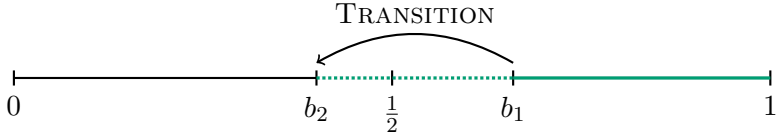
1. Polluting districts are still a majority: $b_2 > \frac{1}{2}$

- If the proposer is G, they will keep the status quo.
- If the proposer is B, they will set the carbon tax to zero.

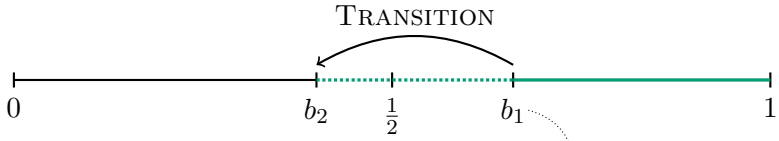
2. Green districts are a majority: $b_2 \leqslant \frac{1}{2}$

- If the proposer is G, they will raise the carbon tax to λ if it is below that level.
- If the proposer is B, they will keep the status quo.

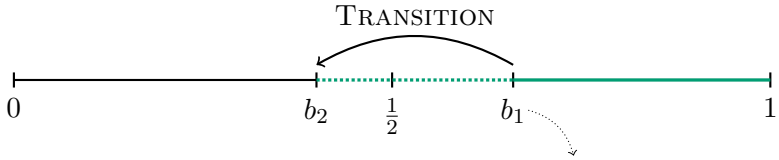
Who Transitions?



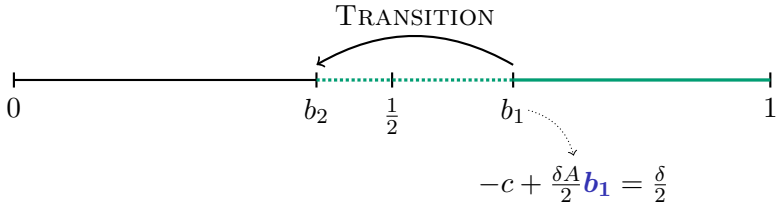
Who Transitions?



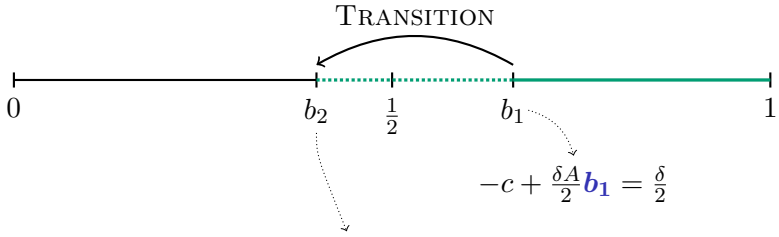
Who Transitions?



Who Transitions?

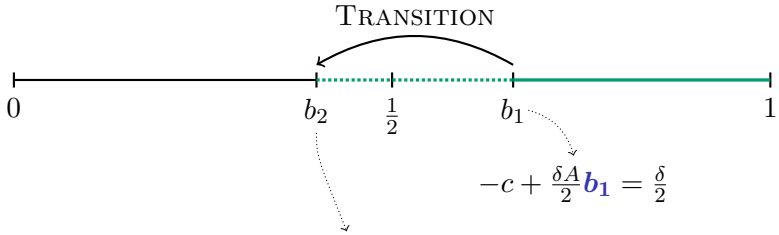


Who Transitions?



Net Benefit of Transition = Period-2 Income in Polluting Sector

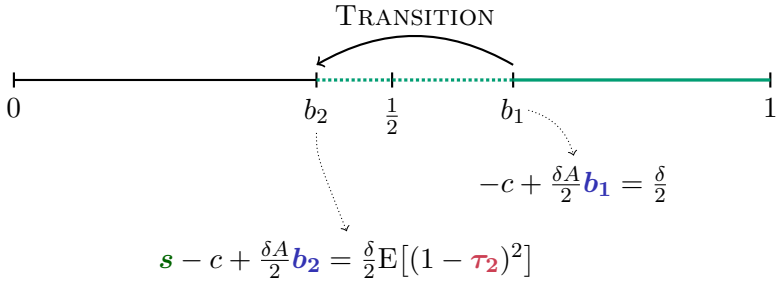
Who Transitions?



Subsidy – Cost of Investment = Discounted Period-2 Income

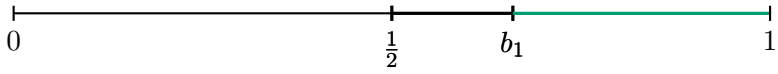
+ Discounted Period-2 Income Net of Expected Carbon Tax

Who Transitions?



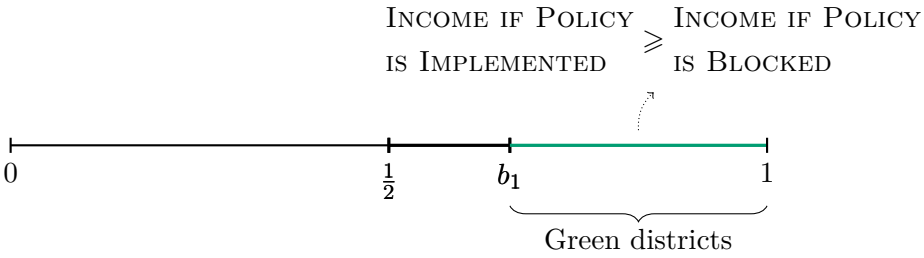
Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.



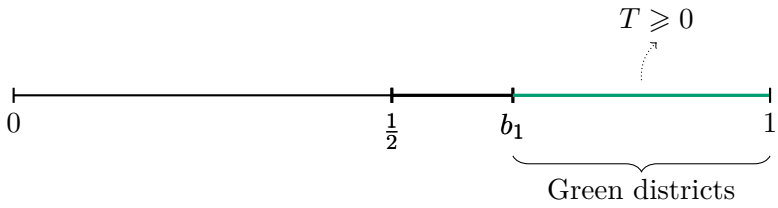
Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.



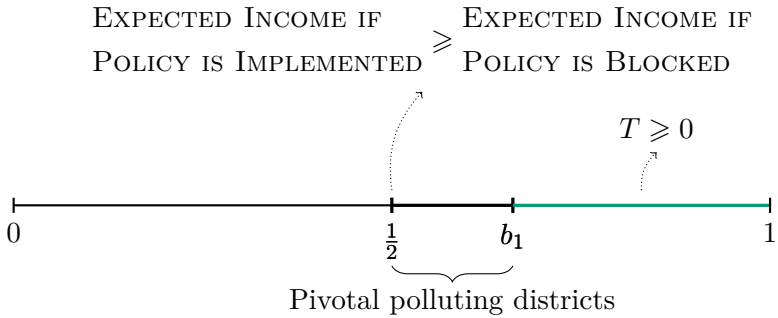
Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.



Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.

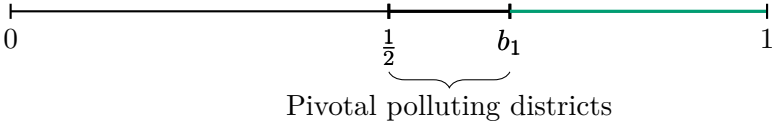


Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.

$$\frac{1}{2}(1-\tau_1)^2 + s - c + \frac{\delta A}{2}\frac{\mathbf{1}}{\mathbf{2}} + T \geqslant \frac{1}{2} + \frac{\delta}{2}$$

$$T \geqslant 0$$



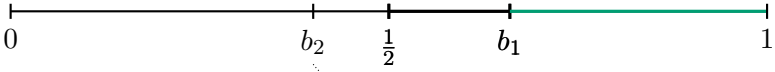
Pivotal polluting districts

Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.

$$\frac{1}{2}(1-\tau_1)^2 + s - c + \frac{\delta A}{2}\frac{\mathbf{1}}{\mathbf{2}} + T \geqslant \frac{1}{2} + \frac{\delta}{2}$$

$$T \geqslant 0$$



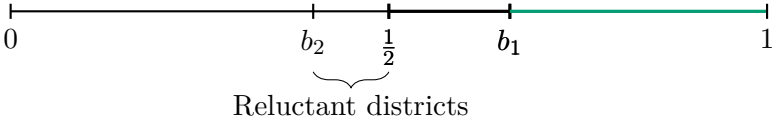
$$s - c + \frac{\delta A}{2}\boldsymbol{b_2} = \frac{\delta}{2}\mathrm{E}[(1-\tau_2)^2]$$

Building a Coalition

Polluting districts are a majority, so a **winning coalition** must include some of them.

$$\frac{1}{2}(1-\tau_1)^2 + s - c + \frac{\delta A}{2}\frac{\mathbf{1}}{\mathbf{2}} + T \geqslant \frac{1}{2} + \frac{\delta}{2}$$

$$T \geqslant 0$$



Political Constraints

Key distributive tension:

Polluting districts demand low taxes and generous subsidies.

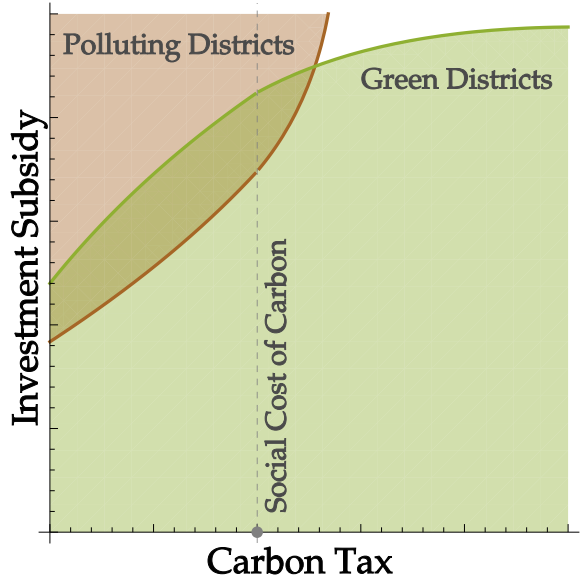
Green districts demand high taxes if subsidies are generous.

Political Constraints

Key distributive tension:

Polluting districts demand low taxes and generous subsidies.

Green districts demand high taxes if subsidies are generous.



Political Constraints

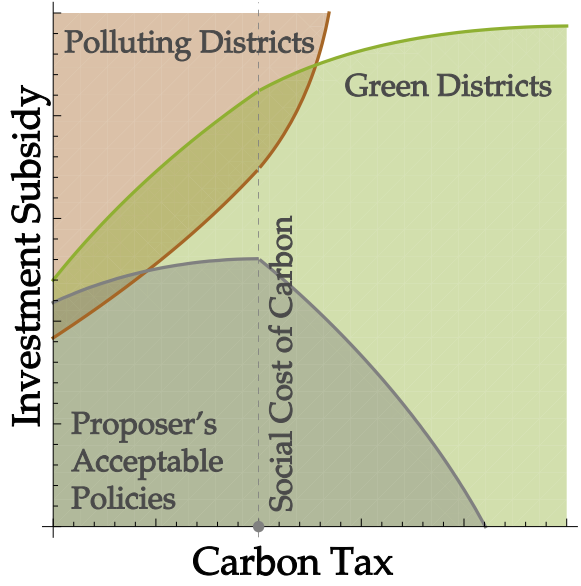
Key distributive tension:

Polluting districts demand low taxes and generous subsidies.

Green districts demand high taxes if subsidies are generous.

Also:

The proposer has to prefer a compromise policy over the status quo.



Why Are Carbon Taxes Low?

Proposition
In equilibrium either the first-period carbon tax is below the social cost of carbon and the subsidy is positive, or no climate policy is enacted.

Why Are Carbon Taxes Low?

Proposition
In equilibrium either the first-period carbon tax is below the social cost of carbon and the subsidy is positive, or no climate policy is enacted.

Why? Imposing costs on polluters today requires more subsidies as compensation: $\tau_1 \uparrow \Rightarrow s \uparrow$.

The benefit of reducing τ_1 from the optimal level is first order (as it allows reducing s), and the cost is second order.

When is the Strategy Feasible?

Improving opportunities in the green sector or reducing capital costs.

When is the Strategy Feasible?

Improving opportunities in the green sector or reducing capital costs.

– Relaxes Political Constraint by Polluting Districts:

$$\frac{1}{2}(1-\tau_1)^2 + s - \boldsymbol{c}\downarrow + \frac{\delta \boldsymbol{A}\uparrow}{4} + T \geqslant \frac{1}{2} + \frac{\delta}{2}.$$

– Tightens Political Constraint by Green Districts:

$$T = \text{Carbon Tax Revenue}\downarrow - \text{Cost of Subsidies} \geqslant 0.$$

When is the Strategy Feasible?

Improving opportunities in the green sector or reducing capital costs.

– Relaxes Political Constraint by Polluting Districts:

$$\frac{1}{2}(1-\tau_1)^2 + s - \boldsymbol{c}\downarrow + \frac{\delta \boldsymbol{A}\uparrow}{4} + T \geqslant \frac{1}{2} + \frac{\delta}{2}.$$

– Tightens Political Constraint by Green Districts:

$$T = \text{Carbon Tax Revenue}\downarrow - \text{Cost of Subsidies} \geqslant 0.$$

The first force dominates.

Result

If the political constraints are feasible and green technology improves or capital costs decrease, the political constraints are still feasible.

Political Turnover

Increasing the probability that a climate-unfriendly proposer takes power

Political Turnover

Increasing the probability that a climate-unfriendly proposer takes power

Affects both constraints through the expected transfer T:

$$\text{Transfer} = \text{Carbon Tax Revenue} - \text{Cost of Subsidies}$$

Political Turnover

Increasing the probability that a climate-unfriendly proposer takes power

Affects both constraints through the expected transfer T:

$$\begin{aligned}\text{Transfer} &= \text{Carbon Tax Revenue} - \text{Cost of Subsidies} \\ &= \text{Period-1 Carbon Tax Base} \times \text{Period-2 Carbon Tax} \\ &\quad + \delta \times \text{Period-2 Carbon Tax Base} \uparrow \times \text{Period-2 Carbon Tax} \downarrow \\ &\quad - \text{Subsidy Level} \times \text{Number of Districts that Transition} \downarrow\end{aligned}$$

Political Turnover

Increasing the probability that a climate-unfriendly proposer takes power

Affects both constraints through the expected transfer T:

$$\begin{aligned}\text{Transfer} &= \text{Carbon Tax Revenue} - \text{Cost of Subsidies} \\ &= \text{Period-1 Carbon Tax Base} \times \text{Period-2 Carbon Tax} \\ &\quad + \delta \times \text{Period-2 Carbon Tax Base} \uparrow \times \text{Period-2 Carbon Tax} \downarrow \\ &\quad - \text{Subsidy Level} \times \text{Number of Districts that Transition} \downarrow\end{aligned}$$

The effect is ambiguous.

Result
If the initial share of polluting districts is large enough, increasing the probability of turnover relaxes the constraints.

Social Cost of Carbon

Increasing the social cost of carbon

Affects both constraints through the expected transfer T:

$$
\begin{aligned}
\text{Transfer} &= \text{Carbon Tax Revenue} - \text{Cost of Subsidies} \\
&= \text{Period-1 Carbon Tax Base} \times \text{Period-2 Carbon Tax} \\
&\quad + \delta \times \text{Period-2 Carbon Tax Base} \downarrow \times \text{Period-2 Carbon Tax} \uparrow \\
&\quad - \text{Subsidy Level} \times \text{Number of Districts that Transition} \uparrow
\end{aligned}
$$

Social Cost of Carbon

Increasing the social cost of carbon

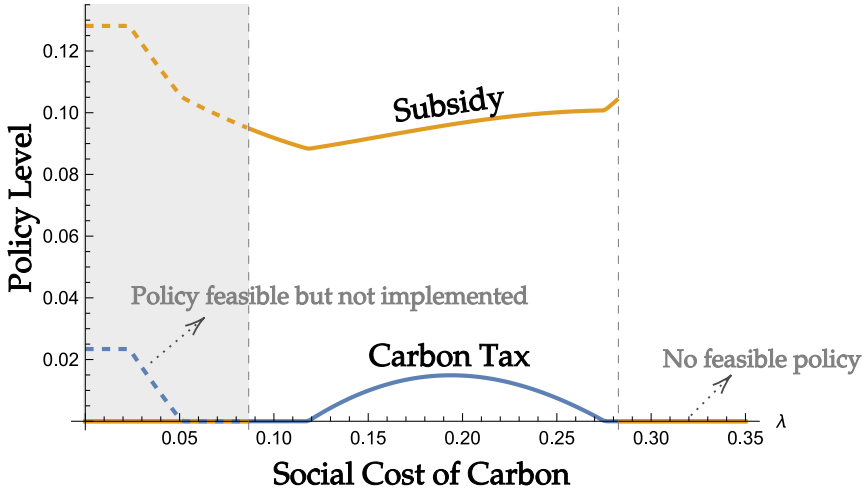
Affects both constraints through the expected transfer T:

$$\begin{aligned}\text{Transfer} &= \text{Carbon Tax Revenue} - \text{Cost of Subsidies} \\ &= \text{Period-1 Carbon Tax Base} \times \text{Period-2 Carbon Tax} \\ &\quad + \delta \times \text{Period-2 Carbon Tax Base} \downarrow \times \text{Period-2 Carbon Tax} \uparrow \\ &\quad - \text{Subsidy Level} \times \text{Number of Districts that Transition} \uparrow\end{aligned}$$

The effect is ambiguous.

Result
If the productivity of green technology is not too large, the constraints are feasible only if the social cost of carbon is not too large.

Social Cost of Carbon



Summary of Results

1. Under what conditions is the strategy feasible?
   - Carbon abatement technology needs to be sufficiently advanced.
   - The social cost of carbon cannot be too low nor too high.
   - The effect of turnover is ambiguous. The risk of the opposition taking agenda-setting power in the future can relax the political constraints today.

2. Can it help us rationalize the pattern of pollution taxation?
   - Yes. Carbon taxes are initially too low because there is a tradeoff between carbon taxes and inefficient compensation.

Robustness

Targeted transfers and subsidies

- We can relax the assumption that transfers and subsidies are uniform.
- I relax the assumption that the government has perfect information about the green productivity of each district, and adopt a mechanism design approach. The optimal menu cannot target districts individually, and the key friction persists.

Robustness

Targeted transfers and subsidies

- We can relax the assumption that transfers and subsidies are uniform.
- I relax the assumption that the government has perfect information about the green productivity of each district, and adopt a mechanism design approach. The optimal menu cannot target districts individually, and the key friction persists.

Alternative policy instruments

- *Production subsidies.*
- *Standards and Feed-in Tariffs.* Equivalent to a revenue-neutral combination of carbon taxes and production subsidies.
- These instruments are inefficient but can also be used to start the policy sequence.

Extensions

Imperfect Competition and Pass-through

Endogenous Reelection Probability

Inefficient Policies to *Stop* the Transition

Imperfect Competition and Pass-through

- In the model producers bear the full cost of the carbon tax.
- If the products are not perfect substitutes, green districts pay some of the cost of the carbon tax as consumers.
- However, for a small carbon tax the uniform rebate is greater than the loss in consumer surplus.
- Same distributive conflict: green districts support carbon taxes and oppose subsidies. Pivotal polluters oppose carbon taxes but demand subsidies.
- The main result still applies: equilibrium policy requires the use of a subsidy and a carbon tax that is initially too low.

Endogenous Reelection Probability

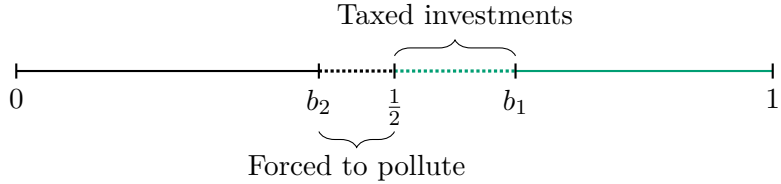
Probabilistic Voting

- Climate policy is unpopular: the *average* voter is against it.
- Implementation is still possible because it only requires support by the *median* voter.
- However, if climate is electorally salient (but not too salient), the green party has an incentive to *increase* carbon taxes *and* subsidies in the first period.
- The reason is that the anti-climate party cannot repeal the carbon tax in the second period once the green coalition is built. Increasing taxes today reduces the difference between electing the pro- and anti-climate parties, which benefits the pro-climate party.

Inefficient Policies to Stop the Transition

Suppose that the climate unfriendly party is in power in the first period

- Suppose that there is an exogenous improvement in green technology, so that $b_2 < \frac{1}{2}$ even if $\tau_2 = 0$.
- Policymaker B has an incentive to use a tax on green investment in order to stop the formation of a green coalition.
- The tax has to stop the median district from investing.
- Polluting districts that are forced to remain in the carbon coalition are compensated with the tax on the districts that invest.



Broader Contribution

Theoretical contribution: incorporating political economy into climate policymaking.

- Microfounded and dynamic political constraints.
- Policy can reduce the political power of polluting industries over time.

Broader Contribution

Theoretical contribution: incorporating political economy into climate policymaking.

- Microfounded and dynamic political constraints.
- Policy can reduce the political power of polluting industries over time.

Political economy creates a **linkage between carbon taxes and green subsidies**:

- Taxing pollution requires subsidies to relax political constraints.
- Subsidies are affected by expectations of future pollution taxation.

Broader Contribution

Theoretical contribution: incorporating political economy into climate policymaking.

- Microfounded and dynamic political constraints.
- Policy can reduce the political power of polluting industries over time.

Political economy creates a **linkage between carbon taxes and green subsidies**:

- Taxing pollution requires subsidies to relax political constraints.
- Subsidies are affected by expectations of future pollution taxation.

Policy implications:

- *Some* inefficient policies are good because of their policy feedback effects.
- Framework for incorporating political constraints into cost-benefit analysis.