The Political Economics of Green Transitions

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Quarterly Journal of Economics, September 2023

The Political Economy of Environmental Policy
Workshop, Stockholm, April 19, 2024

Points of departure

A green transition?

- structural shifts to non-polluting production and consumption
- many agree it's needed, but views on route differ

Most economic anaysis rests on two postulates

- transition mechanism only relies on prices/taxes
- welfare-oriented planner can commit to any path for policies

We reconsider both postulates

- mechanism entails changing values as well
- politicians, who cannot commit, choose policies sequentially

Begin with laissez faire

Green transition without any collective action?

- producers: use green (non-polluting) or brown (polluting) technologies – shares change based on expected profit
- consumers: hold green or brown values that shape demand for goods – shares change based on expected utility

Key complementarity

- firms more likely go green if expect more consumers go green, and vice versa (analog to Rochet-Tirole 2003)
- two-way feedbacks fuel divergent value-technology dynamics towards either green or brown steady state
- former case, market forces drive green transition
- latter case, may be a "brown trap" where welfare-enhancing green transition does not materialize

Go on to add political policymaking

Add Pigouvian taxes/subsidies on brown and green goods

- set in electoral competition without any commitment

Value-technology dynamics reflect equilibrium policy

- politics may address market failure, bring a green transition
- but political failure – due to lacking commitment – still a distinct possibility
- welfare costs of two kinds: (i) society may remain in brown trap, (ii) any green transition is too slow

New perspective on what policy can realistically achieve

- more facilitator than key driver of private change

Finish by a set of extensions

Richer foundation of values

- based on moral, not just economic, concerns – makes green transition more likely and speeds it up

Richer political process

- profit-driven firm lobbying – makes green transition less likely (if brown firms better organized)
- value-driven individual activism – makes more likely and speeds up green transition

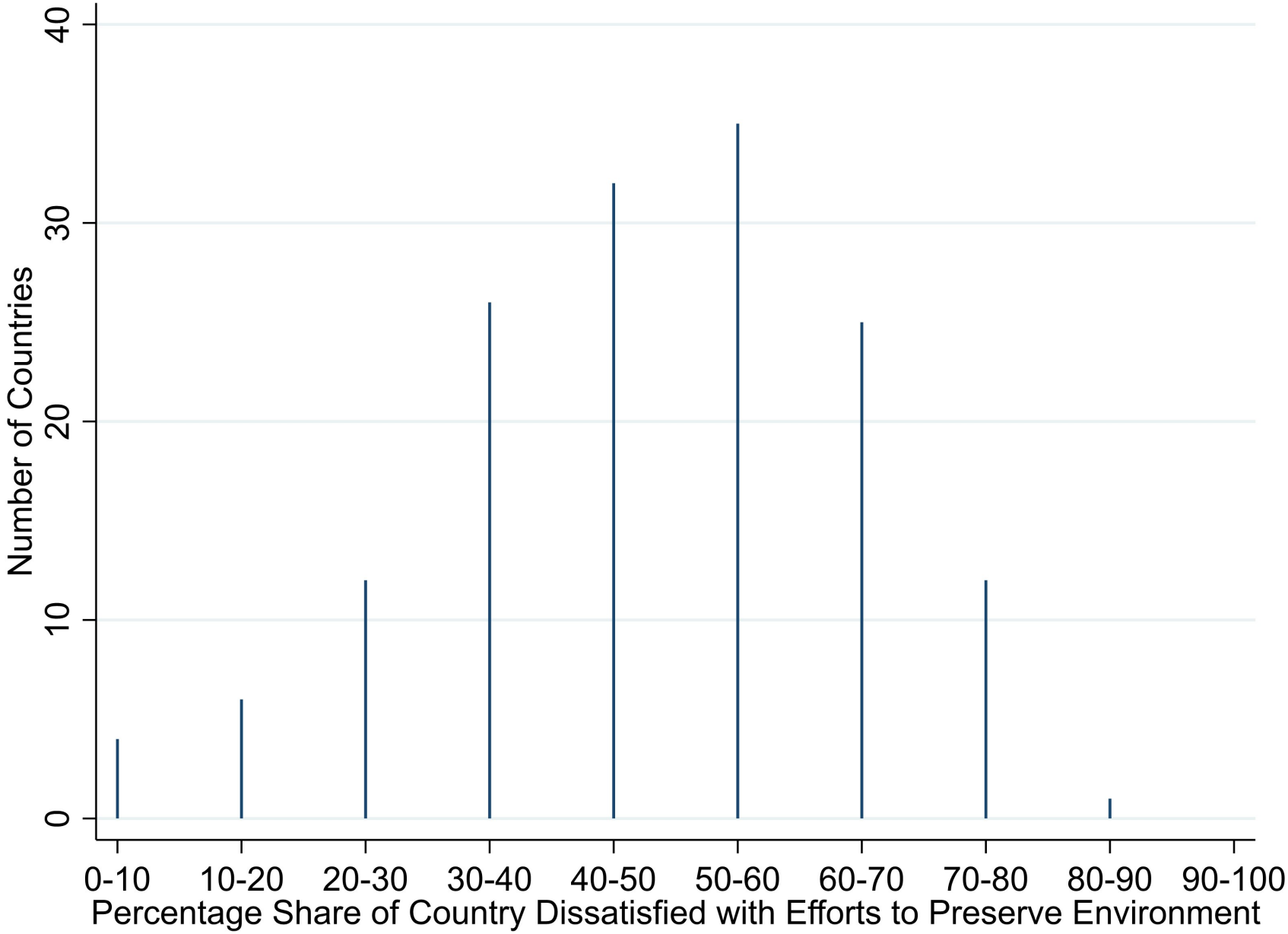
Richer economic dynamics

- technology adoption with crowding and/or learning by doing – modifies, but does not overturn, basic results
- outright green adoption subsidy – may eliminate welfare traps and speed up green transitions
- externality from pollution stock, not flow – makes (endogenous) policy more aggressive

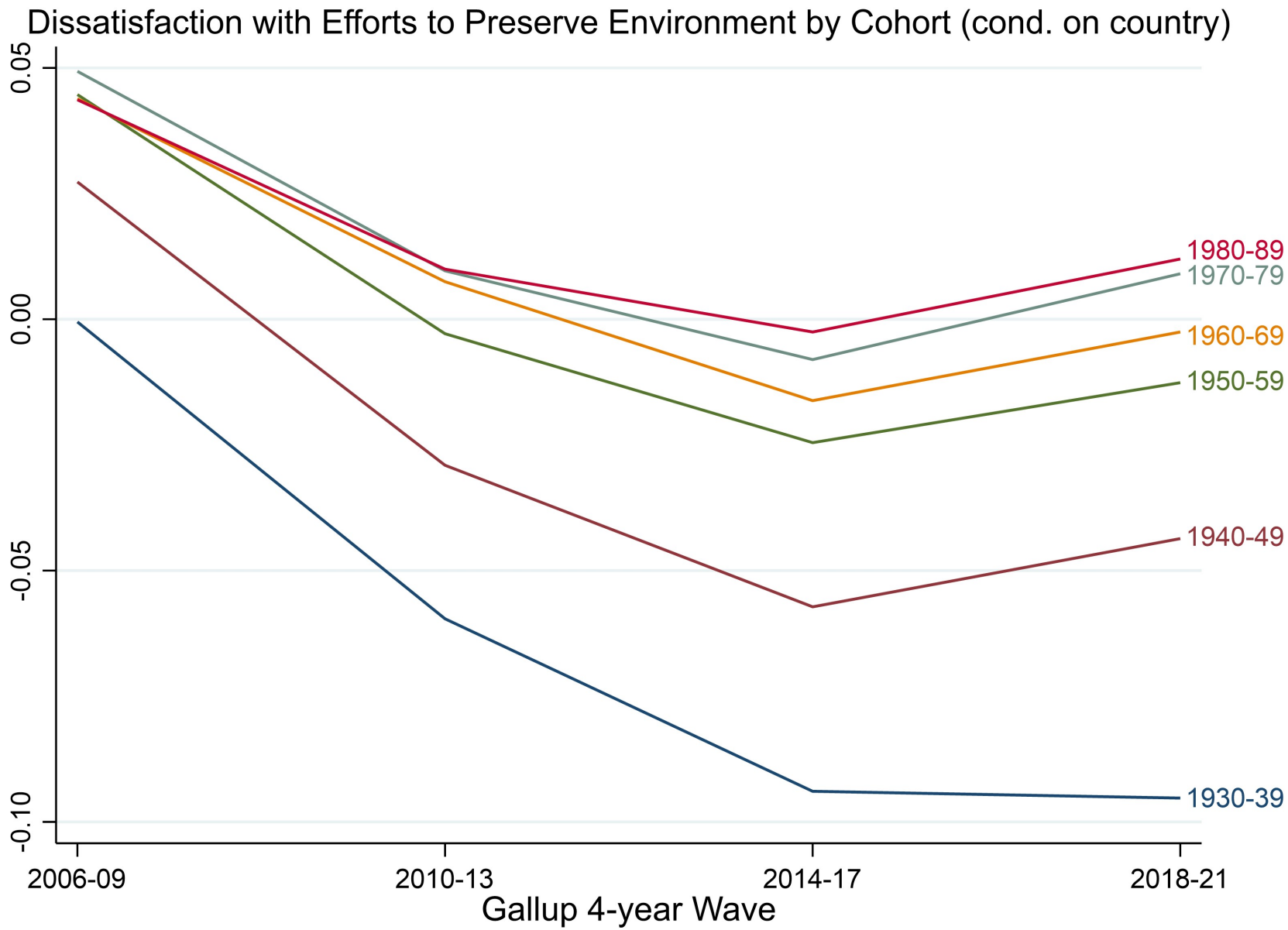
Roadmap

1. Introduction
2. **Background**
3. Laissez faire
4. Political policymaking
5. Extensions
6. Conclusion

2 million+ values (Gallup World Poll) by 142 countries



Values by 6 ten-year cohorts (given country FEs)



Green values and cultural evolution

Green consumer attitudes have social roots

- green preferences via pro-social or self-image motives: theory (Nyborg et el 2006) and data (Delmas et al 2017)
- hugely varying attitudes to individual action and climate policy (Andre et al 2021, Dechezleprêtre et al 2022)

Values may reflect social identities

- better way to capture lifestyles – long-standing in sociology, more recent in economics (Akerlof-Kranton 2000, Bisin-Verdier 2001, Tabellini 2008)
- moral, universalist values (Enke 2020, Enke et al 2022)
- models of cultural evolution (Boyd-Richerson 1985)

Two-way interactions of values and strategic design

- of *policy* by competing parties, or *institutions* by current principals (Besley-Persson 2019a, 2019b, 2022b)

Green technologies and politics of policy

Green-to-brown technology switching

- form of endogenous innovation (Romer 1986, 1990), brown vs. green directed technical change (Acemoglu et al 2012)

Pigouvian taxes and pollution

- set politically, not by planner who commits to optimal path (Dasgupta-Heal 1979, Nordhaus-Boyer 2000, Golosov et al 2014) – but externality tied to flow, not stock, of emissions

Various political mechanisms

- probabilistic electoral competition (Lindbeck-Weibull 1987, Persson-Tabellini 2000)
- firm lobbying of politicians (Baron 1994)
- "private politics" by individual activists (Abito et al 2019)
- "strategic policymaking" (Persson-Svensson 1989, Alesina-Tabellini 1990)

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Baseline model overview

Values and technologies of two kinds

- consumers and firms: green or brown

Time infinite, discrete, denoted by s

- use z for z_s, z' for z_{s+1}

Each period has four stages

1. Start with green consumer, firm shares μ, γ
2. Pricing, production, and consumption
3. Firms pick technologies that shape γ'
4. Consumers pick values that shape μ'

Model overview (continued)

Numeraire good turned to *continuum* of varieties

- monopolistic competition, to analyze profitability
- green, non-polluting goods – indexed $i \in [0, \gamma]$
  quantity, price: $y(i), p(i)$
- brown, polluting goods – indexed $i \in [\gamma, 1]$
  quantity, price: $Y(i), P(i)$

Symmetry assumption

- all green (brown) firms same, except technology-adoption costs, so $y(i) = y$, $Y(i) = Y$, etc

Stage 2 – consumers and demands

Two identities – values

- green $\Gamma = 1$ and brown $\Gamma = 0$ map into preferences

$$\frac{1}{1-\sigma}\left[\begin{array}{c}\int_0^{\gamma}\left[\Gamma\left(1+g\right)^{\sigma}+\left(1-\Gamma\right)\right]y(i)^{1-\sigma}di+\\ \int_{\gamma}^{1}\left[\Gamma\left(1-g\right)^{\sigma}+\left(1-\Gamma\right)\right]Y(i)^{1-\sigma}di\end{array}\right]+x-\lambda\overline{Y}$$

- $\sigma < 1 \sim$ substitution elasticity, g green-values preference shift, x numeraire consumption
- $\lambda > 0$ damage of pollution *flow*, $\overline{Y}$ total brown output

Equilibrium demands

$$y = \left[1+\mu g\right]p^{-\frac{1}{\sigma}} \qquad Y = \left[1-\mu g\right]P^{-\frac{1}{\sigma}}$$

- green share μ raises (cuts) demand for green (brown) goods

Stage 2 – firms, pricing, and profits

Two technologies with clean or dirty inputs

- brown cheaper: marginal cost χ, rather than $\chi + \zeta$
- mark-up pricing optimal

$$p = \frac{\chi + \zeta}{(1 - \sigma)} > P = \frac{\chi}{(1 - \sigma)}$$

- higher green-goods prices cut demand

Equilibrium profits

$$\pi(i) = \sigma\kappa(\zeta)[1 + \mu g] - mi \qquad \Pi = \sigma\kappa(0)[1 - \mu g]$$

- $\kappa(x)$ decreasing – core green profitability lower
- green (brown) firm profits rise (fall) in green-values share: *market-share* effect
- mi cost *per period* to use green technology, decided *last* period – m common, so firms i ordered by switching cost

Stage 4 – value choices

"Darwinian" value (social-identity) dynamics

- green share grows in expected relative "fitness" Δ' – the expected-utility difference of being green vs. brown
- formally, $\mu' \gtreqless \mu$ as $\Delta' \gtreqless 0$

Specific micro foundation (in Appendix A)

- (biological or cultural) "parents" socialize "kids"
- 1st-order approximation of dynamics

$$\frac{\mu' - \mu}{\mu} = \varkappa \Delta'$$

Equilibrium demands imply

$$\Delta'(\gamma') = \frac{\sigma g}{1-\sigma}\left[\gamma' \kappa(\zeta) - (1-\gamma')\kappa(0)\right]$$

- green-values fitness linear in expected green-goods share

Stage 3 – technology choices

Green-firm share reflects expected profits

- go green in $s+1$ if μ' large or i small

$$\gamma'\left(\mu'\right) = \max\left\{0, \frac{\sigma\left(\mu' g\left[\kappa\left(\zeta\right)+\kappa\left(0\right)\right]+\left[\kappa\left(\zeta\right)-\kappa\left(0\right)\right]\right)}{m}\right\}$$

- restrict parameters, so $\gamma'\left(1\right) < 1$ – some brown goods remain even if $\mu = 1$

Together, stages 3 and 4 yield key *complementarity*

- more consumers go green if more firms do – which they do if more consumers do

$$\Delta' = \delta(\mu') = \max\left\{-\frac{\sigma g \kappa\left(0\right)}{1-\sigma}, \delta_0 + \delta_1 \mu'\right\}$$

- where $\delta_0 < -\frac{\sigma g \kappa(0)}{1-\sigma} < 0$, $\delta_1 > 0$, and *assume* $\delta_0 + \delta_1 > 0$

Dynamics under laissez faire

Complementarity drives divergent dynamics

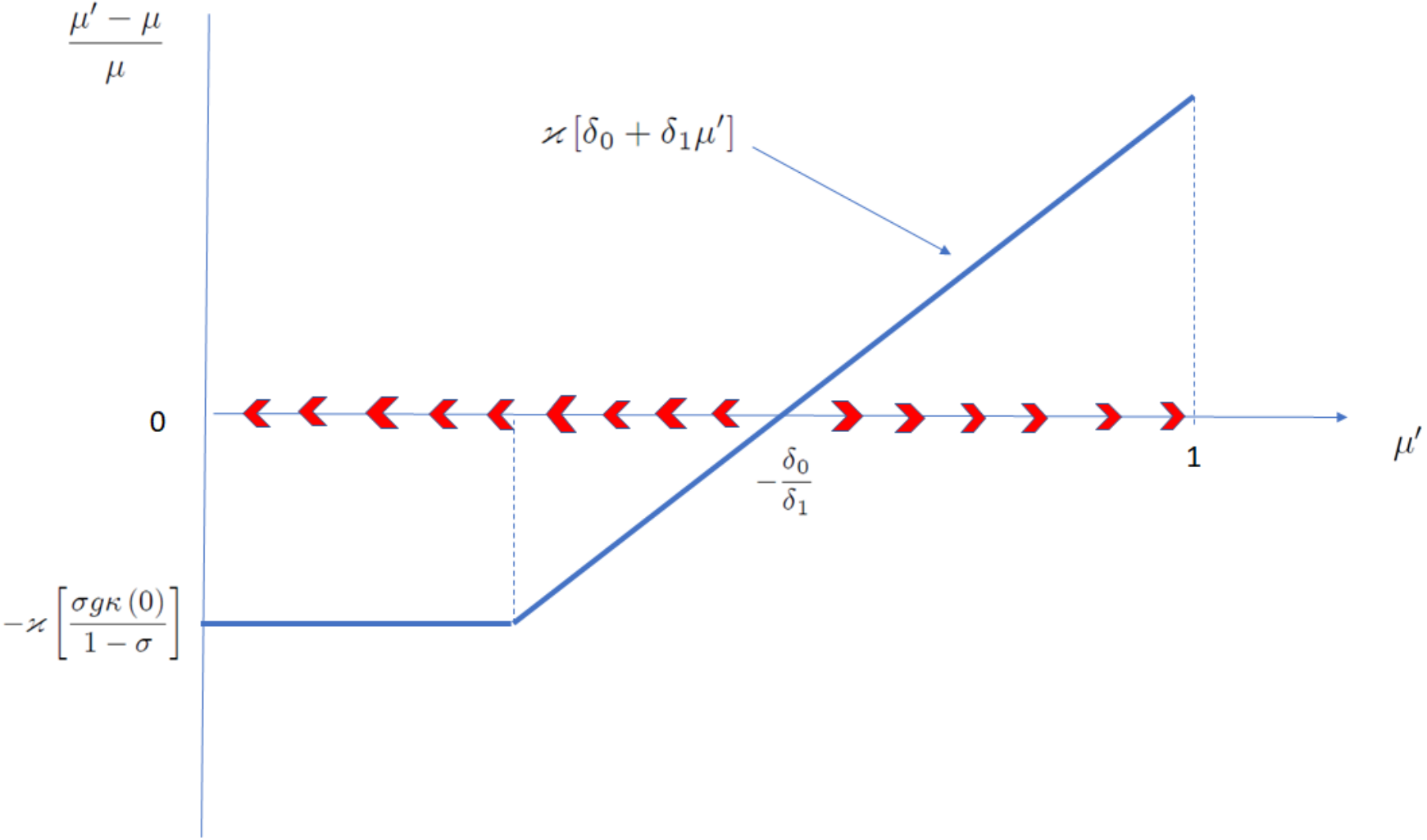
Proposition 1 *Laissez-faire economy goes to green (brown) steady state with* $\mu = 1$ $(\mu = 0)$, *iff initially* $\mu \geq \hat{\mu}$ $(\mu < \hat{\mu})$, *where* $\hat{\mu} = -\delta_0 / \delta_1$

(all proofs in Appendix B)

Two steady states, but unique dynamics

- market forces lead to brown (green) steady state, when initial green consumer share μ below (above) *critical juncture* $\hat{\mu}$

Illustration – Figure 1



- value *cum* technology dynamics may, or may not, sustain green transition under laissez faire

Welfare analysis

Define utilitarian *static* welfare $\Omega(\mu)$

- write social surplus of each unit of green, brown goods
  $w(\zeta) = \left[\frac{\kappa(\zeta)}{1-\sigma} - (\chi+\zeta)\,\kappa(\zeta)^{\frac{1}{1-\sigma}}\right]$,
  $W(\lambda) = \left[\frac{\kappa(0)}{1-\sigma} - (\chi+\lambda)\,\kappa(0)^{\frac{1}{1-\sigma}}\right]$
- sum surpluses for all goods, add lump-sum income, deduct technology-adoption cost: $\Omega(\mu) = \hat{\gamma}(\mu)(1+\mu g)\,w(\zeta) + (1-\hat{\gamma}(\mu))(1-\mu g)\,W(\lambda) + I - \frac{\hat{\gamma}(\mu)^2 m}{2}$

A green transition unambiguously raises $\Omega(\mu)$ under

Condition 1 $w(\zeta) > 0 > W(\lambda)$

- brown-goods externality λ large enough to outweigh extra green-goods production cost ζ
- full green transition desirable, for any μ and $\hat{\gamma}(\mu)$

Clear-cut welfare result

Define *intertemporal* welfare (no discounting, to simplify)

$$\Omega\left(\mu_s\right) + \sum_{j=s+1}^{\infty} \Omega\left(\mu_j\right)$$

- compare two paths for green-values share, $\tilde{\boldsymbol{\mu}} > \boldsymbol{\mu}$ – each element in $\{\tilde{\mu}_s, ..., \tilde{\mu}_\infty\}$ no lower than in $\{\mu_s, ..., \mu_\infty\}$

Proposition 2 *Under Condition 1, welfare higher on any path with* $\tilde{\boldsymbol{\mu}} > \boldsymbol{\mu}$, *and green steady-state welfare superior*

- lower welfare on any path to brown steady state
- if full green transition desirable, society trapped if μ too low, and welfare higher if ongoing transition faster (by higher μ)
- no surprise – firms maximize profit, not social welfare

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Policymaking

Producer taxes (subsidies)

- classical Pigouvian taxes, T and t, raise (cut) production costs – proceeds rebated lump-sum to consumers
- but taxes set period by period (no commitment) in electoral competition between two opportunistic parties

A period now has five stages

1. Start with green consumer, firm shares μ, γ
2. (a) Parties announce $\{t, T\}$; (b) election result realized s t idiosyncratic and aggregate voting shocks
3. Pricing, production, and consumption
4. Firms pick technologies that shape γ'
5. Consumers pick values that shape μ'

Stage 2 – electoral competition

Probabilistic-voting model

- optimistic benchmark: "as if" parties max utilitarian *current* payoff $\Omega(\mu, t, T)$ – explain why static objective below
- gives *static* Pigouvian tax rates

Proposition 3 *Both parties propose*

$$T = (1-\sigma)\lambda - \sigma\chi \qquad t = -\sigma(\chi+\zeta)$$

- $t < 0$ by monopoly pricing, $T > t$ by externality – private agents meet social marginal costs: green $\chi+\zeta$, brown $\chi+\lambda$
- green profits up, but brown profits down (if λ high enough)
- if $\lambda > \zeta$, green goods cheaper to consumers

$$P = \frac{\chi+T}{(1-\sigma)} = \chi+\lambda > p = \frac{\chi+\zeta+t}{(1-\sigma)} = \chi+\zeta$$

Why do parties adopt static objective?

Solve for stage 3-5 equilibrium

- current choices give current green and brown utilities $u(\mu, t, T), U(\mu, t, T)$
- forward-looking choices give future shares of green goods $\gamma' = \gamma(\mu', t', T')$, green values $\mu' = \mu(\gamma', \mu', t', T')$ and relative fitness $\Delta' = u(\mu', t', T) - U(\mu', t', T')$

Consumers/parents and firms *atomistic*

- take future drivers of μ' and γ' as given, as individually pick values and technologies

Political parties *not* atomistic

- do internalize policy effects on current and future payoffs
- when parties set t, T, voters/consumers/parents do like them to raise future payoffs

Culprit is lack of commitment

Parties willing but *unable* to affect future payoffs

- cannot directly commit to t', T'
- cannot indirectly influence $\{\mu', \gamma', t', T'\}$ via t, T

Can only influence current utilities $u(\mu, t, T), U(\mu, t, T)$

- taking $\{\mu', \gamma', t', T'\}$ as given means maximizing static utilitarian objective $\Omega(\mu, t, T)$ – optimal t, T in Proposition 3

Policies become constant

- with fixed parameters, t, T do not change over time

Interacting green shares

Key complementarity still present

- from expressions for green-firm share $\gamma' = \gamma(\mu', t', T')$ and green-value fitness $\Delta' = \Delta(\mu', t', T')$

$$\Delta' = \widehat{\delta}_0(t', T') + \widehat{\delta}_1(t', T')\,\mu'$$

where $\widehat{\delta}_0(t', T') \lesseqgtr 0$ (before $\delta_0 < 0$) and $\widehat{\delta}_1(t', T') > 0$

As in laissez faire, dynamics are divergent

- green-consumer growth still proportional to Δ', but how Δ' rises with μ' depends on policy

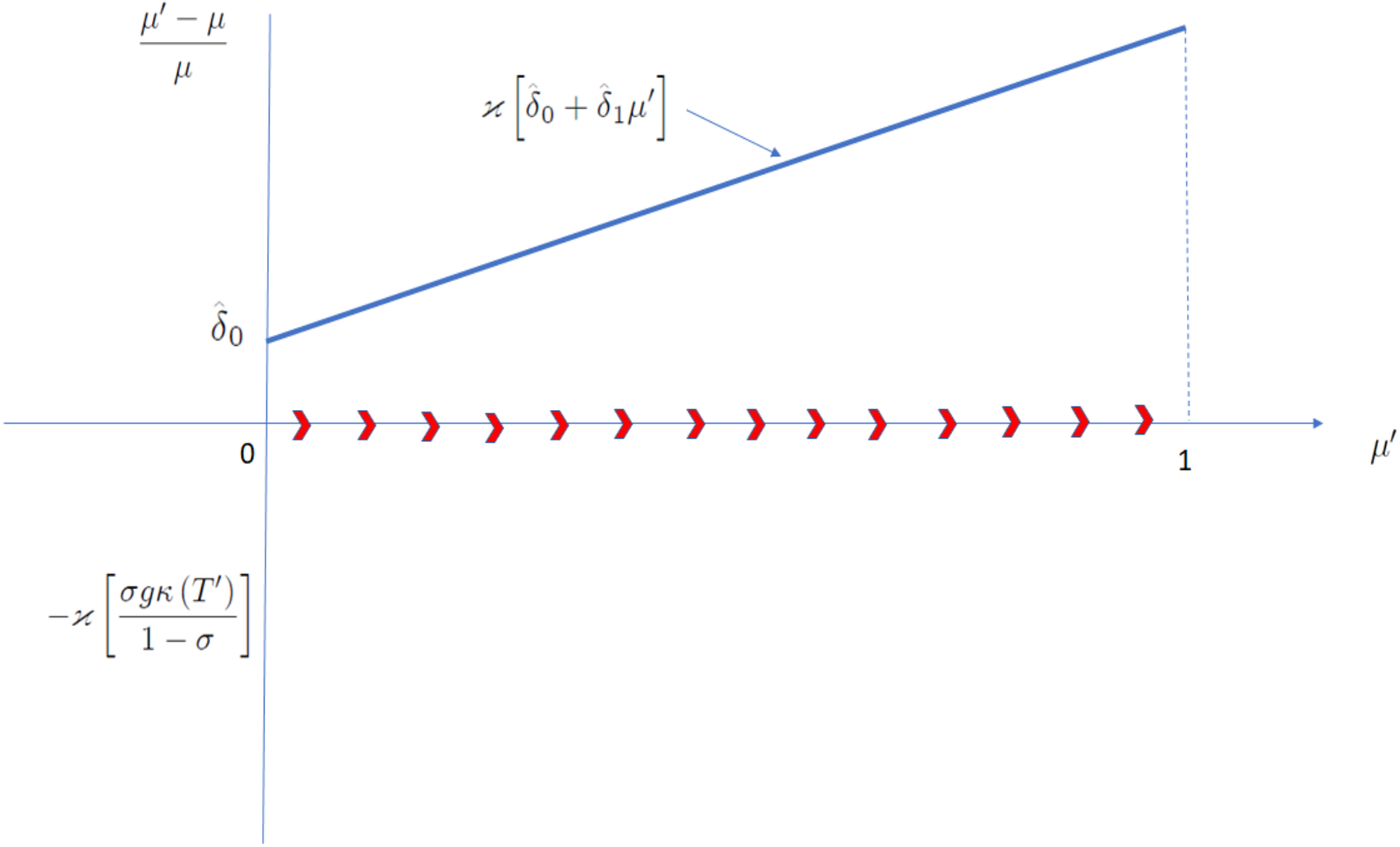
Dynamics with politics

Counterpart to Proposition 1

Proposition 4 *Society with endogenous taxes goes to green (brown) steady state iff initial green share* $\mu \geq \hat{\mu}$ $(\mu < \hat{\mu})$, *where* $\hat{\mu} = -\widehat{\delta}_0(t', T')/\widehat{\delta}_1(t', T')$

- now can have $\hat{\mu} \leq 0$ – green transition for any initial μ, if high T makes up for low μ (see further below)
- if critical juncture $\hat{\mu} > 0$, two steady states as before

Illustration – Figure 2



- consider comparative dynamics with politics

Politics and green transitions

Propositions 3 and 4 together imply

Corollary 3 *Higher externality/green-cost gap $\lambda - \zeta$ raises tax gap $T - t$. May ensure green transition from any green values μ; if not, shifts down critical juncture $\hat{\mu}$ and widens range of μ that permits green transition*

- policy helps prospect for green transition, compared to laissez faire, especially if pollution large
- but brown trap still a clear possibility – then have political failure alongside market failure

Interim bottom line

Policy can help

- equilibrium policy sets $T > t$ – green goods cheaper, more profitable than in laissez faire – more so if $\lambda - \zeta$ large

Modify earlier welfare analysis

- Condition 2 – green transition socially desirable, even if policy prices static externality, and we consider distributive effects (higher μ' and γ' hit green and brown differently)
- Proposition 5 analog to Proposition 2
- Corollary 4 – current policymakers would like to raise μ' via higher T', but cannot
- lack of commitment has two kinds of welfare costs: (i) green transition does not occur, (ii) any green transition too slow

Next, *sketch* how to enrich baseline model

- extend in six (seven) directions, one at a time

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Enrich values – moral concerns of green

Simple modeling of morality

- green consumers/voters face utility loss: θ times distance of pollution from a reference point
- alters voting (Enke 2020, Enke et al 2022) but not demand – parties respond to green voters who prefer higher brown tax T

Main results

Proposition 6 *With moral consumers, parties choose same taxes:*

$$T = (1-\sigma)(\lambda + \mu\theta) - \sigma\chi, \;\; t = -(\sigma+\zeta)\chi$$

- endogenous reference point reflects pollution at highest politically feasible brown-goods tax
- moral values become more strict (lenient) over time, as green values share μ grows (shrinks)

Implications of moral values

Statics and dynamics of policy

- equilibrium T higher, *ceteris paribus*, rising in green share μ
- additional feedback loop on top of market-size effect: expected green-values share μ' raises T' and green-firm share γ', which makes μ' even larger

Green transitions and welfare

- green transition more *likely* and more *rapid* if it occurs – the $\widehat{\delta}_0 + \widehat{\delta}_1 \mu'$ curve shifts up every period
- cuts both welfare costs of lacking commitment

Enrich politics – lobbying by firms

Simple modeling

- add lobbying to electoral competition
- shares ϕ, Φ of green, brown firms pay (optimal) campaign contributions (Baron 1994)
- support party whose policy better for profits – money raises party-win probability by ξ

Main results

Proposition 7 *With electoral competition and lobbying, parties converge on taxes:*

$$T = \frac{(1-\sigma)\lambda - \sigma(1+\Phi\xi)\chi}{1+\Phi\xi\sigma}, t = -\sigma(\chi+\zeta)\frac{1+\xi\phi}{1+\xi\phi\sigma}$$

- Proposition 3 special case for $\phi = \Phi = 0$, or $\xi = 0$

Implications of lobbying

Statics and dynamics of policy

- taxes constant over time, as with electoral competition
- taxes lower if more firms organized (higher ϕ or Φ)

Green transitions and welfare

- if brown firms better organized than green ($\Phi > \phi$), lobbying makes green transition less likely, and more so if money more important in politics (higher ξ)
- raises welfare costs of lacking commitment

Enrich politics – individual activism

Simple modeling

- add "private politics" (Abito et al 2019)
- green activists hurt brown firms, help green firms – costs rise by $\mu d(\lambda)$, fall by $-\mu a(\lambda)$ – more so, if μ and λ higher

Main result

Proposition 8 *With electoral competition and individual activism, both parties choose taxes:*

$$T = (1-\sigma)\lambda - \sigma(\chi + \mu d(\lambda)), \; t = -\sigma(\chi + \zeta - \mu a(\lambda))$$

- parties adapt policy to activism – some crowding out, but still higher (lower) costs of brown (green) firms

Implications of private politics

Statics and dynamics of policy

- more activism – higher $d(\lambda)$ and $a(\lambda)$ – raises brown-green tax gap $T - t$
- this gap rises (falls) with higher (lower) green share μ

Green transitions and welfare

- individual activism and policy interact – new positive feedback loop between green shares γ and μ
- green transition more likely and more rapid, should it occur
- activism cuts both costs of lacking commitment

Enrich economics – endogenous adoption costs

Simple modeling

- green adopting share can push green-technology cost $m' = mH(\gamma', q')$ – up via crowding ($H_\gamma > 0$), or down via learning by doing ($H_q < 0$, where $q' = q + \gamma'$)
- get *economic dynamics* – evolving green-firm share γ may, or may not, drive green (production) transition, even if μ constant
- value dynamics boost or dampen the economic dynamics

Implications

- politicians still can't alter γ' – mirror expected profits π' that current policy does not affect – so t, T set as in Proposition 3
- crowding (and coevolving values) slow down or prevent green transition, compared to baseline model
- learning by doing speeds up or enables green transition

Enrich economics – endogenous adoption subsidy

Simple modeling

- add third instrument: flat grant r for going green
- now, current policymakers *can* affect future technologies γ' directly, and values μ' indirectly

Implications

- r chosen "strategically" to influence future welfare via state variable μ'
- higher r cuts future pollution $\lambda \overline{Y}'$ – this is good for all and trumps any distributive concerns if externality large
- under Condition 2, r used to its maximum – removes welfare traps, and speeds up green transition

Enrich dynamics – *stock* externality

Simple modeling

- *climate* externality λ reflects cumulated (past) emissions Λ, as well as current emissions, with $\lambda' = \lambda(\delta\Lambda + \overline{Y}(T))$
- two state variables μ and Λ

Implications

- choices of t and T shape future externality and future policy
- again, policy chosen strategically: higher T cuts current *and* future pollution λ', and thus affects T'
- T set higher with stock than flow externality
- but may not limit damages – a race between lower pollution flow and higher pollution stock

Major qualification

- *global* climate externality may nullify stronger policy incentives when policymakers *national*

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New results

Address first "hangover" in traditional economic logic

- values rather than taxes as driver – complementarity yields divergent value-technology dynamics
- market failure may, or may not, result in brown trap, as welfare-enhancing green transition does not materialize

Address second hangover

- add politically determined tax policy without commitment – may, or may not, remove brown trap
- political failure results in too slow green transitions
- new perspective on role of policy

Ways forward

Model is a plausible stepping stone

- show how to extend it in several directions
- can add richer value-driven behavior – pricing by motivated green-firm owners, voice or exit by green investors
- can add even richer politics – formation of green social movements, or entry of green parties

More demanding, maybe more rewarding, extensions

- value and technology spillovers – analyze in multi-country framework with global externalities
- reference points for green moral values – can offer an approach to global moral standards
- "double-edged diplomacy" – study interplay of domestic politics and international climate agreements