Climate policy under political pressure

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Dynamic Games and Applications Seminar, November 2023

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1. Introduction

Political pressure

- Environmental protection (including climate policy) is a high priority for many governments. However, implemented policies tend to be less ambitious than promised policies and are far from sufficient to reach long-term goals such as the Paris Agreement [UNEP (2021)].
- Political pressure has been proposed as a possible explanation [Hughes & Urpelainen (2015), Downie (2017), etc.].
  - COP27 saw an unprecedented number of corporate lobbyists from the oil and gas industry.
  - Corporate lobbying has risen significantly over the past two decades [Brulle (2018), Hanegraaf and Poletti (2021)].
  - There is empirical evidence for the effects of lobbying on environmental policy [Fredriksson et al. (2005), Meng & Rode (2019), etc.].
  - Governments also face increasing political pressure from environmental activists (Fridays for Future, Last Generation, Extinction Rebellion, etc.).
- We claim that due to political pressure, preferences of governments become dynamically inconsistent.

- Preferences are dynamically inconsistent, when the incentives to set a future decision variable change as the future approaches or arrives.
- In general, different reasons can be responsible for dynamic inconsistency:
  - hierarchical decision structures [Kydland & Prescott (1977)];
  - non-geometric discounting [Strotz (1955-1956)];
  - changes of instantaneous utility functions [Battaglini (2021), Ulph & Ulph (2013)].
- In the context of environmental policy, dynamic inconsistency has been studied as a result of
  - non-geometric discounting [Cropper & Laibson (1999), Karp et al. (2005, 2008, 2011, 2021)];
  - strategic interactions [Abrego & Perroni (2002), Gersbach & Glazer (1999), Helm et al. (2003), Chiapinelli & May (2022), Acemoglu & Rafey (2018), Pichler & Sorger (2018)];
  - rotation of political power [Battaglini (2021), Ulph & Ulph (2013)].

Contribution of the paper

- We claim that political pressure is likely to make governments' preferences dynamically inconsistent.
- Within a framework that describes the transition from fossile fuel-based energy production to clean energy production, we illustrate how the effect of lobbying can be modelled in a conceptually simple way.
- We provide an alternative to established theories of lobbying such as Grossman & Helpman (1994).

2. Model formulation

The framework

- Based on Harstad (2012, 2016).
- Energy can be produced by a dirty technology and a clean one.
- One unit of energy produced by dirty technology generates one unit of emissions. The amount of energy produced by dirty technology in period t is denoted by g_t, so that the stock of greenhouse gases G_t evolves according to

$$G_{t+1} = \gamma G_t + g_t \qquad G_0 \text{ given.}$$

- Clean technology requires infrastructure. One unit of infrastructure generates one unit of energy per period. The stock of infrastructure R_t and the corresponding investment rate r_t are related by

$$R_{t+1} = \rho R_t + r_t \qquad R_0 \text{ given.}$$

- The total amount of energy produced in period t is $g_t + R_t$.
- Instantaneous welfare in period t is

$$u(g_t + R_t, r_t, G_t) = B(g_t + R_t) - K(r_t) - D(G_t).$$

- In period t, a benevolent government with time-preference factor δ would maximize social welfare

$$u(g_t + R_t, r_t, G_t) + \sum_{s=1}^{+\infty} \delta^s u(g_{t+s} + R_{t+s}, r_{t+s}, G_{t+s}).$$

- There exist interest groups and lobbies which exert pressure on the government. The government gives in to immediate pressure but maintains its long-term goal. Hence it maximizes

$$v(g_t, r_t, G_t, R_t) + \sum_{s=1}^{+\infty} \delta^s u(g_{t+s} + R_{t+s}, r_{t+s}, G_{t+s}),$$

where

$$v(g, r, G, R) = u(g + R, r, G) + pw(g, r, G, R).$$

- The function w reflects the goal of the lobby and p is the intensity of lobbying.
- For the time being: one lobby and exogenous and constant political pressure (will be relaxed later).

Comments on the preferences

- The lobby is myopic and the government does not take into account future pressure of the lobby.
  - Political pressure is often exerted with a particular short-term objective, e.g., to block a particular legislation, to prevent the construction of a particular power station or road, ...
  - The current government reacts to current pressure but anticipates that it will not be in power forever. It still cares for welfare throughout the entire (infinite) planning horizon.
  - Interest groups do not take into account future actions of the government because the latter cannot commit to those actions anyway.

- Since the current-period utility function v differs from the utility function u applied to future periods, the government has dynamically inconsistent preferences: an optimal policy from the point of view of period t is no longer optimal in period $s > t$. Without commitment, the government would deviate from its own plans.
- Sophisticated approach: the government consists of a collection of separate selves, one for each period, who play an intrapersonal game. [Strotz (1955-1956), Phelps & Pollak (1968), Peleg & Yaari (1973), Laibson (1997), ...]
- Definition: A pair of policy functions (ϕ, ψ) is a solution to the government's problem if there exists a continuation value function U such that for all states (G, R) it holds that

$$(\phi(G,R), \psi(G,R)) = \text{argmax}_{(g,r)} \left[v(g,r,G,R) + \delta U(\gamma G + g, \rho R + r) \right]$$

and

$$U(G,R) = u(\phi(G,R)+R, \psi(G,R), G) + \delta U(\gamma G + \phi(G,R), \rho R + \psi(G,R)).$$

A special case: quasi-hyperbolic discounting

- If
$$w(g, r, G, R) = u(g + R, r, G)$$
holds, it follows that
$$v(g, r, G, R) = (1 + p)u(g + R, r, G).$$
Hence, the government maximizes
$$u(g_t + R_t, r_t, G_t) + \beta \sum_{s=1}^{+\infty} \delta^s u(g_{t+s} + R_{t+s}, r_{t+s}, G_{t+s})$$
with
$$\beta = \frac{1}{1 + p} \leq 1.$$
- The lobby cares only about current utility and disregards the future. This introduces a present bias into the government's objective functional as in the popular β-δ model of quasi-hyperbolic discounting.

3. Two specific examples

Linear-quadratic specification

- As in Harstad (2016) or Pichler & Sorger (2018) we postulate the following functional forms

$$B(g+R) = -\frac{1}{2}(g+R-\bar{y})^2\,,\ K(r) = kr\,,\ D(G) = \frac{d}{2}G^2.$$

- Linear policy rules

$$\phi(G,R) = \phi_0 + \phi_G G + \phi_R R\,,$$
$$\psi(G,R) = \psi_0 + \psi_G G + \psi_R R\,.$$

- Steady state is reached in finite time.

Example 1: The traditional (dirty) energy lobby

Suppose that $w(g, r, G, R) = g$ holds.

- Policy functions

$$\phi_0 = \frac{\bar{y} + p - \gamma(1 - \delta\rho)k}{1 + \delta d}\,,\ \phi_G = -\frac{\gamma\delta d}{1 + \delta d}\,,\ \phi_R = -\frac{1}{1 + \delta d}\,,$$
$$\psi_0 = \bar{y} - \frac{(1 - \delta\rho)k}{\delta}\left(1 + \frac{1 - \delta\gamma}{\delta d}\right) + \gamma\phi_0\,,\ \psi_G = \gamma^2 + \gamma\phi_G\,,$$
$$\psi_R = -\rho + \gamma\phi_R\,.$$

- Steady state

$$G^* = \frac{(1 - \delta\rho)(1 - \delta\gamma)k}{\delta^2 d} + \frac{p}{1 + \delta d}\,,$$
$$R^* = \bar{y} + p - \gamma(1 - \delta\rho)k - (1 - \gamma + \delta d)G^*\,.$$

- Feedback

$$\phi_G < 0\,,\ \phi_R < 0\,,\ \psi_G > 0\,,\ \psi_R < 0\,.$$

The effect of pressure

- Policy functions

$$\phi_0 = \frac{\bar{y} + p - \gamma(1-\delta\rho)k}{1+\delta d}\,,\ \phi_G = -\frac{\gamma\delta d}{1+\delta d}\,,\ \phi_R = -\frac{1}{1+\delta d}\,,$$
$$\psi_0 = \bar{y} - \frac{(1-\delta\rho)k}{\delta}\left(1 + \frac{1-\delta\gamma}{\delta d}\right) + \gamma\phi_0\,,\ \psi_G = \gamma^2 + \gamma\phi_G\,,$$
$$\psi_R = -\rho + \gamma\phi_R\,.$$

- Steady state

$$G^* = \frac{(1-\delta\rho)(1-\delta\gamma)k}{\delta^2 d} + \frac{p}{1+\delta d}\,,$$
$$R^* = \bar{y} + p - \gamma(1-\delta\rho)k - (1-\gamma+\delta d)G^*\,.$$

- Comparative statics

$$\frac{\partial\phi_0}{\partial p} > 0\,,\ \frac{\partial\psi_0}{\partial p} > 0\,,\ \frac{\partial G^*}{\partial p} > 0\,,\ \frac{\partial R^*}{\partial p} > 0\,.$$

The energy mix in the long run

- We have seen that pressure from the traditional energy lobby leads to a higher long-run stock of greenhouse gases and a higher long-run stock of clean technology.

- In the long run, the amount of clean energy produced is R^* and the amount of dirty energy produced is $g^* = (1-\gamma)G^*$. The fraction of energy that is produced by clean technology is

$$m = \frac{R^*}{(1-\gamma)G^* + R^*}.$$

- It holds that

$$\frac{\partial m}{\partial p} \gtreqless 0 \;\Leftrightarrow\; \bar{y} \lesseqgtr \frac{1-\delta\rho}{\delta}\left(1 + \frac{1-\delta\gamma}{\delta d}\right)k.$$

  Pressure from the dirty energy lobby can improve the energy mix in the long run if $\bar{y}$ is not too large.

Example 2: Pressure for immediate consumption

Suppose that $w(g,r,G,R) = B(g+R)$ holds.

- Policy functions

$$\phi_0 = \frac{(1+p)\bar{y} - \gamma(1-\delta\rho)k}{1+p+\delta d}\,,\ \phi_G = -\frac{\gamma\delta d}{1+p+\delta d}\,,\ \phi_R = -\frac{1+p}{1+p+\delta d}\,,$$

$$\psi_0 = \bar{y} - \frac{(1-\delta\rho)k}{\delta}\left[1 + \frac{1-\delta\gamma}{\delta d} - \frac{p^2}{(1+p)^2+\delta d}\right] + \gamma\phi_0\,,$$

$$\psi_G = \gamma^2 + \gamma\phi_G\,,\ \psi_R = -\rho + \gamma\phi_R\,.$$

- Steady state

$$G^* = \frac{(1-\delta\rho)(1+p)k}{\delta^2 d}\left[\frac{1+p+\delta d}{(1+p)^2+\delta d} - \frac{\delta\gamma}{1+p}\right]\,,$$

$$R^* = \bar{y} - \frac{\gamma(1-\delta\rho)k}{1+p} - \left(1-\gamma+\frac{\delta d}{1+p}\right)G^*\,.$$

Comparative analysis

- Comparative statics of the policy functions

$$\left.\frac{\partial \phi(G,R,p)}{\partial p}\right|_{(G,R)=(G^*,R^*)} > 0\,,$$

$$\left.\frac{\partial \psi(G,R,p)}{\partial p}\right|_{(G,R)=(G^*,R^*)} > 0\,.$$

- Comparative statics of the steady state

$$\frac{\partial G^*}{\partial p} \gtreqless 0 \;\Leftrightarrow\; p \lesseqgtr \sqrt{1+\delta d}\,,$$

$$\frac{\partial R^*}{\partial p} > 0\,.$$

- Non-monotonic dependence of G^* on p is likely due to the interaction between states and the preference structure (bliss point).

4. Extensions

- Suppose that the intensity of lobbying, p, can be chosen by the lobby and that higher intensity leads to higher cost $C(p)$ for the lobby. In period t, the lobby chooses p_t so as to maximize

$$w(g_t, r_t, G_t, R_t) - C(p_t).$$

- The biased welfare function in period t is

$$v(p_t, g_t, r_t, G_t, R_t) = u(g_t + R_t, r_t, G_t) + p_t w(g_t, r_t, G_t, R_t).$$

In period t, the government seeks to maximize

$$v(p_t, g_t, r_t, G_t, R_t) + \sum_{s=1}^{+\infty} \delta^s u(g_{t+s} + R_{t+s}, r_{t+s}, G_{t+s}).$$

- The lobby can only benefit from exerting pressure, if the government responds appropriately. A hierarchical equilibrium concept (Stackelberg equilibrium) is used to describe this situation.

Stage games and best responses

- Let a state (G, R) and a continuation value function U be given. The subgame or stage game $\Gamma(G, R, U)$ is defined by the government's objective function

$$v(p, g, r, G, R) + \delta U(\gamma G + g, \rho R + r)$$

  and the interest group's objective function

$$w(g, r, G, R) - C(p).$$

- The best response of the government to the interest group's action p is

$$(\mathrm{BR}^g[p], \mathrm{BR}^r[p]) = \mathsf{argmax}_{(g,r)} \left\{ v(p, g, r, G, R) + \delta U(\gamma G + g, \rho R + r) \right\}.$$

- A triple of actions (p, g, r) is a Stackelberg equilibrium of the stage game $\Gamma(G, R, U)$ if $(g, r) = (\mathrm{BR}^g[p], \mathrm{BR}^r[p])$ and if for all feasible actions $\tilde{p}$ of the lobby, it holds that

$$w(\mathrm{BR}^g[p], \mathrm{BR}^r[p], G, R) - C(p) \geq w(\mathrm{BR}^g[\tilde{p}], \mathrm{BR}^r[\tilde{p}], G, R) - C(\tilde{p}).$$

- All players (lobbies and selves of the government) use stationary Markov strategies which map the state of the game (G, R) into their respective action spaces. The strategies of the government are ϕ and ψ whereas the strategy of the lobbies is μ.

- A triple of stationary Markov strategies (μ, ϕ, ψ) is a stagewise Stackelberg equilibrium of the dynamic game if there exists a continuation value function U such that for every state (G, R), the triple $(\mu(G, R), \phi(G, R), \psi(G, R))$ is a Stackelberg equilibrium of the stage game $\Gamma(G, R, U)$ and the equation

$$U(G, R) = u(\phi(G, R) + R, \psi(G, R), G) + \delta U(\gamma G + \phi(G, R), \rho R + \psi(G, R))$$

holds.

Suppose that $w(g, r, G, R) = g$ and $C(p) = (c/2)p^2$ hold.

- There exists a stagewise Stackelberg equilibrium in which the lobby's strategy is given by

$$\mu(G, R) = \hat{p} := \frac{1}{c(1 + \delta d)}.$$

  The emission and investment strategies of the government and the steady-state stocks of greenhouse gases and clean technology are as in the case of exogenous pressure $p = \hat{p}$.

- In this example, equilibrium pressure is independent of the state (G, R). This is an implication of the fact that the response coefficients ϕ_G, ϕ_R, ψ_G and ψ_R are independent of p. Hence, the marginal benefit of pressure for the lobby is independent of (G, R). Since the marginal cost is independent of the state by assumption, the optimal choice of p is so, too.

Extension 2: Multiple lobbies

- Suppose that there is pressure p^g from the traditional (dirty) energy lobby, which wants to maximize g. In addition, there is pressure p^r from a lobby with the goal of maximizing r.
- Policy functions

$$\phi(G,R) = \frac{\bar{y} + p^g - \gamma[(1-\delta\rho)k - p^r]}{1+\delta d} - \frac{\gamma\delta d}{1+\delta d}G - \frac{1}{1+\delta d}R,$$

$$\psi(G,R) = \bar{y} - \frac{1-\delta\rho}{\delta}\left(1 + \frac{1-\delta\gamma}{\delta d}\right)k + \frac{p^r(1+\delta d)}{\delta^2 d} + \gamma^2 G - \rho R + \gamma\phi(G,R).$$

- Steady state

$$G^* = \frac{(1-\delta\gamma)(1-\delta\rho)k - p^r}{\delta^2 d} + \frac{p^g + \gamma p^r}{1+\delta d},$$

$$R^* = \bar{y} + p^g + \gamma p^r - \gamma(1-\delta\rho)k - (1-\gamma+\delta d)G^*.$$

Multiple lobbies (continued)

- Comparative statics of the policy functions

$$\frac{\partial \phi(G,R)}{\partial p^g} > 0\,,\ \frac{\partial \phi(G,R)}{\partial p^r} > 0\,,\ \frac{\partial \psi(G,R)}{\partial p^g} > 0\,,\ \frac{\partial \psi(G,R)}{\partial p^r} > 0.$$

- Comparative statics of the steady state

$$\frac{\partial G^*}{\partial p^g} > 0, \frac{\partial G^*}{\partial p^r} < 0\,,\ \frac{\partial R^*}{\partial p^g} > 0, \frac{\partial R^*}{\partial p^r} > 0.$$

5. Conclusions

Main points

- Pressure from interest groups is an important aspect in environmental policy making:
  - It may help to explain a shortfall of implemented policy measures compared to publicly expressed policy goals.
  - It is likely to generate dynamically inconsistent preferences of policy makers.
  - It should be taken into account in models used for policy advice.
- We have illustrated some consequences of political pressure in a modelling framework that has been used to study climate policy and international environmental agreements. It may be useful to apply the same idea in other contexts or models.
- Our approach is conceptually simple and provides an alternative to existing theories of lobbying and bribery, such as Grossman & Helpman (1994).

Future research

- Within the present modelling framework:
  - Extend the model to multiple countries.
  - Include a capital stock for the dirty energy (black capacity).
- Implementation of the optimal policy in a micro-founded model