

Voting models II

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These notes were prepared for the EAERE FEEM VIU European Summer School in resource and environmental economics, Vence, 2003. Be aware that they may contain mistakes.

Voting models II

Outline of lecture

- Performance voting.
- Application to environmental policy choices.
- Probabilistic voting

A distinction can be made between pre-election and post-election politics:

- Pre-election politics takes place before elections are held and focuses on the link between policy announcements and voting behavior.
 - Election promises are credible (commitment).
 - Forward-looking voting behavior.
- Post-election politics takes place after elections are held and focuses on accountability and reputation effects.
 - Election promises are irrelevant (no commitment) => performance is key.
 - Backward-looking (retrospective) voting behavior.

Conflict between pre- and post-election politics when

- ideology matters.
- rent-seeking matters.
- the state of the world changes.

↓

Conflict between ex ante and ex post incentives.

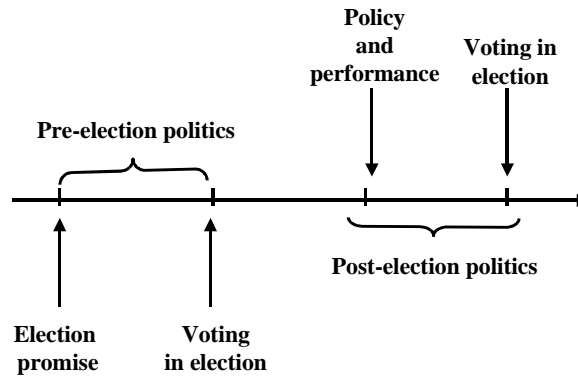


Figure 1:

Performance voting

In a representative democracy, voters delegate decision making power to elected politicians

⇒ agency problems can arise.

How can elections help solve these agency problems?

Elections play two useful roles:

- Punish politicians for bad behavior (implicit incentive contracts).
- Find and keep the most competent politicians (selection device).

The Ferejohn (1986) model of performance voting

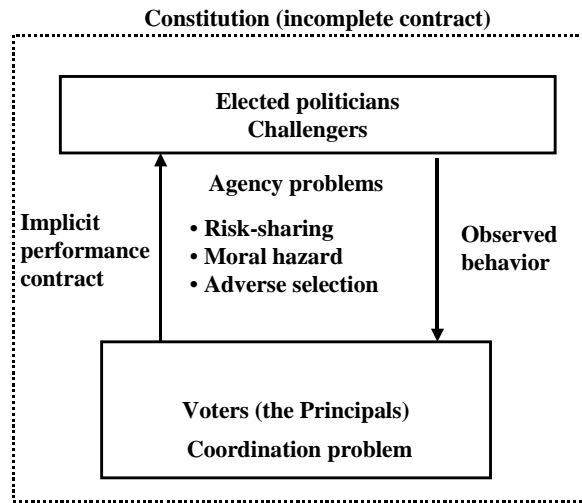


Figure 2:

- Three key characteristics of democracies:
 - Elections are repeated and take place through time.
 - Politicians care about being in power.
 - Voters hold politicians responsible for what they do while in office.

- Preferences

- An elected politician has the following per-period utility function:

$$v(a_t) = w - a_t$$

where w is the ego-rent associated with holding office and a_t is the policy action taken in period t . Notice that politicians dislike taking actions. We assume that $a_t \in [0, 1]$.

- A representative voter (all voters are identical) has the following per-period utility function:

$$u(a_t, \theta_t) = a_t \theta_t$$

where θ_t is random and drawn every period from the distribution, $F(\theta_t)$, with mean $\bar{\theta}$. The draws are independent. We refer to θ_t as the state of the economy.

- Notice that the voter and the politician are both risk neutral (issues of risk sharing do not arise).
- Individuals live for ever and discount the future using the discount factor β .
- Notice the conflict of interest between the politician who wants $a_t = 0$ and the voters who want $a_t = 1$.

- Political institutions

- Politicians are elected in a democratic election by majority rule.
- There is an election at the beginning of each period.
- The election term is one period.
- Once a politician has been voted out of office, he or she can never be reelected.
- Politicians cannot commit to implement particular policies (the constitution is an incomplete contract).
- All politicians are alike.
- There is always a challenger that is willing to run against the incumbent.

- Information (three cases).

- Policy as well as the state of the economy are observable and verifiable by voters (symmetric information).
- Policy and the state of the economy are non-verifiable information to voters. They only observe their utility ($a_t\theta_t$). Politicians observe the state of the world before they decide on policy (moral hazard problem).

- The state of the world is common knowledge and verifiable. The type of the politician is not known to voters (adverse selection problem).

Symmetric information

The timing of events in each period:

- Voters announce a performance standard at the beginning of the incumbent's tenure.
- The incumbent implements a policy which is observed by voters.
- The state of nature is revealed to all players.
- An election is held in which the incumbent is running against a challenger.

- Assume that θ_t are iid from a uniform distribution defined on the unit interval, i.e.,

$$F(\theta_t) = \theta_t \text{ for } 0 \leq \theta_t \leq 1$$

and

$$f(\theta_t) = 1 \text{ for } 0 \leq \theta_t \leq 1$$

Definition 1 (*Voting strategy*) A retrospective voting rule is a voting function $(\eta_t(\cdot))$ and a performance standard (\bar{a}_t) such that

$$\begin{aligned}\eta_t(a_t, \bar{a}_t) &= 1 \iff a_t \geq \bar{a}_t \\ &= 0 \text{ otherwise}\end{aligned}$$

where $\eta_t(a_t, \bar{a}_t)$ is the probability that a politician that implements policy a_t when the performance standard is \bar{a}_t is reelected. We denote by A the set of all such voting rule.

Definition 2 (*Implementation strategy*). An implementation strategy for a politicians is a mapping $a: A \rightarrow [0, 1]$.

Definition 3 (*Political equilibrium*) A strategy profile is a Markov Perfect equilibrium if, after any history, each player's strategy under the profile is optimal, given that he or she expects all other players to use their equilibrium strategies.

- No history dependent trigger (subgame perfect) strategies are allowed.
- No physical link between the periods.

The incumbent

- For a given sequence of performance standards $\{\bar{a}_t\}_{t=0}^{\infty}$, the value function of the incumbent politician is

$$v(a_t) = w - a_t + \eta(a_t, \bar{a}_t)\beta \max v(a_{t+1})$$

The incumbent has the choice between two actions:

- He can satisfy the standard and get reelected. Doing so yields:

$$v_C(a_t) = w - \bar{a}_t + \beta \max v_C(a_{t+1})$$

Notice that $\max v_C(a_{t+1})$ is independent of \bar{a}_t (and θ_t).

- He can implement $a_t = 0$ and get voted out of office. Doing so yields:

$$v_D = w$$

- The best response of the incumbent to $\{\bar{a}_t\}_{t=0}^{\infty}$ (and the associated voting strategies) is

$$a_t = \bar{a}_t \Leftrightarrow v_C(\bar{a}_t) \geq v_D(0)$$

and $a_t = 0$ otherwise.

- Rewrite this to get the following “compliance constraint”

$$a_t = \bar{a}_t \Leftrightarrow \bar{a}_t \leq \beta \max v_C(a_{t+1})$$

Voters

- Voters design the retrospective voting rule to maximize expected utility:

$$Eu = E_{\theta} \sum_{t=0}^{\infty} \beta^t \theta_t a_t = \frac{1}{2} \sum_{t=0}^{\infty} \beta^t a_t$$

subject to the compliance constraint.

- Notice that this basically breaks down into a sequence of one period problems.

- Non-binding compliance constraint: $\bar{a}_t = 1$ for all t .
- Binding compliance constraint: $\bar{a}_t = \beta \max v_C(a_{t+1}) < 1$ for all t .
- The performance standard is stationary and so,

$$\bar{a} = \beta \max v_C(a_{t+1}) = \beta \frac{w - \bar{a}}{1 - \beta}$$

or

$$\bar{a} = \beta w$$

Proposition 1 *A stationary political equilibrium is as follows. Every period voters announce the performance standard*

$$\bar{a} = \min\{1, \beta w\}$$

and the incumbent implements $a_t = \bar{a}$ and is reelected.

- Notice that there are incomplete voter control despite the fact that they can observe perfectly what the incumbent is doing.
- Notice that the voting strategy is (weakly) time consistent.
- Voter can control politicians better, the more the incumbent values being in office (i.e., the higher is β and/or the higher is the ego-rent). Anything that makes politician value political office more increases accountability!

Environmental Instrument Choices

- Buchanan and Tullock (AER, 1975) showed that industry interests prefer quantitative controls to taxes and argued that these interested (due to a comparative advantage in organizing political lobbying) prevail over voters, who prefer emission taxes, in the political process. Thus, we should observe quantitative controls, as we did for many years and still to a large extent do.
- The performance voting model provides a convenient framework for analyzing these questions formally. It allows us to model the conflict between voters and special-interests explicitly and to identify circumstances under which special-interests do not prevail over general-interests.

The Model

- Infinite time horizon, $t = 0, 1, 2, \dots$
- Consumers have utility

$$\sum_{t=0}^{\infty} \beta^t [y_t + g_t + u(x_t) + u_e(1 - e_t)].$$

- y_t is a numeraire good.
- g_t is public good (financed by (pollution taxes)).
- x_t is private good sold a price p_t .
- e_t is emission.
- β is the discount factor.

- A continuum of heterogeneous firms with measure 1 produce x .
- Each firm produces one unit of x at zero marginal cost.
- Total production is 1 and so, $p_t = p = u'(1)$.
- Production pollutes the environment (one-to-one).
- Abatement technology

$$C_{it}(a_i) = \frac{(1 - e_i)^2}{2\theta_{it}}$$

where

- $a_i = 1 - e_i$ is abatement.
- $\theta_{it} = A_t\theta_i$ is “abatement productivity.”

- Abatement costs differ across firms: θ is distributed according to

$$F(\theta)$$

with support on $[\theta_L, \theta_H]$. Moreover,

$$\mu = \int_{\theta_L}^{\theta_H} \theta dF(\theta) = E\theta$$

$$\eta = \frac{1}{\int \frac{1}{\theta} dF(\theta)} = \frac{1}{E\frac{1}{\theta}}$$

where $\mu > \eta$ (by Jensen’s inequality).

- Abatement costs differ across time, as A_t evolves (think of productivity growth).

Regulation

- The environmental target is fixed exogenously at $\bar{e}_t \in [0, 1]$ but can change from period to period.
- Abatement costs are private information to firms.
- Two regulation instruments:
 - Q : Quantity controls (uniform emission quota).
 - T : Pollution taxes (with revenue recycling to voters).

Quantity controls

- Uniform standards: \bar{e}_t (one period).
- Not least cost abatement.
- Profits for the whole industry are

$$V(Q) = p - \frac{(1 - \bar{e})^2}{2\eta A}$$

Pollution taxes

- The tax τ_t is levied on emissions.
- The revenue is recycled to consumers.

- Firms maximize

$$p - \frac{(1 - e_{it})^2}{2\theta_{it}} - \tau_t e_{it}$$

and emit

$$1 - e_{it} = \tau_t \theta_{it}$$

- To reduce total emission to the target, the tax rate must satisfy

$$\tau_t = \frac{1 - \bar{e}_t}{A_t \mu}$$

and profits for the whole industry are

$$V(T) = p - \frac{(1 - \bar{e})^2}{2\mu A} - \frac{\bar{e}(1 - \bar{e})}{\mu A}$$

Comparison of profit levels

- Trade-off between two effects:
 - Absence of abatement cost minimization: $[Q]$
 - Financial cost of the tax: $[T]$

Lemma 1 (*Profit levels*). *The industry prefers $[Q]$ if and only if*

$$\bar{e}_t > \frac{\mu - \eta}{\mu + \eta} \equiv \varepsilon.$$

Otherwise, the industry prefers taxes!

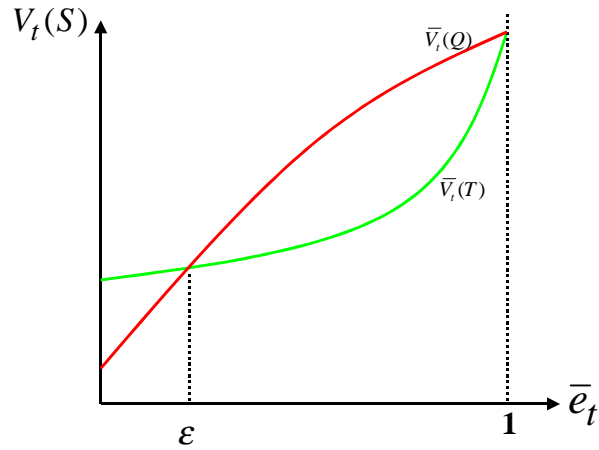


Figure 3:

- If the target is lax, [Q] is preferred to [T] because the absence of least cost abatement does not matter too much.
- If the target is intermediate, [Q] is preferred to [T] because the financial burden under [T] is high.
- If the target is very strict, [T] is preferred to [T] because of the Laffer curve effect and the desire to undertake abatement at least cost.
- Thus, this result is driven by the fact that the efficiency loss is increasing as the target gets stricter [not a general feature].

Political Process

- Environmental regulation is decided by democratically elected politicians.

- Repeated elections
 - politicians are drawn from the households and elected by majority rule.
 - politicians cannot commit to policy platforms.
 - politicians are delegated the power to decide on $S_t \in \{Q, T\}$.
 - voters use performance standards to judge the behavior of elected politicians.
 - In particular, the incumbent is reelected if and only if:

$$\eta(S_t) = \begin{cases} 1 & \text{if } S_t = T \\ 0 & \text{otherwise} \end{cases}$$

(otherwise a challenger is voted in).

- Lobbying activities:
 - The firms organize an industry-based lobby group

$$\sum_{t=0}^{\infty} \beta^t (\bar{V}(S_t) - b(S_t))$$
 - The lobby group offers monetary payments to the politician in exchange for specific policies (Bernheim and Whinston, 1986):

$$b(S)$$
 - Notice the difference between the incentive instrument of the lobby and the electoral.

- Power and politics
 - Politicians derive utility from holding office, m (for megalomania).
 - Discretionary power to collect payments from an industry lobby group, $b(S_t)$.
 - No comebacks (outside option normalized to zero).

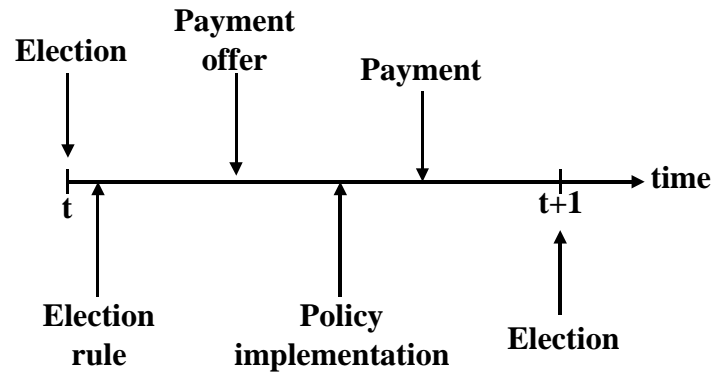


Figure 4: The timing of events.

- Per period utility of the politician holding office in period t :

$$m + b(S_t)$$

- Discount rate is β .

The Game

- Political equilibrium of the dynamic democracy is Markov perfect equilibrium.
- A Markov perfect equilibrium path is a sequence of regulation implementations, payment functions and performance standards that are best responses to each other and to not depend on payoff irrelevant aspects of the game.

Political equilibrium

Proposition 2 *Let $\bar{e}_t = \bar{e}$ and $A_t = A$ and define $M = \frac{\beta m}{1-\beta}$. Then the following stationary policy sequences are implemented in Markov perfect equilibrium:*

1. $\hat{S} = Q$ if $\bar{e} \geq \varepsilon$ and $\bar{V}(Q) \geq \bar{V}(T) + M$;
2. $\hat{S} = T$ otherwise.

- The logic of the proof:

1. The value function of the politician is

$$v(S_t) = b(S_t) + m + \eta(S_t)\beta v(S_{t+1})$$

2. Voters reelect if and only if $S_t = T$.
3. Lobby will never pay for $S_t = T \Rightarrow b(T) = 0$.
4. Lobby needs to compensate the politician for loss of office if it wants $S_t \neq T$.

(a) How much? $\beta v(S_{t+1}) = \frac{\beta m}{1-\beta} \equiv M$.

5. Thus, the industry gets [Q] if i) that is what it wants $\bar{e} \geq \varepsilon$ and ii) it is willing to pay enough to get it.

Remarks

- The model can be used to analyze transition between instrument regimes, but the formulation above is too simplistic:
 - Tradable permit instrument.
 - Price effects.

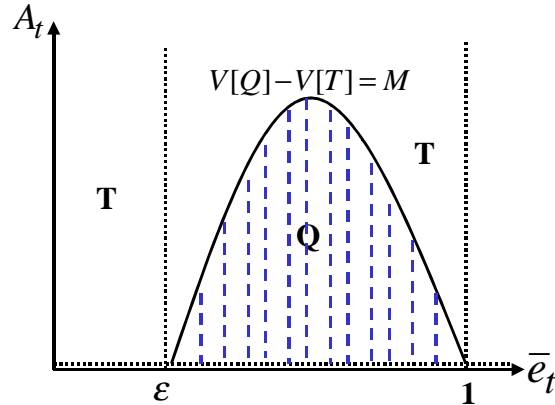


Figure 5:

Concluding Remarks

How useful are voting models as a tool for analyzing environmental policy choices.

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- Single issue elections on environmental policy are not, well, very common. Elections typically have many issues at the same time.
- In relation to environmental policy voting is typically one and perhaps not the most important determinant. Lobbying surely plays a role, so combining voting models with lobbying models is fruitful. Performance voting and probabilistic voting models can be combined with lobbying models (in particular the common agency approach).
- Voting models with institutional details (particular voting rules, checks and balances etc.) that can be mapped into observable features of real

world institutions seems a fruitful way of proceeding. That is, add details rather than going for the institutional free approach.

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