14.750x: How to design voting systems?

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Political institutions: democracy

- How to design voting systems?
- The Median Voter Theorem
- Applications of the Median Voter Theorem

How to model voting

- In order to introduce models of voting and politicians, we need to start by making some assumptions about people's preferences
- Suppose there are three choices that people are deciding on: $\{A, B, C\}$
- In principle, you could imagine 6 different ways preferences could be ordered:
    - $A > B > C$
    - $A > C > B$
    - $B > A > C$
    - $B > C > A$
    - $C > A > B$
    - $C > B > A$

Single-peaked preferences

- For the moment, we need to make a simplifying assumption on these preferences – we need to assume that they are "single-peaked." This is defined as

Definition (Single-Peaked Preferences)

Preferences are said to be single-peaked if the alternatives can be represented as points on a line, and each utility function has a maximum at some point on the line and slopes away from the maximum on either side.

- I'll come back to what happens if we don't have single-peaked preferences

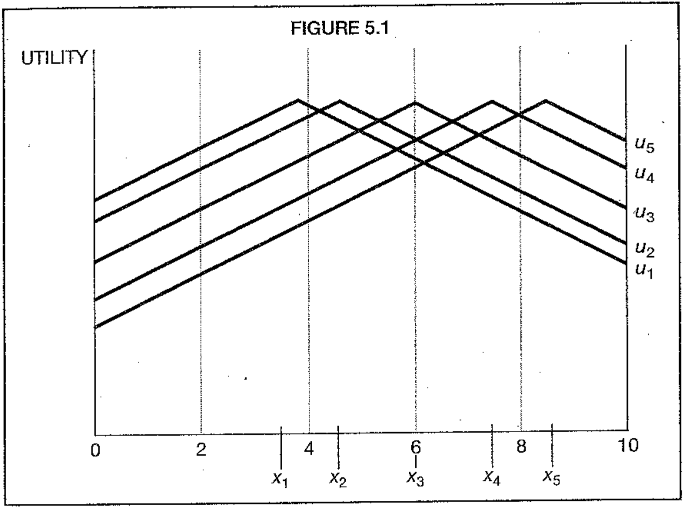
Example of single-peaked preferences

- How do we write down single-peaked preferences?
- Suppose we are making a decision about where to put a public good g on the interval $[0, 1]$
- An example of single-peaked preferences would be something like

$$u_i = -(g - b_i)^2$$

- In this example, b_i is individual i's *bliss point*.
- Some examples:
    - General "liberal vs. conservative" preferences
    - Tax rate and level of spending on public education
    - Where to locate a public good (e.g., I prefer it near my house, and my utility declines in distance from my house – albeit this is the one-dimensional version)

Example of single-peaked preferences



What does single-peakedness rule out?

- Suppose that we had ordered on a line A, B, C.Suppose I told you that we had people that
  - $B > A > C$
  - $B > C > A$
- If everyone's preferences are single-peaked, could someone have the preferences:
  - $A > C > B$? No. Why? Because B is in the middle.
- In practice, many of the economic things we care about – e.g. tax rates, size of government, how much money to spend on defense, etc – are continuous variables that can sensibly be modeled with single-peaked preferences
- The kinds of things where single-peakedness becomes more of a problem are unordered choices. Examples?
  - Which band should play at a special campus-wide concert?
  - What color should we paint the bridge?

What does single-peakednes buy us?

- Single-peakedness is very useful analytically.
- Suppose I am interested in the question of voting between two levels of funding for education, $e = 1$ and $e = 2$.
- With single-peakedness, I know that everyone whose bliss point $b_i < 1$ will vote for $e = 1$, and everyone whose bliss point $b_i > 2$ will vote for $e = 2$.
- What about someone whose bliss point $b_i = 1.75$?

The Median Voter Theorem

- Suppose preferences are single-peaked over a single-dimensional policy space.
- Suppose there are two candidates, 1 and 2.
- The two candidates simultaneously announce (and can commit) to implement policies p_1 and p_2.
- Voting is by majority rule.
- Then we have the following result:

Theorem (Median Voter Theorem)

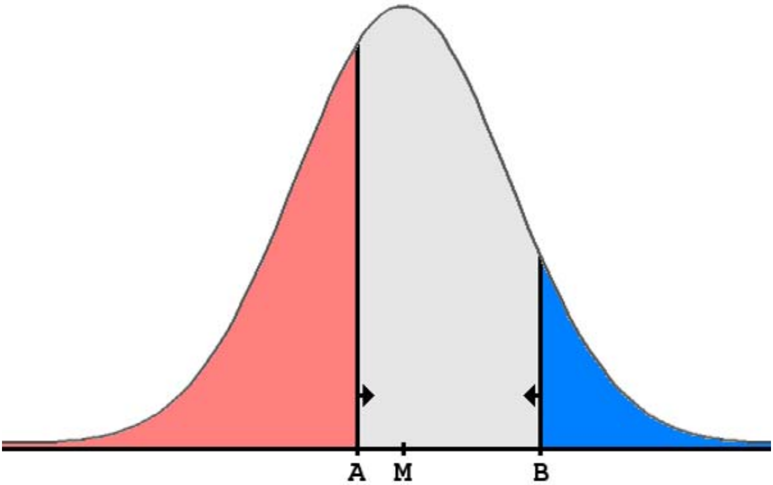
If preferences are single-peaked, and there are two candidates who can commit in advance to policies and care only about winning, then in equilibrium, $p_1 = p_2 = b_{median}$.

The Median Voter Theorem

Proof.

- Suppose not.
- Without loss of generality, suppose that p_1 has more votes than p_2 and that $p_1 < b_{median}$.
- Then p_2 will deviate and instead choose $p_2 = p_1 + \varepsilon$, with ε small, so that $p_2 < b_{median}$.
- From single-peakedness, all the voters with ideal points in the interval $[p_2, \infty)$ prefer p_2 to p_1.
- Since $p_2 < b_{median}$, this is more than half of the voters.
- So p_2 would win, and thus would prefer to deviate.So it is not an equilibrium for p_1 to win with $p_1 < b_{median}$.
- Thus the only equilibrium where there is no profitable deviation is $p_1 = p_2 = b_{median}$.

Example



What this does and doesn't mean

- This is a key result in voting theory.
  - Why?
  - Because it suggests there is a huge force driving candidates towards the preferences of the median voter – if they need to get more than 50% of the votes, the best way to do that is to have the median preferences – and if you don't, the other guy will
  - There are lots of reasons it may not hold exactly – e.g. Mitt Romney's positions may not exactly equal Barack Obama's – but it is a force driving them to the center
- Note that it assumes that politicians care only about winning – they don't also care about policy
  - E.g. Barack Obama would be happy to move to the right of Mitt Romney if he thought there were more than 50% of the votes there
  - This is probably not strictly true, but it is a useful benchmark

What this does and doesn't mean

- Note that intensity of preferences doesn't matter in this result
    - I may *really, really* dislike Candidate A, but my vote counts just as much as someone who is close to indifferent
    - This is a consequence of one person, one vote, and the inability of voting to collect preference information
    - It is, however, one of the fundamental ways in which elections are different than economic decisions
    - We can also think about ways of relaxing this (e.g. if you pay a cost of voting, people with stronger preferences may be more likely to vote; campaign contributions; etc). But once again, it's a useful benchmark

Condorcet's Paradox: Why did we assume single-peaked preferences

- Let's go back to our 3 option example we talked about a few lectures ago. There are 3 options, A, B, and C.
- In principle, you could imagine 6 different ways preferences could be ordered:
  - $A > B > C$
  - $A > C > B$
  - $B > A > C$
  - $B > C > A$
  - $C > A > B$
  - $C > B > A$

Condorcet's Paradox: Why did we assume single-peaked preferences

- Suppose that we have 3 people with preferences as follows:
  1. $A > B > C$
  2. $B > C > A$
  3. $C > A > B$
- Suppose we had a vote between A and B. Who would win? A
- Suppose we had a vote between B and C. Who would win? B
- Suppose we had a vote between C and A. Who would win? C
- Who would you expect to win if there was transitivity? A.
- But we do not have transitivity. Instead we have what's called a *Condorcet Cycle*

$$A \succ B \succ C \succ A$$

  where I'm using $\succ$ to denote the social preference ordering by majority votes.

Condorcet Cycles and Condorcet Winners

- What we just saw is an example of Condorcet's Paradox
- To be precise here are some definitions

Definition (Condorcet Winner)

A *Condorcet Winner* is an alternative such that it gains a majority of votes when paired against each of the other alternatives.

Definition (Condorcet Cycles)

A *Condorcet Cycle* occurs when there is a violation of transitivity in the social preference ordering.

Example (Condorcet Cycle)

With three alternatives $x \succ y \succ z \succ x$.
With four alternatives, you could have $x \succ y \succ z \succ q \succ x$.

Condorcet's Paradox and Condorcet Winners

Theorem

If a Condorcet Cycle occurs, then there is no Condorcet Winner.

Proof.

Consider a Condorcet Cycle of arbitrary length of the form

$$x \succ a_j \succ ... \succ a_k \succ x$$

Is x a Condorcet Winner?
No, because $x \succ a_j$ and $a_k \succ x$.
Is anything else a Condorcet Winner?
No, because there is alternative that defeats it from the assumption that $x \succ a_j \succ ... \succ a_k \succ x$.

Condorcet's Paradox and Condorcet Winners

Example

Consider the case with 3 alternatives.
Suppose that $x \succ y \succ z \succ x$.
Is x a Condorcet Winner?
No, because $z \succ x$.
Is anybody else a Condorcet Winner?
No, because $x \succ y$ (so y is not) and $y \succ z$ (so z is not).

Condorcet's Paradox and Condorcet Winners

Theorem

A Condorcet Cycle occurs whenever there is not a Condorcet Winner.

- I'll do the cases where there are 3 and 4 alternatives, although I believe the theorem is general.

Proof.

[Proof (3 alternatives)] Suppose there is not a Condorcet Winner.
Then we know there are at least 3 alternatives such that $x \succ y$ and $z \succ x$.
Why? Otherwise, x would be a Condorcet Winner.
What about y vs z? We know that $y \succ z$ because if $z \succ y$ then z would be a Condorcet Winner.
But now we have that $x \succ y$,$z \succ x$, and $y \succ z$. So that implies that $x \succ y \succ z \succ x$ and we have a Condorcet Cycle.

Condorcet's Paradox and Condorcet Winners

Proof.

[Proof (4 alternatives)] Supper there is a not a Condorcet Winner. Then we know there are at least 3 alternatives such that $x \succ y$ and $z \succ x$.
Suppose that $y \succ z$. Then $x \succ y \succ z \succ x$ and we're done.
So suppose that $z \succ y$. So now we have $x \succ y$, $z \succ x$, and $z \succ y$.
Clearly we need to have $q \succ z$ or else z would be a Condorcet winner.
So now we have $x \succ y, z \succ x, z \succ y, q \succ z$. So now we have
$q \succ z \succ x \succ y$.
But something (either x or y) must be preferred to q or else q would be a Condorcet winner.
If it's x, then we have $q \succ z \succ x \succ q$ and we're done.
If it's y, then we have $q \succ z \succ x \succ y \succ q$ and we're done.

Single-peakedness and Condorcet Winners

Theorem

If preferences are single-peaked, then the ideal point of the median voter is (weakly) a Condorcet Winner.

Proof.

Denote by b_{median} the ideal point of the median voter. Consider any alternative $a < b_{median}$.
All voters with ideal points $b_j > b_{median}$ will prefer b_{median} to a. Since this is at least 50% of the voters (by the definition of median), we know that $b_{median} \succeq a$.
Same is true for all alternatives $a > b_{median}$.
Thus there is no alternative that can strictly defeat b_{median}. □

- This is why single-peaked preferences are so useful – they mean that we don't have to worry about Condorcet Cycles, since they guarantee a Condorcet Winner

Agenda setting and Condorcet Cycles

- If there are Condorcet Cycles, then the order in which we vote makes a huge difference.
- Recall our example of preferences that generate a Condorcet Cycle
  1. $A > B > C$
  2. $B > C > A$
  3. $C > A > B$
- Suppose we first voted on A vs. B, and then voted on the winner vs. C. What would happen?
  - $A \succ B$. Then $C \succ A$. So we'd end up with C.
- Suppose instead we voted on A vs. C, and then voted on the winner vs. B. What would happen?
  - $C \succ A$. Then $B \succ C$. So we'd end up with B.
- Suppose instead we voted on B vs. C, and then voted on the winner vs. A. What would happen?
  - $B \succ C$. Then $A \succ B$. So we'd end up with A.

Agenda setting and Condorcet Cycles

- This example showed that the order in which we schedule votes can make a huge difference in outcomes
  - In fact, in this particular case, the person who decides which order we vote on things can end up with any outcome they want!

- This example illustrates the power of agenda setting – i.e., deciding which options we consider and in what order we consider them
- Who are agenda setters in real life?
  - In Congress, the Speaker of the House and the Senate Majority Leader set the agenda. In fact, that's their main power.
  - The President also has agenda setting powers (in a more informal sense)
  - You can't accomplish everything as agenda setter – but you can see how it's very powerful

What's the right thing to do when you have Condorcet Cycles?

- Given that Condorcet Cycles can exist, so there is no clear Condorcet winner, what is the "right" way for societies to make decisions?
  - I.e. is there some way to aggregate preferences that is "best" in some sense?
- The answer is, there is no right answer.
- Nothing is perfect.
- This is one of the most famous results in social choice theory, and it's called Arrow's Impossibility Theorem.

Arrow's Impossibility Theorem

- To state the theorem we need a few definitions:
- Denote the set of alternatives by A, the members of society as G, and the social decision rule as $\succ$.
- An individual's preferences are "*rational*" if they are complete and transitive. That is,
  - For any two alternatives, a and b, each individual in society can (weakly) rank them, i.e. $a > b$, $a = b$, or $b > a$.
  - And, for any three alternatives, a, b, c, if $a > b$ and $b > c$, then $a > c$. (and likewise for weak inequalities)

Arrow's Impossibility Theorem

- To state the theorem we need a few definitions:
  - Assumption 1 (Universal Domain). We assume that all individuals i have rational preferences over all the alternatives in A, but beyond that, they can have any set of rational orderings.
  - Assumption 2 (Pareto Optimality). If every member of G prefers a to b (i.e. if $a >_i b \, \forall i$), then the social decision rule must prefer a to b ($a \succ b$).
  - Assumption 3 (Independence of Irrelevant Alternatives). Suppose we have two different societies G and G', but within G and G', everyone has the same orderings of alternatives a and b. Then if $a \succ_G b$, then $a \succ_{G'} b$.
    - That is, if everyone in G and G' have the same orderings of alternatives a and b, the social ordering between a and b must be the same, even if members of G and G' have different rankings of other alternatives c.
  - Assumption 4 (No dictatorship). There is no particular individual $i^* \in G$ such that the preferences of i^* determine the social ranking $\succ$, regardless of other group members. That is, nobody is the dictator

Arrow's Impossibility Theorem

- We can now state the theorem:

Theorem (Arrow's Impossibility Theorem)

There is no social ranking function $\succ$ such that for any group G whose members all have rational preferences, $\succ$ is a rational (transitive) ranking and satisfies the Universal Domain, Pareto Optimality, Independence of Irrelevant Alternatives, and No Dictatorship assumptions.

- What does this mean?
- It means that the problem of Condorcet Cycles and agenda setting is a very deep, fundamental problem.
- If you want a social ordering that has Universal Domain, Pareto Optimality, Independence of Irrelevant Alternatives, and No Dictatorship, you can't also have transitivity – you will get cycles.

Borda Rule

- An alternative to majority rule
- Two-third majority rule
- What does it fail?

- Another alternative
- Borda Count
- Everybody ranks all candidates.
- We add up the ranks
- The one with the lowest total rank wins
- What does it fail?

An example of how the MVT is a powerful tool

Adapted from Meltzer and Richards (1981): "A Rational Theory of the Size of Government"

- Here is a simple example of how the median voter theorem is a powerful tool for analyzing policy
- Revenue:
  - Suppose we have only one variable: the income tax rate, denoted τ
  - So every individual pays fraction τ of their income as taxes. This means that if my income is y, my after tax income is $y(1-\tau)$.
  - Suppose that the income distribution is $f(y)$.
  - What is average tax revenue per person?
  - Revenue per person is

$$R_{avg} = \int \tau y f(y) = \tau \int y f(y) = \tau y_{avg}$$

So total revenue is just equal to τ times the average income level in the population.

An example of how the MVT is a powerful tool

- Costs of taxation:
  - Almost all taxes are distortionary – e.g., you work less to avoid high taxes, and the higher the taxes, the greater the distortions
  - This is an accepted premise among economists but the data suggests that effects on effort are small. Mostly taxes lead to tax avoidance.
  - For simplicity, let's assume that the costs per person of taxes are equal to $\delta\tau^2$
- Expenditures:
  - The government uses taxes for one purpose: to provide some shared good that everyone consumes equally.
  - The total amount of this good per person is equal to

$$R = \tau y_{avg}$$

An example of how the MVT is a powerful tool

- So each person's final consumption is

$$C = y\left(1-\tau\right) + \tau y_{avg} - \delta\tau^2$$

- Here's the policy question: how high will τ be? i.e., how high will the tax rate and amount of government expenditure be? How do we figure this out?
- This is where the median voter theorem comes in.

Applications: An example of how the MVT is a powerful tool

- What would the median voter want?
- The median voter would want to solve

$$\max_{\tau} y_{median}(1-\tau) + \tau y_{avg} - \delta\tau^2$$

- How do we solve this? Take the derivative with respect to τ to find

$$\begin{aligned} y_{avg} - y_{median} &= 2\delta\tau \\ \tau &= \frac{y_{avg} - y_{median}}{2\delta} \end{aligned}$$

- So the tax rate – and hence the size of government – is increasing in the difference between average income and median income.
- Why is this? Because politics makes decisions based on the median voter, but average tax rates are based on the average.

Examples

$$\tau = \frac{y_{avg} - y_{median}}{2\delta}$$

- Suppose there are 5 people. Let's assume $\delta = \frac{1}{2}$ to make life easy.
- Case 1: Incomes $= \{0, 1, 2, 3, 4\}$
  - What is the median? 2
  - What is the mean? 2
  - What is the tax rate? 0.

Examples

$$\tau = \frac{y_{avg} - y_{median}}{2\delta}$$

- Suppose there are 5 people. Let's assume $\delta = \frac{1}{2}$ to make life easy.
- Case 2: Incomes $= \{0, 1, 2, 3, 9\}$
    - What is the median? 2
    - What is the mean? 3
    - What is the tax rate? 1.

Examples

$$\tau = \frac{y_{avg} - y_{median}}{2\delta}$$

- Suppose there are 5 people. Let's assume $\delta = \frac{1}{2}$ to make life easy.
- Case 2: Incomes $= \{0, 1, 2, 3, 59\}$
  - What is the median? 2
  - What is the mean? 13
  - What is the tax rate? 11.

What's going on?

- What's going on?
  - In this model what's happening is that the policy is driven by the difference between the median and the mean.
  - So when you get a lot of inequality (particularly, if you have some very rich people), the median voter can gain a lot from setting a higher tax rate and taxing the rich.
- Why was there no tax rate in case 1 when median and mean were the same?
  - Median voter gets no benefit. Taxation is costly, so optimum is 0.

More than 2 candidates

- Note that the median voter theorem does not generalize to cases with more than 2 candidates.
- Technical assumption: suppose you have the same policy position as another candidate. Then the two candidates split the votes at that level.
- Suppose that the policy space is $[0, 1]$, and people are uniformly distributed. With 2 candidates the equilibrium is: $\frac{1}{2}$.
- Now suppose that there are three candidates. Suppose candidates 1 and 2 were at $p_j = \frac{1}{2}$. What could candidate 3 do?
- Candidate 3 could announce $\frac{1}{2} + \varepsilon$ and win! So everyone at $\frac{1}{2}$ is no longer the equilibrium.
- Instead, the equilibrium has the candidates spaced out a bit.

The Median Voter Theorem in Practice

- What are the predictions of the Median Voter Theorem? We'll look empirically at two predictions:

1. What happens if I change the electorate?
    - Suppose the electorate had ideal points uniformly distributed on $[0, 1]$. What is the policy outcome?
    - Now suppose we enfranchise new voters, so the electorate shifts to be distributed on $\left[0, \frac{3}{2}\right]$. What is the policy outcome?
    - How might we examine this in the data?
2. What happens if I prevent some people from becoming candidates?
    - E.g., suppose I have a policy that says that the candidates must only be women, or must be poor people, etc
    - What would happen?
    - (Aside: why might I want to do that?)

Changing the electorate and the MVT

Miller 2008: "Women's Suffrage, Political Responsiveness, and Child Survival in American History"

- What does it mean to change the electorate? How could you do that?
- We'll study one dramatic example from the US: the enfranchisement of women

Changing the electorate and the MVT

- What would the predictions of the median voter theorem tell us?
- Suppose we can choose whether to spend public money on roads or clean water. Denote by α the share of municipal expenses on clean water, so $\alpha \in [0, 1]$.
- Suppose that preferences are as follows:

$$u_i = - |\alpha - b_i|$$

  - For men, $b_i \sim \mathit{Uniform}\left[0, \frac{3}{4}\right]$
  - For women, $b_i \sim \mathit{Uniform}\left[\frac{1}{4}, 1\right]$
- What do these preferences look like? Are they single-peaked?
- What is the policy outcome if only men can vote?
- What is the policy outcome if everyone can vote?

Women's suffrage in the United States

- Women's suffrage in the United States
  - Universal women's suffrage was achieved in 1920 with the ratification of the 19th amendment to the U.S. constitution
  - However, before that, 29 of the 48 states had already extended suffrage to women
  - This happened over a roughly 30 year period

Women's suffrage in the United States

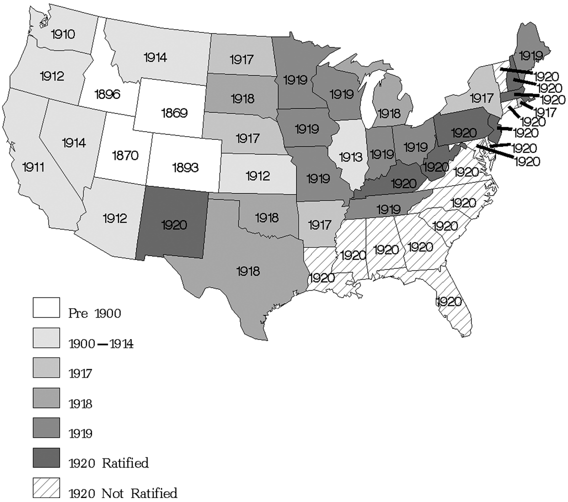


FIGURE I

Women's suffrage in the United States

- This is a differences-in-differences approach:

$$\ln\left(d_{sy}\right) = \alpha + \beta v_{sy} + \delta_y + \delta_s + \delta_s \times t + \varepsilon_{sy}$$

  - where d is the outcome, s is a state, y is a year
  - δ_y are year fixed effects and δ_s are state fixed effects.What do they do?
  - $\delta_s \times t$ is a state-specific time trend. What is this?
  - What does β mean if the outcome $\ln\left(d_{sy}\right)$ is in logs?
- What would have happened if we had just compared states in cross-section?
- Are the states that are early adopters of women's suffrage a random sample?

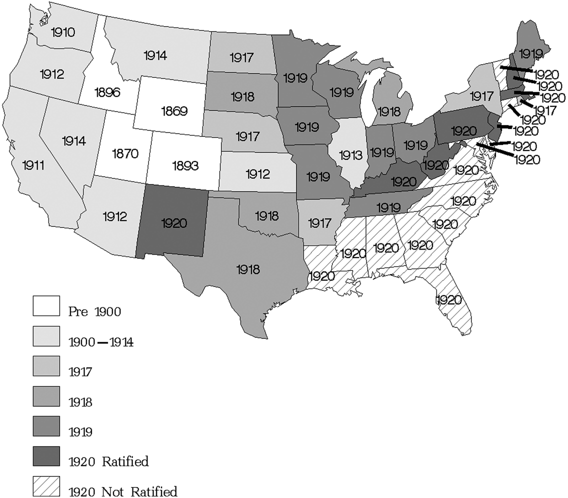

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FIGURE I

Impact on spending

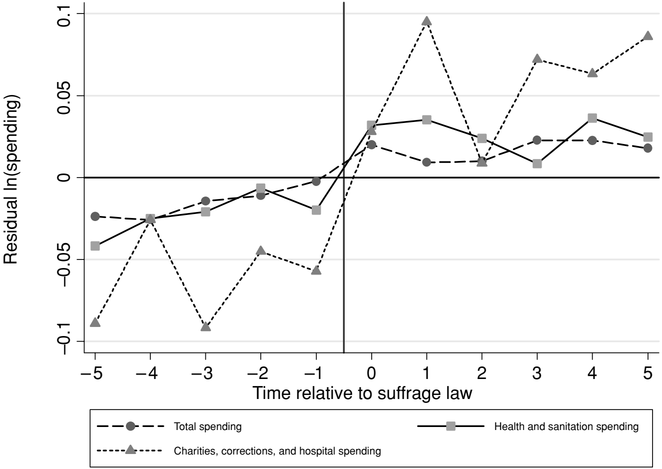

FIGURE II
Municipal Public Spending and Women's Suffrage Law Timing

Impact on municipal spending

TABLE II
WOMEN'S SUFFRAGE LAWS AND MUNICIPAL AND STATE PUBLIC FINANCE

Dependent variable	Estimate (standard error)	N	R^2
Panel A: Municipal public finance			
ln(total spending)	0.079***	3,661	0.97
	(0.029)		
ln(health conservation and sanitation spending)	0.061*	3,661	0.94
	(0.036)		
ln(charities, hospitals, and corrections spending)	0.360***	3,454	0.92
	(0.105)		
ln(total infrastructure investment)	0.012	3,658	0.85
	(0.086)		
ln(health conservation and sanitation infrastructure investment)	0.152	3,629	0.70
	(0.114)		
ln(charities, hospitals, and corrections infrastructure investment)	0.580**	1,462	0.71
	(0.276)		
Panel B: State public finance			
ln(total revenue)	0.010	673	0.89
	(0.084)		
ln(property tax revenue)	0.070	579	0.94
	(0.209)		
ln(total spending)	−0.057	688	0.87
	(0.088)		
ln(highway spending)	0.300	667	0.90
	(0.215)		
ln(education spending)	0.137	689	0.75
	(0.157)		
ln(social service spending)	0.206***		

Impact on state spending

Panel B: State public finance			
ln(total revenue)	0.010	673	0.89
	(0.084)		
ln(property tax revenue)	0.070	579	0.94
	(0.209)		
ln(total spending)	−0.057	688	0.87
	(0.088)		
ln(highway spending)	0.300	667	0.90
	(0.215)		
ln(education spending)	0.137	689	0.75
	(0.157)		
ln(social service spending)	0.206***	688	0.84
	(0.071)		

Impact on mortality

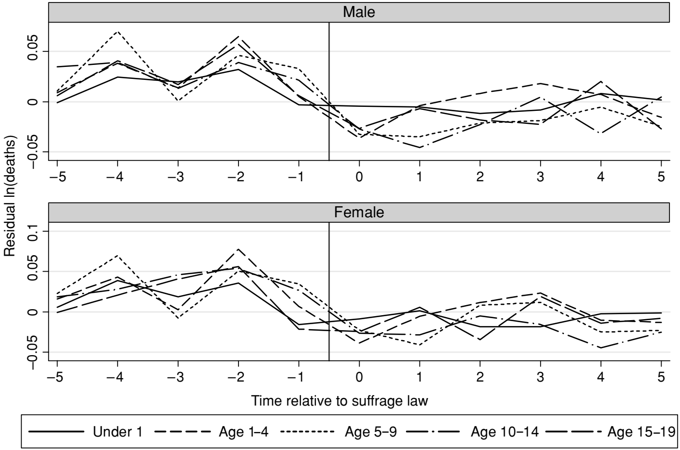

FIGURE IV

Impact on mortality

- The growth in public health spending fueled unprecedented door-to-door hygiene campaigns.
- Child mortality in turn declined rapidly by 8-15 percent (20,000 annual child deaths nationwide)
- Reductions occurred exclusively among infectious childhood killers sensitive to hygienic conditions.

Reservations for Politicians

Chattopadhyay and Duflo (2004): Women as Policy Makers: Evidence from a Randomized Policy Experiment in India

- Indian village councils in India which have authority over local public goods decisions
- In 1993, an Indian Constitutional amendment mandated representation for women and minorities.
    - For minorities: in each district, representation in each local council, and among the heads of all the council, must be equal to the share of SC/ST in the district.
    - For women, in each list (reserved for SC, ST, and general), every third list to be reserved for women.
- Since the reservations for women were essentially randomly assigned, they focus on women

Reservations for Politicians

- Question: Does the identity of the leader affect the type of investment decisions made by the Panchayat?
- What would the Median Voter Theorem predict?
    - If democracy is perfect, since the leader must still be elected by everyone, one could expect that his (or her) platform represent the preferences of the median voter.
    - So mandating a woman as candidate wouldn't necessarily matter.

Reservations make a big difference in women being elected

TABLE I

FRACTION OF WOMEN AMONG PRADHANS IN RESERVED AND UNRESERVED GP

	Reserved GP (1)	Unreserved GP (2)
West Bengal		
Total Number	54	107
Proportion of Female Pradhans	100%	6.5%
Rajasthan		
Total Number	40	60
Proportion of Female Pradhans	100%	1.7%

Assignment of women looks as if it was random

TABLE II

VILLAGE CHARACTERISTICS IN RESERVED AND UNSERVED GP, 1991 CENSUS

	West Bengal			Rajasthan		
Dependent Variables	Mean, Reserved GP (1)	Mean, Unreserved GP (2)	Difference (3)	Mean, Reserved GP (4)	Mean, Unreserved GP (5)	Difference (6)
Total Population	974	1022	−49	1249	1564	−315
	(60)	(46)	(75)	(123)	(157)	(212)
Female Literacy Rate	.35	.34	.01	.05	.05	.00
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Male Literacy Rate	.57	.58	−.01	.28	.26	.03
	(.01)	(.01)	(.01)	(.02)	(.02)	(.03)
% Cultivated Land that Is Irrigated	.45	.43	.02	.05	.07	−.02
	(.03)	(.02)	(.04)	(.01)	(.01)	(.02)
Dirt Road	.92	.91	.01	.40	.52	−.11
	(.02)	(.01)	(.02)	(.08)	(.07)	(.10)
Metal Road	.18	.15	.03	.31	.34	−.04
	(.03)	(.02)	(.03)	(.07)	(.06)	(.10)
Bus Stop or Train Station	.31	.26	.05	.40	.43	−.03
	(.04)	(.02)	(.04)	(.08)	(.07)	(.10)
Number of Public Health Facilities	.06	.08	−.02	.29	.19	.10
	(.01)	(.01)	(.02)	(.08)	(.06)	(.10)
Tube Well Is Available	.05	.07	−.02	.02	.03	−.01
	(.03)	(.02)	(.07)	(.02)	(.02)	(.03)
Handpump Is Available	.84	.88	−.04	.90	.97	−.06
	(.04)	(.03)	(.05)	(.05)	(.02)	(.05)
Wells	.44	.47	−.02	.93	.91	.01
	(.07)	(.04)	(.08)	(.04)	(.04)	(.06)
Tap Water	.05	.03	.01	.12	.09	.03
	(.03)	(.02)	(.03)	(.05)	(.04)	(.06)
Number of Primary Schools	.95	.91	.04	.93	1.16	−.23
	(.07)	(.03)	(.08)	(.09)	(.10)	(.15)
Number of Middle Schools	.05	.05	.00	.43	.33	.10
	(.01)	(.01)	(.01)	(.08)	(.07)	(.10)
Number of High Schools	.09	.10	−.01	.14	.07	.07
	(.01)	(.01)	(.02)	(.06)	(.04)	(.07)
F-Statistics: Difference Jointly Significant			.93			1.54
(p-value)			(.53)			(.11)

Notes: 1. There are 2120 observations in the West Bengal regressions, and 100 in the Rajasthan regressions. 2. Standard errors, corrected for clustering at the GP level in the West Bengal regressions, are in parentheses.

The Impact of Reservations for Women

- The goal is to answer the question: when women have power, do the political decisions better reflect the needs of women?
- Since women live in the same place as men, there is no straightforward way to measure preferences.
- The authors used revealed preferences: what have men and women complained about in the last year?
    - In West Bengal and Rajasthan: women strongly prefer drinking water.
    - West Bengal: men prefer education and irrigation.
    - Rajasthan: Men prefer roads. The opposite in West Bengal
- The idea is that in areas reserved for women, we should see more investment in water everywhere, less investment in school and irrigation in West Bengal, more investment in roads in West Bengal, and less investment in roads in Rajasthan

What else could it be?

- Are there other ways in which women sarpanches are different?
- New?
- Lame duck

Results

TABLE IV

ISSUES RAISED BY WOMEN AND MEN IN THE LAST 6 MONTH

	West Bengal						Rajasthan					
	Women			Men	Average	Difference	Women			Men	Average	Difference
	Reserved	Unreserved	All				Reserved	Unreserved	All			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Other Programs												
Public Works	.84	.84	.84	.85	.84	−.01	.60	.64	.62	.87	.74	−.26
Welfare Programs	.12	.09	.10	.04	.07	.06	.25	.14	.19	.03	.04	.16
Child Care	.00	.02	.01	.01	.01	.00	.04	.09	.07	.01	.02	.06
Health	.03	.04	.04	.02	.03	.02	.06	.08	.07	.04	.03	.03
Credit or Employment	.01	.01	.01	.09	.05	−.08	.06	.06	.05	.04	.09	.01
Total Number of Issues	153	246	399	195			72	88	160	155		
Breakdown of Public Works Issues												
Drinking Water	.30	.31	.31	.17	.24	.13	.63	.48	.54	.43	.49	.09
Road Improvement	.30	.32	.31	.25	.28	.06	.09	.14	.13	.23	.18	−.11
Housing	.10	.11	.11	.05	.08	.05	.02	.04	.03	.04	.04	−.01
Electricity	.11	.07	.08	.10	.09	−.01	.02	.04	.03	.02	.02	.01
Irrigation and Ponds	.02	.04	.04	.20	.12	−.17	.02	.02	.02	.04	.03	−.02
Education	.07	.05	.06	.12	.09	−.06	.02	.07	.05	.13	.09	−.09
Adult Education	.01	.00	.00	.01	.00	.00	0	0	.00	.00	.00	.00
Other	.09	.11	.10	.09	.09	.01	.19	.21	.20	.12	.28	.05
Number of Public Works Issues	128	206	334	166			43	56	99	135		
Public Works												
Chi-square	8.84		71.72				7.48		16.38			
p-value	.64		.00				.68		.09			

Notes: 1. Each cell lists the number of times an issue was mentioned, divided by the total number of issues in each panel. 2. The data for men in West Bengal comes from a subsample of 48 villages. 3. Chi-square values placed across two columns test the hypothesis that issues come from the same distribution in the two columns.

Results

TABLE V

EFFECT OF WOMEN'S RESERVATION ON PUBLIC GOODS INVESTMENTS

	West Bengal			Rajasthan		
	Mean, Reserved GP	Mean, Unreserved GP	Difference	Mean, Reserved GP	Mean, Unreserved GP	Difference
Dependent Variables	(1)	(2)	(3)	(4)	(5)	(6)
A. *Village Level*						
Number of Drinking Water Facilities	23.83	14.74	9.09	7.31	4.69	2.62
Newly Built or Repaired	(5.00)	(1.44)	(4.02)	(.93)	(.44)	(.95)
Condition of Roads (1 if in good	.41	.23	.18	.90	.98	−.08
condition)	(.05)	(.03)	(.06)	(.05)	(.02)	(.04)
Number of Panchayat Run	.06	.12	−.06			
Education Centers	(.02)	(.03)	(.04)			
Number of Irrigation Facilities	3.01	3.39	−.38	.88	.90	−.02
Newly Built or Repaired	(.79)	(.8)	(1.26)	(.05)	(.04)	(.06)
Other Public Goods (ponds, biogas,	1.66	1.34	.32	.19	.14	.05
sanitation, community buildings)	(.49)	(.23)	(.48)	(.07)	(.06)	(.09)
Test Statistics: Difference Jointly Significant			4.15			2.88
(*p*-value)			(.001)			(.02)
B. *GP Level*						
1 if a New Tubewell Was Built	1.00	.93	.07			
		(.02)	(.03)			
1 if a Metal Road Was Built or Repaired	.67	.48	.19			
	(.06)	(.05)	(.08)			
1 if There Is an Informal Education	.67	.82	−.16			
Center in the GP	(.06)	(.04)	(.07)			
1 if at Least One Irrigation Pump Was Built	.17	.09	.07			
	(.05)	(.03)	(.05)			
Test Statistics: Difference Jointly Significant			4.73			
(*p*-value)			(.001)			

Notes: 1. Standard errors in parentheses. 2. In West Bengal, there are 322 observations in the village level regressions, and 161 in the GP level regressions. There are 100 observations in the Rajasthan regressions. 3. Standard errors are corrected for clustering at the GP level in the village level regressions, using the Moulton (1986) formula, for the West Bengal regressions.

Are Reservations Welfare Improving?

- Results suggest that rules which favor election of women ensure that public goods better represent the preferences of women.
- These results are not reversed in the second cycle: women elected for the second time invest in a very similar way to women elected in the first cycle; there is no "backlash" in places where men come back in power after the end of reservation.
- While this is clearly a redistribution towards women, we cannot conclude that the allocation is welfare improving: it depends on the preferences for roads, schools, wells.
- But what does it imply for the median voter theorem?

Reservations for Minorities

Pande (2003): "Can Mandated Political Representation Increase Policy Influence for Disadvantaged Minorities?"

- Setting:
  - State-level legislatures in India
  - Do reservations of seats for low-caste legislators affect policy?
- Empirical strategy:
  - What is the problem she is trying to solve?
  - Law requires percent of seats reserved for SC/ST legislators be equal to their percentage in the state's population
  - Census updates the population every 10 years
  - This takes effect at the next state election after the census.
  - Pande exploits the different lag structure caused by the interaction of state election cycles with the census (plus two other nationally-mandated rule changes) to gain identification.
  - Can you explain her empirical strategy in words?

Reservations for Minorities

- She estimates

$$Y_{st} = \alpha_s + \beta_t + \gamma R_{st} + \phi P_{st\_census} + \delta P_{st} + \eta X_{st} + \varepsilon_{st}$$

  where R_{st} is share reserved seats, P_{st} is SC/ST population share and P_{st_census} is the latest census estimate of the population share
- This is an example of a difference-in-difference
  - How is that?
  - The key is that it includes state fixed effects (α_s) and year fixed effects (β_t)
  - So we are learning one's going on controlling for the fact that states are different, and that years are different, and just looking at what happens when they change the share of seats that are reserved
- Outcomes:
  - Total spending
  - Education
  - Land reform
  - SC/ST job quotas and targeted welfare spending

Results

	Total spending				Educ	
	(1)	(2)	(3)	(4)	(5)	(6)
SC reservation	−0.005	−0.009	−0.006	−0.004	−0.15	−0.141
	(0.005)	(0.005)	(0.005)	(0.007)	(0.122)	(0.121)
ST reservation	0.023***	0.028***	0.019***	0.019***	−0.542***	−0.385***
	(0.003)	(0.006)	(0.006)	(0.006)	(0.082)	(0.136)
SC census population share		0.011***	0.006	0.006		−0.039
		(0.004)	(0.006)	(0.006)		(0.050)
ST census population share		−0.004	−0.011**	−0.011**		−0.168
		(0.005)	(0.005)	(0.005)		(0.104)
SC current population share			0.012	0.011		
			(0.008)	(0.009)		
ST current population share			0.028***	0.029***		
			(0.007)	(0.008)		
Other controls	NO	NO	NO	YES	NO	NO
Adjusted R^2	0.96	0.96	0.96	0.96	0.72	0.73
Number of observations	519	519	519	505	513	513

Results

TABLE 7—POLITICAL RESERVATION AND TARGETED POLICY OUTCOMES

	Job quotas				SC welfare spending				ST welfare spending			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
SC reservation	0.539***	0.493***	0.659***	0.675***	0.011	0.082	0.083	0.126	−0.524	−0.511	−0.436	−0.305
	(0.120)	(0.115)	(0.108)	(0.135)	(0.181)	(0.196)	(0.200)	(0.198)	(0.324)	(0.324)	(0.289)	(0.301)
ST reservation	0.199*	−0.316	−0.301	−0.371*	0.092	0.067	0.076	−0.024	0.713**	0.693**	1.019***	0.863***
	(0.109)	(0.204)	(0.225)	(0.223)	(0.103)	(0.104)	(0.108)	(0.127)	(0.335)	(0.330)	(0.301)	(0.325)
SC census population share		0.188***	−0.071	−0.113		−0.052	−0.055	−0.104		−0.063	−0.145	−0.195
		(0.065)	(0.073)	(0.081)		(0.077)	(0.080)	(0.068)		(0.151)	(0.170)	(0.169)
ST census population share		0.559***	0.842***	0.861***		−0.033	−0.028	0.07		0.033	0.19	0.317*
		(0.170)	(0.190)	(0.192)		(0.077)	(0.080)	(0.081)		(0.138)	(0.161)	(0.187)
SC current population share			0.648***	0.699***			−0.052	−0.092			−0.435**	−0.347**
			(0.132)	(0.172)			(0.121)	(0.123)			(0.189)	(0.172)
ST current population share			−0.675**	−0.689**			−0.12	−0.163			−0.576**	−0.706***
			(0.294)	(0.313)			(0.136)	(0.131)			(0.233)	(0.257)
Other controls	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	NO	YES
Adjusted R^2	0.88	0.9	0.9	0.91	0.76	0.76	0.76	0.76	0.83	0.83	0.84	0.84
Number of observations	519	519	519	505	274	274	274	274	298	298	298	298

Why might there be deviations from the median voter?

- There are several reasons why there might be deviations.
- Importantly the fact that politicians cannot always commit
- This is captured by a citizen-candidate model. Which assumes no commitment
- It follows that we need to think about who would bother running for office.
- If people have to pay some cost to run for office:
  - We may not necessarily always have 2 candidates
  - And even if we have two candidates, they won't have the same position in equilibrium

Setup

- Setup:
  - Village elects individual who implements policy $\in [0, 1]$
- Each person has preferred choice ω_i
- Distribution of preferences is symmetrical around the median.
  - Median voter's preference is m
- If outcome is x_j, utility is:
  - $-|x_j - \omega_i|$ if i was not a candidate and
  - $-|x_j - \omega_i| - \delta_i$ if i was a candidate
- Timing:
  - Each person decides whether to run or not. If no candidates μ' is policy.
  - Citizens vote strategically for candidates.
  - Assuming somebody runs for office, the winner's preference x_j is policy.
- Note that in this model, you can't commit to any policy other than your most preferred policy.

How does this change things?

- Suppose we had the result before that both candidates had the median voter's policy
  - So $p_1 = p_2 = m$
- Is this an equilibrium?
  - Suppose candidate 2 decides not to run.
  - Policy will be unchanged (it will still be m), and candidate 2 will no longer have to pay δ_i
  - So $p_1 = p_2 = m$ is not an equilibrium because candidate 2 will deviate and not run!
  - What is the key assumption here?
- What is the equilibrium with 2 candidates and costly politics?
  - Symmetric around the median: Positions $m + \varepsilon$ and $m - \varepsilon$. Why? Otherwise, one candidate would always win and the loser wouldn't run.
  - ε cannot be too small (otherwise not worth it). In this example ε must be at least δ.
  - ε cannot be too large (otherwise a third candidate could enter in the middle)

2 candidates

- Note that there are many possible equilibria.
- Why? Suppose we're at an equilibrium with $\varepsilon > \delta$, so $p_1 = m - \varepsilon$ and $p_2 = m + \varepsilon$
- If ε is close to δ, someone just to the left of p_2 won't bother running because the gain is too small.

How does this help us think about reservations?

- Suppose that
  - For women, $\omega_i \in [0, W]$
  - For men, $\omega_i \in [M, 1]$
  - Women also face higher barriers to being candidates $(\delta_m < \delta_w)$
- Then the conditions under which women never run for office without reservations are:

$$
\begin{aligned}
1.\ \delta_w - \frac{\delta_m}{2} &> \mu' - m \\
2.\ \delta_w &> m
\end{aligned}
$$

Proof

- Condition 1: No woman runs even unopposed ($\delta_w - \frac{\delta_m}{2} > \mu' - m$). A woman would run unopposed if $\mu' - x_j \geq \delta_w$, so most "man-friendly" woman candidate is $x_j^w = \mu' - \delta_w$. A man would run against this candidate if $x_j^m \geq \delta_m + x_j^w = \delta_m + \mu' - \delta_w$. This man would win if $x_j^m - m < m - x_j^w$.
- Substituting we get that

$$\begin{aligned} x_j^m - m &< m - x_j^w \\ \delta_m + \mu' - \delta_w - m &< m - \mu' + \delta_w \\ \mu' - m &< \delta_w - \frac{\delta_m}{2} \end{aligned}$$

Intuition: If cost of running is high, only women with strong pro-women views are willing to run. But then men can defeat these women.

Proof continued

- Condition 2: No woman runs against a man ($\delta_w > m$). Two candidates must be symmetric around median voter for it to be an equilibrium, and will win with probability $\frac{1}{2}$. So the most you can possibly gain is $2m$ with probability $\frac{1}{2}$, or m. But if $\delta_w > m$, even the most extreme woman's cost of running is higher than her expected gain.

Implication

- Point of Proposition 1: biases $\delta_w > \delta_m$ and μ' mean that without reservations, it is possible that women may never be candidates, biasing the equilibrium outcome away from women.
- What will happen in this case?
  - We'll either get the default u'
  - Or some man will run unopposed.
- Reservations for women allow women to run and can improve women's welfare under these circumstances.
- Propositions 2 and 3 in the paper:
  - Reservations can increase or decrease women's welfare and that of median voter.
  - Increase intuitive (move implemented policy towards median)
  - How could it decrease? No candidate may run, so get default rather than mix of lobbying and citizen-candidate.

How is this different from the median voter model?

- In this model, candidates
  - Can't commit to policies other than their ideal point. What does it mean? Is this a reasonable assumption?
  - Have to pay a cost to run for office. Is this a reasonable assumption?
- The basic setup gets us away from the starkest version of the median voter results
  - However, in the limit as δ gets small, we get back to the median voter result
  - So how far we are from the median voter depends on how large δ is
- With heterogeneity in δ, we can get groups with high δ systematically excluded from policy – even though they vote.

Concluding thoughts

- The Median Voter Theorem provides a strong benchmark for voting models:
  - With 2 candidates, they tend to be towards the median
  - So thinking about who the median voter can be a useful first approximation for policy
  - And changes in who the median voter is produce predictable changes in policy
- But we should think about this as a guideline, not a solid rule