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Negative Voters: Electoral Competition with Loss-Aversion

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Negative Voters: Electoral Competition with Loss-Aversion*

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Abstract

This paper studies how voter loss-aversion affects electoral competition in a Downsian setting. Assuming that the voters' reference point is the status quo, we show that loss-aversion has a number of effects. First, for some values of the status quo, there is policy rigidity: both parties choose platforms equal to the status quo, regardless of other parameters. Second, there is a moderation effect when there is policy rigidity, the equilibrium policy outcome is closer to the moderate voters' ideal point than in the absence of loss-aversion. In a dynamic extension of the model, we consider how parties strategically manipulate the status quo to their advantage, and we find that this decreases policy rigidity and increases moderation. Finally, we show that with loss-aversion, incumbents adjust less than challengers to changes in voter preferences, and as a result, favorable (unfavorable) preference shocks, from the point of view of the incumbent, intensify (reduce) electoral competition. These two predictions are new, and we test them using elections to US state legislatures, where we find empirical support for them.

KEYWORDS: electoral competition, loss-aversion, incumbency advantage, platform rigidity

JEL CLASSIFICATION: D72, D81

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1 Introduction

There is now considerable evidence that citizens place greater weight on negative news than on positive when evaluating candidates for office, or the track records of incumbents. In the psychology literature, this is known as negativity bias.[1] For example, several studies find that U.S. presidents are penalized electorally for negative economic performance but reap fewer electoral benefits from positive performance (Bloom and Price, 1975, Lau, 1985, Klein, 1991).

Similar asymmetries have also been identified in the UK and other countries. For example, for the UK, Soroka (2006) finds that citizen pessimism about the economy, as measured by a Gallup poll, is much more responsive to increases in unemployment than falls. Kappe (2013) uses similar data to explicitly estimate a threshold or reference point value below which news is "negative", and finds similar results. Nannestad and Paldam (1997) find, using micro-level data for Denmark, that support for the government is about three times more sensitive to a deterioration in the economy than to an improvement.

Soroka and McAdams (2015) argue that this negativity bias on the part of voters is an example of a more general bias whereby suggest that humans respond more to negative than to positive information, and they link this bias to loss-aversion. In this paper, we study the impact of voter negativity bias on electoral competition in an otherwise quite standard Downsian setting. Following Soroka and McAdams (2015), we explain negativity bias in terms of loss-aversion; our model is formally set up as one where voters suffer an additional loss if a party platform offers lower utility than the reference point; the additional ingredient of probabilistic voting means that when the platform is "negative" i.e. generates a utility below the reference point, it lowers the probability that the citizen votes for that party by more than a "positive" platform of the same distance from the reference point increases that probability.

This is one of the very few papers to incorporate loss-aversion into models of political choice. A recent important contribution by Alesina and Passarelli (2015), discussed in detail in Section 2 below, studies loss-aversion in a direct democracy setting, where voters vote directly in a referendum on the size of a public project or policy. However, to our knowledge ours is the first paper to study the effect of loss-aversion in a representative democracy setting.[2]

In more detail, we study a simple Downsian model with moderate and extremist voters where the moderates are loss-averse. There are two parties comprised of left and right extremists who also value political office, who choose policy positions on the real line. Moderates have an ideal point normalized to zero, but vote probabilistically. In this setting,

[1] See for example, the survey on negativity bias by Baumeister et al. (2001).

[2] For an informal discussion of the role of loss-aversion in politics, see Jervis (1992).

without loss-aversion, the model is a variant of the well-known one of Wittman (1983), where in equilibrium, parties set platforms by trading off the probability of winning the election against the benefits of being closer to their ideal points.

We assume initially, as in Alesina and Passarelli (2015), that the reference point is the status quo policy. This assumption is widely made in the literature on loss-aversion applied to economic situations (e.g. de Meza and Webb (2007) for a principal-agent problem, Freund and Özden (2008) in the context of lobbying on trade policy), and seems realistic, since benefits and costs of political reforms are normally assessed relative to the current situation for given existing policies.[3]

We first establish that loss-aversion affects the election probability of each party. Once the moderate voters' utility from a party's policy platform falls below utility from the reference point, the re-election probability starts to fall more rapidly than without loss-aversion. Thus, there is a kink in the election probability for each party at this point. This kink has a number of implications for electoral competition.

First, there is *policy rigidity* ; for a range of values of the status quo (where the absolute value of the status quo lies in an interval $[x^-, x^+]$, $0 < x^- < x^+$) both parties choose platforms equal to the status quo, regardless of other parameters. In this case, the outcome is insensitive to small changes in other parameters, such as the weight that political parties place on office, the variance of probabilistic voting shocks, or shifts in the ideal points of the moderates. Second, that there is a *moderation effect* of loss-aversion; when there is policy rigidity, the equilibrium policy outcome is closer to the moderate voters' ideal point than in the absence of loss-aversion.

We then consider the dynamic effects of loss-aversion of electoral competition. Our baseline model does not really allow us to investigate how equilibrium platforms evolve over time. It also abstracts from a potentially very important fact that forward-looking parties may have an incentive to *strategically manipulate* the status quo to their advantage. To investigate these issues, we turn to a multi-period version of our model. We find that if the political parties are risk-averse, the range of status quo values for which there is policy rigidity, as described above, decreases. The reason is that with risk-aversion, there is an incentive for *strategic manipulation of the status quo*; starting at any policy platform that is short-run optimal for a party, a small move in the platform towards zero (the ideal point of the moderates) will reduce next period's status quo in absolute value the event that the party wins, and thus reduce the variance of the policy outcome. If the party is strictly risk-averse, this makes the party better off. We also find Note also that the policy

[3] Extensions to the case of a forward-looking reference point as in Kőszegi and Rabin (2006) are discussed in the Appendix. Due to probabilistic voting, the reference point is stochastic. There, it is shown that the political equilibrium exhibits policy moderation, as in the backward-looking case, but perhaps not surprisingly, due to the forward-looking reference point, there is no longer policy rigidity.

moderation effect is strictly greater than in the case without loss-aversion.

Third, we consider in detail, both theoretically and empirically, shifts in the distribution of preferences of both moderate and extremist voters. Theoretically, we consider a scenario where one party has won the previous election and this party's platform is the voter reference point. Starting from this position, without loss aversion, shift in either direction (left or right) in the ideal points has the same effect on both incumbent and challenger - both move their equilibrium platforms in the direction of the preference shift by the same amount. But, with loss-aversion, there is asymmetric adjustment : regardless of the direction of the preference shock - i.e. left or right - the incumbent platform will adjust by less than the challenger's platform. In other words, loss-aversion generates a particular kind of asymmetry, which is testable; incumbents adjust less than challengers. The underlying force is that the status quo works to the advantage of the incumbent.

The second testable prediction of the model is the following. Say that a preference shock is favorable (unfavorable) for the incumbent if it is in the same direction as the incumbent's ideological bias i.e. a leftward (rightward) shift for the left (right) party. Then, following a "favorable" preference shock for the incumbent, the gap between platforms decreases, but following an "unfavorable" preference shock for the incumbent, the gap between platforms increases. That is, favorable (unfavorable) preference shocks intensify (reduce) electoral competition.

These predictions are both new, and we take them to data on elections to US state legislatures. We employ a new dataset introduced by Bonica (2014b) which crucially for our purposes, contains estimates of the platforms of all candidates, winners and losers, in state legislature elections based on the campaign donations they received. We combine these with detailed election results to identify shocks to the distribution of voters and parties' responses for all state legislatures over a 20 year period. These data have the important advantage of representing a large sample of, institutionally and politically homogeneous elections, with which to take the theory to the data. Using these data we find, as predicted by the theory, that parties with majorities are significantly less responsive to shocks. we also find, very robustly, that following a "favorable" (resp. "unfavorable") preference shock for the incumbent, the gap between platforms, decreases (increases).

The remainder of the paper is organized as follows. Section 2 reviews related literature, Section 3 lays out the model, and Section 4 has the main theoretical results. Section 5 discusses the US data we use to test out main hypothesis, the empirical specification, and the empirical results, and finally Section 8 concludes.

2 Related Literature

1. *Alesina and Passarelli (2015)*. This paper, henceforth AP, is the most closely related to what we do. In their paper, citizens vote directly on a one-dimensional policy, which generates both costs and benefits for the voter. In this setting, for loss-aversion to play a role, the benefits and costs of a project of variable scale must be evaluated relative to separate reference points. This is because if loss-aversion applies to the net benefit from the project, it does not affect the ideal point of any voter. We do not need this construction, because we assume probabilistic voting, an assumption widely made in the literature on electoral competition (Persson and Tabellini, 2000).

In their setting, they show the following (Propositions 1-4). First, a range of voter types prefer the status quo to any other level of the policy. Second, the policy outcome (the most preferred point of the median voter) varies with the status quo. Third, there is policy moderation with loss-aversion; an increase in loss-aversion compresses the distribution of ideal points of the voters, and in particular, increases the number of voters who prefer the status quo. Finally, if there is a shock to the median voter, the this only has an effect on the outcome if the shock is sufficiently large.

Several of our results are similar in spirit to these, although the details differ substantially. Our finding of policy rigidity i.e. for a range of values of the status quo, platforms are equal to the status quo, is similar to their first finding. But, our moderation effect of loss-aversion i.e. that the equilibrium policy outcome is closer to the moderate voters' ideal point than in the absence of loss-aversion, is somewhat different to theirs. Furthermore, the dynamic behavior of our model is quite different to theirs; for example, we have a strategic choice of the reference point by political parties in equilibrium. Finally, our main empirical prediction i.e. that incumbents adjust less than challengers to voter preference shocks, has no counterpart in their analysis.

2. *Related empirical work.* Our empirical work is related to that of Adams et al. (2004) and Fowler (2005). Both are concerned, like us, with understanding the dynamics of political competition. In particular, both study responses to changes in the identity of the median voter. (Adams et al., 2004) use a panel of national election results for European political parties, to relate parties' manifesto positions to the preferences of the median voter. Unfortunately, their model is only identified for a subset of the cases they consider and appropriately restricting the sample limits the robustness of their results.[4]

These difficulties, as well as greater institutional homogeneity, mean we prefer to focus on the United States. Fowler (2005) considers elections to the US Senate over the period 1930-2010, and finds that senators tend to moderate their positions following a close election. In passing, he considers a hypothesis similar to ours – whether the loss of the

[4]Details are available upon request.

other senator changes response of the winning senator to the margin of victory – but finds no significant effect. This may reflect that his data are only available for those candidates elected, that is we do not know what senators who lost would have done. It may also reflect the important roles of incumbency and candidates' personal characteristics in senatorial elections.[5]

3. *Electoral competition with behavioral and cognitive biases.* A small number of papers study electoral competition with behavioral biases. An early contribution is Aragones (1997), who also models voter negativity bias. However, the formal details, as well as the results, are very different to this paper. Specifically, in her setting, policy is binary, and voters vote for the party that has generated the lowest cumulative value of a "dissatisfaction index" for them in the past; so, there is no kink, or non-differentiability, in the re-election probability as the platform varies that is central to our analysis. Parties have no ideological preferences and cannot commit to policies before elections. The main finding is that parties act *as if* they have ideological preferences.

Callander (2006) and Callander and Wilson (2008) introduce a theory of context-dependent voting, where for example, for a left wing voter, the attractiveness of a left wing candidate is greater the more right wing is the opposing candidate, and apply it to the puzzle of why candidates are so frequently ambiguous in their policy.

More recently, Razin and Levy (2015) study a model of electoral competition in which the source of the polarization in voters' opinions is "correlation neglect", that is, voters neglect the correlation in their information sources. Their main finding is that polarization in opinions does not necessarily translate into platform polarization by political parties compared with rational electorates. This contrasts with our result that loss-aversion always reduces platform polarization.

Matějka and Tabellini (2015) studies how voters optimally allocate costly attention in a model of probabilistic voting. Voters are more attentive when their stakes are higher, when their cost of information is lower and prior uncertainty is higher; in equilibrium, extremist voters are more influential and public goods are under-provided, and policy divergence is possible, even when parties have no policy preferences.

Finally, Bisin et al. (2015) consider Downsian competition between two candidates in a setting where voters have self-control problems and attempt to commit using illiquid assets. In equilibrium, government accumulates debt to respond to individuals' desire to undo their commitments, which leads individuals to rebalance their portfolio, in turn feeding into a demand for further debt accumulation.[6]

[5] An early contribution was Stone (1980) who argued that district electorates exercised very little control on the positions of their representatives.

[6] Passarelli and Tabellini (2013) is also somewhat related; there, citizens belonging to a particular interest group protest if government policy provides them with utility that is below a reference point that is deemed fair for that interest group. In equilibrium, policy is distorted to favour interest groups who are more likely

4. *Other behavioral voting models.* There are also a number of recent papers that consider other aspects of voter biases on political outcomes in non-Downsian settings, either where party positions are fixed, or where policy can be set ex post e.g. political agency settings.[7]

Several of these papers show that behavioral and cognitive biases can make voters better off, because these biases induce changes in behavior either by the incumbent politician, or by the voters themselves. For example, Ashworth and Bueno De Mesquita (2014) and Lockwood (2015) consider deviations from the full rationality of the voter in a political agency setting. Ashworth and Bueno De Mesquita (2014) consider voters who in their words,"fail to filter". This refers to the stylized fact that voters vote for or against the incumbent partly in response to events (like natural disasters, or losses by a favorite football team) that the voters should know are outside of the politicians' control. They capture this by the assumption that the voter's payoff to the incumbent is affected by a random shock. Failing to filter can make the voter better off.[8] Lockwood (2015) shows that voters who suffer from confirmation bias, a very well-established cognitive bias, can actually be better off, because confirmation bias decreases pandering by incumbents.

Levy and Razin (2015), find that the cognitive bias of correlation neglect can improve outcomes for voters, due to a second-best argument; in their setting, information aggregation via voting is initially inefficient, because voters underweight their information when deciding how to vote. If a voter ignores the fact that two of her signals are correlated, she will "overweight" the signals, and thus put more weight on her information, offsetting the original distortion.[9]

5. *Multi-period electoral competition*. This paper shows how loss-aversion may create dynamic linkages between successive election outcomes. There is now a substantial literature on repeated elections; the closest strand of this literature are those contributions in a Downsian setting where parties can make ex ante policy commitments. In an influential contribution, Duggan (2000) studied a model where individual citizens have policy preferences and also care about office, and can pre-commit to policy positions before elections. Every period the incumbent faces a challenger in an election, where the

to protest or who do more him when they riot. However, in their setting, there is no voting, so the main point shared feature between that paper and ours is that we both consider the role of reference points in social choice.

[7]Other contributions in non-Downsian settings include Ghirardato and Katz (2006), Ellis (2011) . The former show that if voters are ambiguity-averse, they might strictly prefer abstaining to voting, even if voting is costless. Ellis (2011) extends the arguments of Ghirardato and Katz (2006) to investigate information aggregation in large elections.

[8]Spiegler (2013) studies a related phenomenon in a political economy setting, where salient, recent events are intuitively perceived to be causes of an observed outcome.

[9]Ortoleva and Snowberg (2013), in a related paper, show theoretically that overconfidence and ideological extremeness are connected. They find empirically, using a large US election study, that overconfidence is the most reliable predictor of ideological extremeness and an important predictor of voter turnout.

latter is randomly selected from the population[10]. The dynamic model of Section 4.2 is rather different to the Duggan model; in our setting, the winning platform is a state variable that affects party preferences over platforms in the next period, and thus provides incentives for strategic manipulation.

3 The Model

3.1 The Environment

Apart from loss-aversion, the set-up is a version of the standard Downsian model. There are three sets of voters E_L, E_R, M. Each voter i has an ideal point x_i in the policy space $X = [-1,1]$. There equal numbers of voters in each of E_L, E_R, and these voters are extremists i.e. have extreme ideal points, $x_i = -1,\ i \in E_L,\ x_i = 1,\ i \in E_R$. The voters in M are moderates. We assume for the moment that all moderates have ideal points of zero. The extremists group themselves into two parties, L and R, which simultaneously choose platforms x_L, x_R and compete for the votes of the moderates. They are assumed to be able to commit to implement these platforms. Thus, the basic framework is that of Downsian competition.

3.2 Voter Payoffs

Following Osborne (1995), we assume that "ordinary" or intrinsic utility over alternatives $x \in X$ for voter i is given by $u_i(x) = -l(|x - x_i|)$ where l is twice differentiable, strictly increasing, symmetric and convex in $|x - x_i|$, and that $l(0) = l'(0) = 0$. So, for any $x \in [-1,1]$, the payoffs of the L and R party members are $u_L(x) \equiv -l(|x+1|)$, $u_R(x) \equiv -l(|x-1|)$. Also, the payoff of a moderate voter is $u(x) \equiv -l(|x|)$.

We suppose that the moderates are loss-averse, but parties, being made up of professional decision-makers, are not loss-averse. Following Kőszegi and Rabin (2006, 2007, 2009), we specify the gain-loss utility over policy for moderate voter i as;

$$v(x;r) = \begin{cases} (u(x) - u(r)), & u(x) \geq u(r) \\ \lambda(u(x) - u(r)), & u(x) < u(r) \end{cases} \tag{1}$$

The parameter $\lambda > 1$ measures the degree of loss-aversion, and $r \in X$ is a reference point, defined more specifically below. The empirical evidence gives a value for λ of around 2 (see, Abdellaoui et al., 2007). Then, overall policy-related utility for the moderates is the

[10] This model has since been extended in various directions. to allow for term limits (Bernhardt et al., 2004), multi-dimensional policy spaces (Banks and Duggan (2008)), for political parties who can choose candidates, ((Bernhardt et al., 2009)), and to the case where candidates also differ in valence (Bernhardt et al., 2011).

sum of u and v;

$$u(x)+v(x;r)=\begin{cases} 2u(x)-u(r), & u(x)\geq u(r) \\ (1+\lambda)u(x)-\lambda u(r), & u(x)<u(r) \end{cases} \tag{2}$$

All moderate voters also are subject to a common preference shock ε drawn from a distribution F which is symmetric around zero, with support $[-\sigma,\sigma]$, which captures other features that may affect choice between candidates. Given ε, any moderate voter will vote for party R, given platforms x_L, x_R, if and only if

$$u(x_R)+v(x_R;r)\geq \varepsilon+u(x_L)+v(x_L;r) \tag{3}$$

Without loss of generality, we restrict x_R to be non-negative, and x_L to be non-positive.

Finally, following Alesina and Passarelli (2015), we assume that voters are "backward looking" in that the reference point r is an initial policy outcome, the *status quo*, x_S. The case of a forward-looking reference point, as in Kőszegi and Rabin (2006, 2007, 2009), is considered in the Appendix. In the Koszegi-Rabin case, from the point of view of the individual voter, the reference point is a probability distribution over party platforms, (x_L, x_R) with probabilities $1-p$, p, where p is the probability of a win for the R party. We show that in this case, loss-aversion induces policy moderation, but that there is no policy rigidity.

3.3 Win Probabilities

From (3), given platforms x_L, x_R, and the fact that $r=x_S$, the probability that a moderate votes for R is

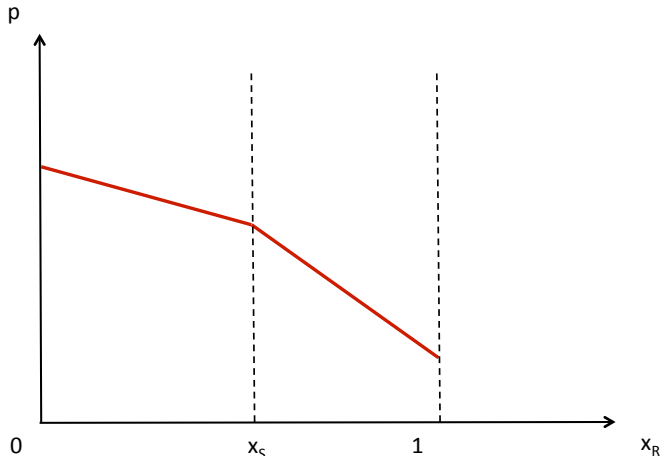
$$p(x_L,x_R;x_S)=F\left(u(x_R)+v(x_R;x_S)-u(x_L)-v(x_L;x_S)\right) \tag{4}$$

Then, given (2), we can explicitly calculate;

$$p(x_L,x_R;x_S)=\begin{cases} F\left(2(u(x_R)-u(x_L))\right) & u(x_L),u(x_R)\geq u(x_S) \\ F\left(2u(x_R)-(1+\lambda)u(x_L)+(\lambda-1)u(x_S)\right) & u(x_R)\geq u(x_S)>u(x_L) \\ F\left((1+\lambda)u(x_R)-2u(x_L)-(\lambda-1)u(x_S)\right) & u(x_L)\geq u(x_S)>u(x_R) \\ F\left((1+\lambda)u(x_R)-(1+\lambda)u(x_L)\right) & u(x_L),u(x_R)<u(x_S) \end{cases} \tag{5}$$

So, p is continuous and differentiable in x_L, x_R except at the points $|x_R|=|x_S|$, $|x_L|=|x_S|$. Figure 1 shows the win probability for party R as x_R rises from 0 to 1, for a fixed x_L; for clarity, we assume in the Figure that F is uniform on $[-\sigma,\sigma]$ and $u(x)=-|x|$. It is clear from (5) that there is a kink at the point where $x_R=|x_S|$; specifically, to the left of this point, a small increase in x_R decreases p by $\frac{1}{\sigma}$, and to the right, a small increase in x_R

Figure 1: The Win Probability



decreases p by $\frac{1+\lambda}{2\sigma} > \frac{1}{\sigma}$. This is shown if Figure 1.

This kink in the win probability function drives all of our results.

Finally, for convenience, we assume that the variance of ε is large enough that p is strictly between 0 and 1 for all $x_R, -x_L \in [0,1]$, $x_S \in [-1,1]$. This requires $p(0,1;0) > 0$, or $\sigma > (1+\lambda)(u(0) - u(1))$.

Note finally from (5) or Figure 1 that loss-aversion affects the election probability of each party, even though the policy space is one-dimensional and there is a single reference point x_0. This is in sharp contrast to AP, where for loss-aversion to play a role, the benefits and costs of a project of variable scale are evaluated separately relative to different reference points. We do not need this construction, because we assume probabilistic voting, an assumption widely made in the literature on electoral competition (Persson and Tabellini, 2000).

3.4 Assumptions

Before proceeding, we state and explain some simplifying assumptions[11]. First, no crucial role is played by concavity of the moderate voters' utility function, so we abstract from this by assuming that moderates have linear, or absolute value preferences:

A1. *Moderate voters are risk-neutral;* $u(x) = -|x|$.

However, we will allow the extremists to have strictly concave utility functions, as party risk-aversion is important in a dynamic setting (see Section 4.2 below). Second, we will characterize equilibrium by first-order conditions for the choice of x_L, x_R. For this to

[11] These are similar to those used in Proposition 4 of Bernhardt et al. (2009).

be valid, we require that party payoffs π_L, π_R defined below in (6) are strictly concave in x_L, x_R respectively. So, we assume that:

A2. *Party members are risk-neutral or risk-averse i.e.* $l''(x) \geq 0$, *and the density of* f *is non-decreasing.*

It is shown in the Appendix that A1 and A2 together imply concavity of π_L, π_R. Finally, we require, for non-trivial results, that the return to office, M, is not so large that parties compete to full convergence of platforms. The following assumption ensures this.

A3. $0.5u_R'(0) = -0.5u_L'(0) = 0.5l'(1) > (1+\lambda)f(0)M$.

This says that at $x = 0$, each party prefers to move x slightly in the direction of their ideal point (with expected benefit e.g. of $0.5u_R'(0)$ for party R), even at the cost of reducing the probability of victory slightly, and thus foregoing some office-related rent (measured by the term $(1+\lambda)f(0)M$).

4 Results

4.1 Baseline Results

Party payoffs are calculated in the usual way as the probability of winning, times the policy payoff plus M, plus the probability of losing, times the resulting policy payoff. For parties R, L respectively, this gives

$$\begin{aligned} \pi_L &= (1-p(x_L,x_R))(u_L(x_L)+M) + p(x_L,x_R)(u_L(x_R)) \\ \pi_R &= p(x_L,x_R)(u_R(x_R)+M) + (1-p(x_L,x_R))(u_R(x_L)) \end{aligned} \tag{6}$$

with $p(x_L, x_R)$ defined in (5). We are interested in characterizing the symmetric Nash equilibria of the game with these payoffs, and actions $x_L, x_R \in [-1, 1]$. We begin with the following intermediate result.

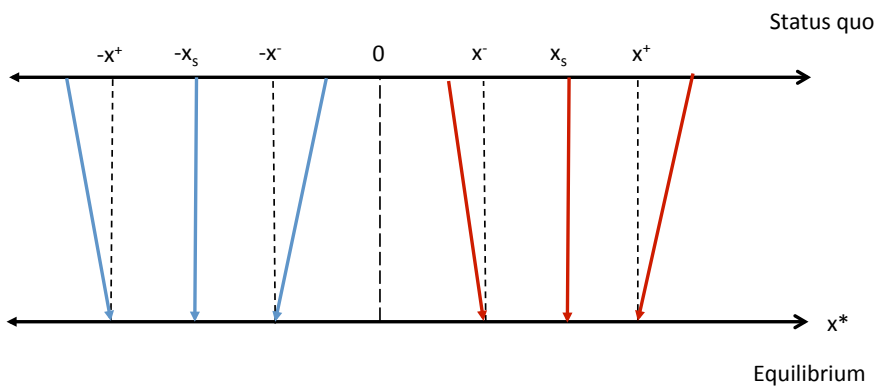
***Lemma* 1.** *Given A1-A3, there exist unique solutions* x^+, x^- ,$x^+ > x^- > 0$ *to the equations*

$$0.5u_R'(x^+) - 2f(0)\Big(u_R(x^+) - u_R(-x^+) + M\Big) = 0 \tag{7}$$

$$0.5u_R'(x^-) - (1+\lambda)f(0)\left(u_R(x^-) - u_R(-x^-) + M\right) = 0 \tag{8}$$

It is easily checked that these solutions x^+, x^- are the symmetric Nash equilibria in the games where party R's re-election probability is $p = F(2(u(x_R) - u(x_L)))$ and $p = F((1+\lambda)(u(x_R) - u(x_L)))$ respectively. In each case, $0.5u_R'(x) > 0$ is the utility gain for party members from moving away from the moderates' ideal point, 0; in equilibrium,

Figure 2: The Baseline Result



this is offset by the lower win probability i.e. the term in $f(0)$. Note that $x^+ > x^- > 0$, as there is a stronger incentive to converge to 0 when $\lambda > 1$.

We are now in a position to characterize the equilibrium in the overall game.

***Proposition* 1.** *If $x^+ < |x_S|$, then $x_R = -x_L = x^+$ is the unique symmetric equilibrium. If $x^- > |x_S|$, then $x_R = -x_L = x^-$ is the unique symmetric equilibrium. If $x^+ \geq |x_S| \geq x^-$, then $x_R = -x_L = |x_S|$ is the unique symmetric equilibrium. The interval $[x^-, x^+]$ is increasing in voter loss-aversion, λ.*

This baseline result is best understood graphically. Figure 2 below shows how the initial status quo maps into the equilibrium platforms. Clearly, for $x^+ \geq |x_S| \geq x^-$, there is *platform rigidity* induced by voter loss-aversion; the equilibrium platform is just equal to the status quo value x_S. If the status quo is closer to the moderates' median, zero, than x^-, there is adjustment away from the status quo x_S from the status quo x_S to x^-. If the status quo is further from zero than x^+, there is adjustment towards zero to x^+.

Note that in the absence of loss-aversion, from Proposition 1 and Lemma 1, the equilibrium platforms are simply $x_R = -x_L = x^+$. So, bearing this in mind, Proposition 1 shows that there are several important impacts of loss-aversion. First, as just remarked, there is platform rigidity ; for a range of values of the status quo (i.e. for $x^+ \geq |x_S| \geq x^-$), the outcome is insensitive to changes in other parameters, such as the weight M that political parties place on office, or the variability of voter preference shocks, σ. This platform rigidity is similar in spirit to the entrenchment effect found the by AP[12].

Second, there is a *moderation effect* of loss-aversion; the equilibrium policy outcome is closer to the moderate voters' ideal point than in the absence of loss-aversion. In AP,

[12]The rigidity of policy with respect to shifts in the mean preference of the moderates is studied separately below

there is also a moderation effect of loss-aversion (their Proposition 3), although there, the details are rather different; an increase in loss-aversion compresses the distribution of ideal points of the voters, and in particular, increases the number of voters who prefer the status quo.

Finally, we close this section with an example showing how the equilibrium can be computed.

Example. Assume that $l(z) = z$, i.e. political parties have absolute value preferences and that ε is uniformly distributed on $\left[-\frac{\sigma}{2}, \frac{\sigma}{2}\right]$. Then, $u_L = -|x+1| = -(1+x)$, $u_R = -|x-1| = -(1-x)$. Moreover, from the uniform distribution, we have;

$$p = F\left(v(x_L; x_S) - v(x_R; x_S)\right) = \frac{1}{2} + \frac{v(x_L; x_S) - v(x_R; x_S)}{\sigma}$$

Then, it is easily verified that (7),(8) become;

$$\begin{aligned} 0.5 - \frac{2}{\sigma}(-(1-x^+) + 1 + x^+ + M) &= 0 \\ 0.5 - \frac{1+\lambda}{\sigma}(-(1-x^-) + 1 + x^- + M) &= 0 \end{aligned}$$

These solve to give $x^+ = \frac{\sigma}{8} - \frac{M}{2}$, $x^- = \frac{\sigma}{4(1+\lambda)} - \frac{M}{2}$. By assumption A3, $x^- = \frac{\sigma}{4(1+\lambda)} - \frac{M}{2} > 0$. So, for $|x_S| \in \left[\frac{\sigma}{4(1+\lambda)} - \frac{M}{2}, \frac{\sigma}{8} - \frac{M}{2}\right]$, there is platform rigidity i.e. $x^* = |x_S|$. Note that as claimed in Proposition 1, the length of the interval $\left[\frac{\sigma}{4(1+\lambda)} - \frac{M}{2}, \frac{\sigma}{8} - \frac{M}{2}\right]$ is increasing in λ. □

4.2 Strategic Effects

The baseline model abstracts from the potentially very important fact that this period's platform chosen by the election winner will be next-period's status quo. So, with multiple elections, forward-looking parties may have an incentive to *strategically manipulate* the status quo to their advantage. To investigate this issue, we study a two-period version of the baseline model. Extensions to more than two periods are also discussed below. We assume that the above interaction between the parties unfolds over periods $t = 1, 2$ with an initial status quo x_S. Each extremist voter lives for two periods, and so parties are long-lived. Let $(x_{L,t}, x_{R,t})$ be platforms at time t, and the status quo at the beginning of the game be x_S as before. So, the status quo at $t = 2$ will be the will be the platform of the winning party at date 1.

Independent voters are assumed to be myopic or only live for one period, so their behavior is captured by (5), i.e. $p(x_{L,t}, x_{R,t}; x_{S,t})$ is the win probability for party R, given status quo $x_{S,t}$ and platforms $x_{L,t}, x_{R,t}$. In period $t = 1, 2$, the party members have per

period payoffs

$$\begin{aligned}\pi_{R,t} &= p(x_{L,t},x_{R,t};x_{S,t})(u_R(x_{R,t})+M)+(1-p(x_{L,t},x_{R,t};x_{S,t}))u_R(x_{L,t}) \\ \pi_{L,t} &= (1-p(x_{L,t},x_{R,t};x_{S,t}))(u_L(x_{L,t})+M)+p(x_{L,t},x_{R,t};x_{S,t})u_L(x_{R,t})\end{aligned} \tag{9}$$

and overall payoffs

$$\pi_{L,1}+\delta\pi_{L,2},\ \pi_{R,1}+\delta\pi_{R,2}$$

We solve the model backwards. At period $t=2$, the equilibrium is as described in Proposition 1, with $x_S = x^*$, where x^* is the platform of the winning party. So, at the end of period 1, the continuation payoff for party R, given a winning platform x^* in period 1, is

$$V(x^*) = 0.5M + \begin{cases} 0.5(u_R(x^+)+u_R(-x^+)), & x^+ < x^* \\ 0.5(u_R(x^*)+u_R(-x^*)), & x^+ \geq x^* \geq x^- \\ 0.5(u_R(x^-)+u_R(-x^-)), & x^- > x^* \end{cases} \tag{10}$$

To look at the properties of V, we start with the simplest case, absolute value preferences for the parties i.e. where *political parties are risk-neutral i.e.* $l'' \equiv 0$. Here,

$$u_R(-x^*)+u_R(x^*) = -(1+x^*)-(1-x^*) \equiv -2$$

So, from (10), the continuation payoff is just $V(x^*) = 0.5M$ and thus is independent of x^*. So, in both periods, the only symmetric equilibrium must be the one described in Proposition 1. Intuitively, with risk-neutrality, parties do not care about next period's status quo and so there is thus no incentive to strategic manipulation of next period's status quo via platform choice in the current period. Formally, we can state:

***Proposition* 2.** *If political parties are risk-neutral i.e.* $l'' \equiv 0$, *there is a unique symmetric equilibrium in both periods as described in Proposition* 1.

It is clear (by simple backward induction) that this conclusion applies in any $T-$period version of the model, for $T \geq 2$. So, a *necessary precondition* for strategic effects is party risk-aversion. To see why risk-aversion is required for a strategic incentive to manipulate the status quo, note from (10) that if political parties are risk-averse, and $x^* \in (x^-, x^+)$, then $V'(x^*) = 0.5(u_R'(x^*)+u_R'(-x^*))$. As $-x^* < x^* < 1$, and $u_R(x^*)$ is increasing and strictly concave on $[-1,1]$, this derivative is negative. In other words, party R (and also party L) prefers to move the status quo in the next period closer to the independent voter's ideal point, *in order to reduce the variance of the electoral outcome in the next period.*

To proceed to the formal analysis with party risk-aversion, we need to make one more assumption. To motivate this, note that for party R*'s* overall payoff to be concave in $x_{R,t}$,

we require $V(x^*)$ to be concave in x^*. This requires

$$V''(x) = 0.5(u_R''(x) - u_R''(-x)) = \int_{-x}^{x} u_R'''(z)dz \leq 0 \tag{11}$$

So, the required condition on the underlying loss function is :

A4. $l''' \leq 0$.

Moreover, let the platform $\hat{x}^+$ solve

$$0.5u_R'(\hat{x}^+) - 2f(0)(u_R(\hat{x}^+) + M - u_R(-\hat{x}^+) + \frac{\delta}{4}(u_R'(\hat{x}^+) - u_R'(-\hat{x}^+)) = 0 \tag{12}$$

Note from A4 that the last term in (12) is negative, so comparing (12) to (7), we see that $\hat{x}^+ < x^+$. We can then state the following.

***Proposition* 3.** *Assume A1-A4. Then, there exists a unique symmetric equilibrium with the following properties. In the second period, the equilibrium is as described in Proposition 1. In $t = 1$, the equilibrium has the following structure; if $\hat{x}^+ < |x_S|$, then $x_{R,1} = -x_{L,1} = \hat{x}^+$. If $x^- > |x_S|$, then $x_{R,1} = -x_{L,1} = x^-$. If $\hat{x}^+ \geq |x_S| \geq x^-$, then $x_{R,1} = -x_{L,1} = |x_S|$. Moreover, $\hat{x}^+ < x^+$, and $\hat{x}^+$ is decreasing in δ.*

So, the equilibrium has platform rigidity in the first period if and only if $|x_S| \in [x^-, \hat{x}^+]$. So, as $\hat{x}^+ < x^+$, there is less platform rigidity in the first period than in the one-period case. Moreover, the amount of rigidity is decreasing, the more forward-looking are the political parties i.e. the higher is δ. The intuition for these results is that the higher δ, the more party R cares about next period's payoffs, and so the greater an incentive it has to move the policy outcome in the first period towards zero, in order to reduce polarization i.e. the variance of the outcome in the second period. Note also that as $\hat{x}^+ < x^+$, there is now strictly greater moderation than in the case without loss-aversion.

4.3 Preference Shocks

A key question which will help us draw out the observable implications of the theory is to ask how an initial equilibrium responds to changes in voter preferences, as such shifts can be identified empirically, as described in Section 5.

To do this, assume absolute value preferences for the political parties for convenience. Also, suppose that initially, the platforms are at their steady-state values, so the status quo is either x_S or $-x_S$, $x_S \in [x^-, x^+]$, depending on whether the R party or the L party won the previous election. Now consider a rightward shift in the distribution of preferences, so all ideal points of both party members and the independents shift rightward by $\Delta\mu$ i.e. the independents shift from $-|x|$ to $-|x - \Delta\mu|$, and the L and R party preferences shift from

$-|x+1|$, $-|x-1|$ to $-\left|x+1-\Delta\mu\right|$, $-\left|x-1-\Delta\mu\right|$, respectively. A rightward shift is without loss of generality, because due to the symmetry of the model and the equilibrium descried in Proposition 1, if the L (R) party will react to a left shift by $\Delta\mu$ in voter preferences in exactly the same way as the R (L) party reacts to a right shift.

Then, without loss-aversion, it is easy to check that adjustment to the shock is symmetric i.e. the equilibrium platform of the R party moves from x^+ to $x^+ + \Delta\mu$, and the platform of the L party moves from $-x^+$ to $-x^+ + \Delta\mu$. But what happens with loss-aversion?

***Proposition* 4.** *Following a preference shock $\Delta\mu > 0$, the equilibrium outcome is the following.*

(a) If the shock is small, i.e. $\Delta\mu \leq \min\left\{x_S - x^-, x^+ - x_S\right\} \equiv \Delta\mu_{\min}$, then if R is the incumbent, so that the status quo is x_S, the equilibrium is $x_R = x_S$, $x_L = -x_S + 2\Delta\mu$. If L is the incumbent, so that the status quo is $-x_S$, then the outcome is $x_R = x_S + 2\Delta\mu$, $x_L = -x_S$.

(b) If the shock is large i.e. $\Delta\mu > \max\left\{x_S - x^-, x^+ - x_S\right\} \equiv \Delta\mu_{\max}$, then if R is the incumbent, so that the status quo is x_S, the outcome is $x_R = \Delta\mu + x^-$, $x_L = \Delta\mu - x^-$. If L is the incumbent, so that the status quo is $-x_S$, then the outcome is $x_R = \Delta\mu + x^+$, $x_L = \Delta\mu - x^+$.

(c) If the shock is intermediate, with $x^+ - x_S < \Delta\mu \leq x_S - x^-$, if R is the incumbent, the outcome is $x_R = x_S$, $x_L = -x_S + 2\Delta\mu$, and if L is the incumbent, $x_R = \Delta\mu + x^+$, $x_L = \Delta\mu - x^+$.

(d) If the shock is intermediate, with $x_S - x^- < \Delta\mu \leq x^+ - x_S$, if R is the incumbent, the outcome is $x_R = \Delta\mu + x^-$, $x_L = \Delta\mu - x^-$, and if L is the incumbent, the outcome is $x_R = x_S + 2\Delta\mu$, $x_L = -x_S$.

The outcomes in the small and large shock cases are shown in Figure 3(a),(b) below[13]. Each of the figures shows the initial equilibrium value of x_S, the status quo. If R won the last election, we denote this x_S, and if L won the last election, we denote this $-x_S$. The figures differ only in the size of the shift $\Delta\mu$. The red and blue lines show the movement of R and L parties respectively (colors here are for US readers; blue for Democrat, red for Republican). A solid (dotted) line shows how that party's position moves given that it won (lost) the last election.

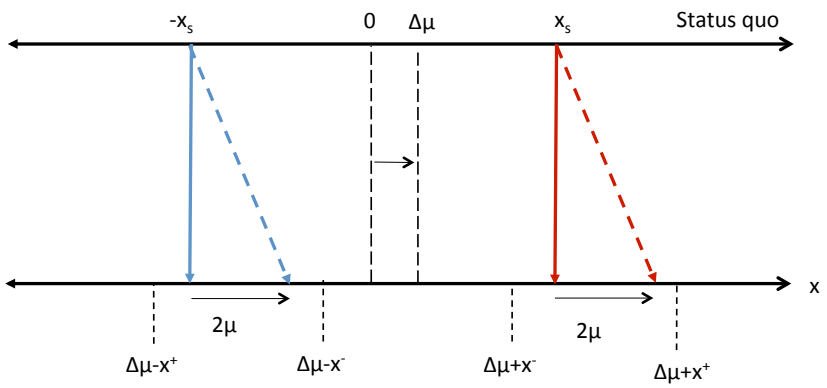
For example, in Figure 1, by Proposition 1, if R won the last election, as $x_S \in [x^- + \Delta\mu, x^+ + \Delta\mu]$, the party's position does not move, and so equilibrium requires that party L's position moves by $2\Delta\mu$. The reverse is true if L won the last election.

To give an easier interpretation to these results, consider the *amount of adjustment* in platforms made by either party as $\Delta\mu$ varies. This is $\Delta x_R = x_R - x_S$, $\Delta x_L = x_L + x_S$

[13] We do not show the intermediate shock cases for reasons of space, and also because they are combinations of the small and large shock cases.

Figure 3: Responses to Different Sized Shocks

(a) Response to a Small Shock



(b) Response to a Large Shock

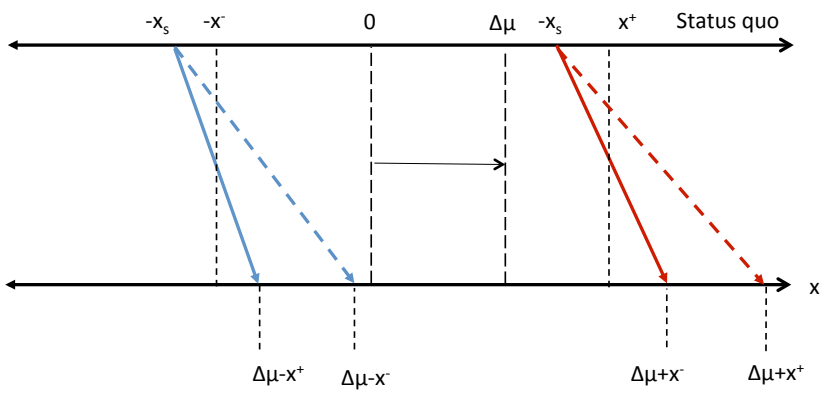
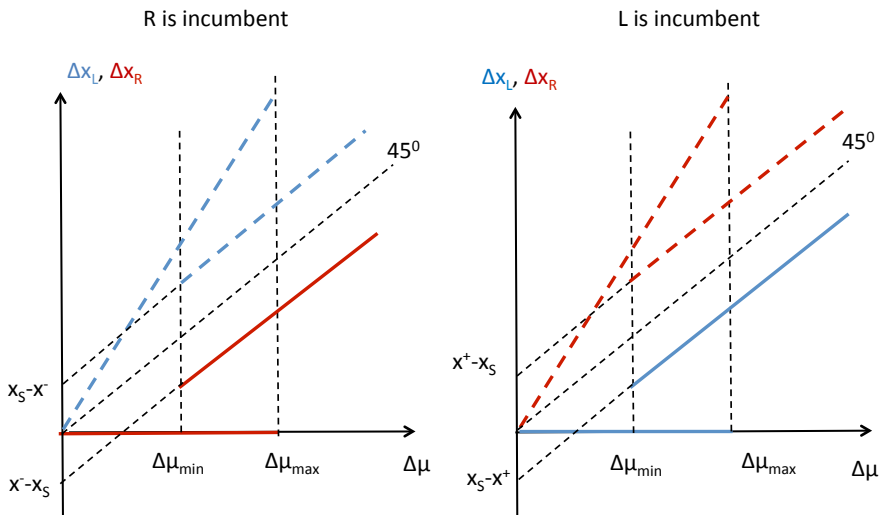


Figure 4: Overview of Responses to a Preference Shock



for parties R, L respectively. Then, from Proposition 4, it is possible to graph $\Delta x_R = x_R - x_S$, Δx_L against $\Delta\mu$.These reactions are shown on the two panels of Figure 4 below. The first (second) panel shows the case where R (L) is the incumbent, and the reactions of incumbent and challenger platforms to the shock are denoted by solid and dotted lines respectively. As in Figure 3, red (blue) lines denote the R party and the L-party respectively.

Note that when $\Delta\mu_{\min} \leq \Delta\mu \leq \Delta\mu_{\max}$, the adjustment of both the incumbent and challenger can take on two values, depending on the exact value of x_S; both are shown on the Figure. For example, if R is the incumbent, when $\Delta\mu_{\min} \leq \Delta\mu \leq \Delta\mu_{\max}$, from Proposition 4, then the L party either does not adjust at all (case (c) of the Proposition) or adjusts by $\Delta\mu + x^- - x_S$ (case (d)).

It is easily verified from Proposition 4 that in the case where R is the incumbent, party R's adjustment, shown by the solid red line, must be less than party L's adjustment, shown by the dotted blue line, as shown in the left panel. From the right panel, the reverse must be true. Note also that if the shock was a leftward shift in the mean of the moderates i.e. $\Delta\mu < 0$, Figure 4 would continue to apply with the L and R indices reversed. So,we have shown:

***Proposition* 5.** *(Asymmetric Adjustment) With loss-aversion, the incumbent party always has a smaller platform adjustment to the shock than the challenger. Moreover, the adjustment to the shock is non-linear for both the incumbent and challenger.*

This result, combined with our observation that there is symmetric adjustment to the shock without loss-aversion, shows that loss-aversion generates a particular kind of

asymmetry, which is testable; incumbents adjust less than challengers. The underlying force is that the status quo works to the advantage of the incumbent[14].

An immediate consequence of Proposition (5) We now turn to consider how a shock affects the equilibrium gap between the platforms i.e. $\Delta_{RL} = x_R - x_L$. the initial gap is of course, $x_S - (-x_S) = 2x_S$. So, the gap between the platforms increases (decreases) iff $x_R - x_L > 2x_S$ ($x_R - x_L < 2x_S$). Say that a preference shock is favorable (unfavorable) for the incumbent if it is in the same direction a the incumbents ideological bias i.e. $\Delta\mu > 0$ is favorable for L, and $\Delta\mu < 0$ is favorable for L.

Then, we can show;

Proposition 6. *(Changes in Party Polarization) Following a "favorable" preference shock for the incumbent, the gap between platforms, $\Delta_{RL} = x_R - x_L$ decreases. Following an "unfavorable" preference shock for the incumbent, the gap between platforms, $\Delta_{RL} = x_R - x_L$ increases.*

A formal proof is in the Appendix, but the result can also be gleaned from Figure 3 above. In the first panel, a favorable shock for R is shown, and clearly R adjusts less than L, meaning that the difference between their platforms must become smaller. In the second panel, an unfavorable shock for L is shown, and clearly R adjusts more than L, meaning that the difference between their platforms must become larger. This is also a testable prediction.

5 Data and Measurement

The previous section makes two robust theoretical predictions; incumbents adjust less than challengers to changes in voter preferences, and parties become less (more) polarized following a "favorable" ("unfavorable") preference shock for the incumbent . In the next three sections, we takes these predictions to data on elections to US state legislatures. As noted by Besley and Case (2003), the US states are a natural laboratory for empirical exercises of this kind.

We use new data collected by Bonica (2014b) which allow us to estimate separately the distribution of voter preferences in each electoral district in each state in each election. In particular, Bonica's data are based on a new method which recovers the platforms of all candidates, not just the winner, for election to state legislatures, based on the campaign donations they received. This is important as it means that we are not forced to make assumptions about the preferences of candidates who lost. We then combine Bonica's data

[14]The result that the adjustment is non-linear is also found by AP, who show that if there is a shock to the median voter, this only has an effect on the outcome if the shock is sufficiently large. (AP, Proposition 4).

with election results at the district level to construct estimates of the preferences of the median voter in each district at each election as described below.

In this way, we can measure changes to the distribution of voters' preferences, and parties' responses to these changes for all state legislatures over a 20 year period. The details of this procedure are in Section 5.1. Using these data we find, as predicted by the theory, that parties with majorities are less responsive to shocks.

5.1 Data Description

Our data are for elections to the lower-chamber of all state legislatures for the period 1990–2012.[15] These data have much to commend them for our purposes. First, consistent with the theory, there are effectively only two parties, Democratic and Republican; we do not study the ideological positions of independent candidates, who in any case, attract very few votes.[16] Second, compared to the European elections studied by e.g. Adams et al. (2004), this is a large sample, with common electoral rules; each state holds general elections every two years.[17] They also have important advantages compared to using data on elections to the US Senate, as done by Fowler (2005), because almost all states have term limits for the lower-chamber, which limits the accumulation of incumbency advantages of other types, which may confound the effect we are looking for (Caughey and Sekhon (2011)).

Data describing the number of voters for each candidate in each district for every election are taken from Klarner et al. (2013). These are then matched by candidate, district, and election to the DIME database Bonica (2014a) that accompanies Bonica (2014b). These data are remarkable in that they provide estimates of the ideological position of almost every candidate in every election over the period we study. These are obtained using publicly available campaign finance information, collated by the National Institute on Money in State Politics and the Sunlight Foundation. Bonica (2014b) proposes a correspondence analysis procedure that exploits the fact that many politicians receive funds from multiple sources and many sources donate to multiple politicians to recover estimates for the positions of both politicians and donors. As this procedure is applied simultaneously at the federal and state level, estimates for candidates in state-level elections are in a common space, and comparable over time and between states. Crucially, as donors donate to losing candidates we observe the ideological position of *all* candidates.

[15] This includes the single Nebraskan chamber, but excludes New England, Massachusetts, and Vermont.

[16] Where information is available, we do include the ideological positions of independent candidates in the calculation of the median voter's ideology, but their positions have a very small effect on the calculation, as these candidates attract very few votes.

[17] Most electoral districts are single-member, but some states have multi-member electoral districts, and we exclude these states in our baseline specification; see below.

5.2 Measuring Voter Preferences and Party Platforms

To test our two hypotheses, we need a measure of each party's position and that of the median voter, at a given election in a given state. Given a set of candidates $c = 1, \ldots, C_d$ in each district $d = 1, \ldots, D_s$ of state S, $Platform_{ct}$ is the platform of candidate c at election t, as measured by Bonica and $Votes_{ct}$ is the number of votes they received. The t variable is the set of even years {1990,..2012}, as elections are held in all states every even year. $Platform_{ct}$ is normalized such that −1 is the most left-wing position observed and 1 is the most right-wing observed in any election.

As a first step, we define the preference of the mean voter in each district d as the voter-weighted average position of the candidates;

$$\mu_{dt} = \sum_{c=1}^{C_d} \frac{Platform_{ct} \times Votes_{ct}}{\sum_C Votes_{ct}} \tag{13}$$

Our baseline estimate of the ideology of the median voter at the state level, μ_{st} is then simply $\mu_{st} = \mu_{Mt}$, where districts are ordered by μ_d and $M = \frac{D_s+1}{2}$. In other words, our estimate of the ideology of the median voter at the state level, μ is defined as the ideology of the mean voter in the median district. Given that typically there are a large number of districts, this is likely to be close to the true median, even though within a district, without making distributional assumptions, we cannot identify the median voter and thus we work with the mean voter.

Formula (13) highlights why an estimate of the platform of both candidates is so important – it allows us to consistently estimate μ_{st} without recourse to additional assumptions or additional information (see, Kernell, 2009). One further refinement is that this procedure for constructing μ_{st} is done separately for the two parties, as typically neither party contests all districts in a state, so we end up with μ_{pst}.

Our variable measuring changes, or shocks, to voter preferences is then simply:

$$Shock_{pst} \equiv \Delta\mu_{pst} = \mu_{pst} - \mu_{ps,t-1}. \tag{14}$$

Figure A.1 illustrates μ_{st} describes how the median voter of each state has varied over time. We can see that, as would be expected, voters in New York or Oregon are to the left of voters in Georgia or Oklahoma. We can also see that for some states, such as California or Texas, μ_{st} has varied less over time than others such as Arizona or Idaho.

This measure (14) has the advantage of corresponding directly to the theory. It does not necessarily use all of the available information, however. As a robustness test we will repeat our analysis using the state-wide *mean* voter position, μ'_{st}. We calculate the mean

voter in state s in year t as

$$\mu'_{st} = \frac{1}{D_s} \sum_{d=1}^{D_s} \mu_{dt}. \tag{15}$$

i.e. the average of the district mean ideologies. Again, as a refinement, this is done for each party separately. Inspection of Figure A.2 suggests that the choice between μ_{st} and μ'_{st} may not be that important as there is little empirical difference in the distributions across states in a given year of the mean and median voters.

The other main explanatory variable is a dummy Inc_{st} recording whether the party s holds a majority of seats in the legislature in the period prior to election t. The dependent variable is a (state) party's position, $Position_{pst}$. We define this as the median of the positions of all candidates of that party in the election at t including both incumbent and challengers i.e. the median of all the values of $Platform_{ct}$, for all candidates belonging to party p in state s. The decision to treat incumbents and challengers equally is made for both statistical and substantive reasons.

Firstly, the substantive reason is that it well known (see, Poole, 2007, Poole and Rosenthal, 2006) that individual politicians' positions are relatively stable over time and that most of the change in the views of representatives is due to electoral turnover. Thus, the response of incumbents to an electoral shock is likely to be relatively small. The second, statistical, reason relates to this. If we were to focus only on those who were elected we would introduce a substantial composition effect – for a given shock those still in office are those more isolated from changes in the median voter. Thus, a leftward move in the median voter, might mean the average republican incumbent moves rightward. In the context of our model the dynamic implications would create a substantial econometric problem. By considering both incumbents and challengers we not only avoid the composition effect, but also observe better a party's response to changes in the distribution of voters.

Our measure $Position_{pst}$ is a party's median representative rather than the mean as this corresponds both better to standard theory, and is less likely to be distorted by the preferences of extreme representatives. It is possible however that in the presence of a large number of uncompetitive seats, perhaps due to gerrymandering, a party's median representative will not have changed position despite large changes in its platform in competitive districts. However, as we will see, all of our results are robust to using the mean representative instead.

We introduce the data with an example, that illustrates our empirical strategy. We take California as our example as it has a large population, and a relatively large state-legislature, in which neither party is overly dominant. Figure 5 describes the results of the Californian State Legislature elections in 2004 and 2006. Panel 5a plots kernel density

estimates of voters' preferences in 2004 and 2006 i.e. the kernel of the distribution of μ_{dt}. We can see that the solid 2004 curve is to the right of the dashed 2006 curve. This represents a leftward move in the position of the average voter between the two elections. The prediction of the theory is that this move, given the Democrats had a majority in 2004 should have led the Republican party to move to the left.

The kernel density estimates of representatives positions for each party in Panel 5b show that this is precisely what happens. The distribution of Democrats changes little – there is a slight move to the left, particularly in the left-wing of the party – but as predicted the Republican party moves markedly to the left. The nature of this move is revealed by looking at the histograms in panels 5c and 5d. We can see again that there are no pronounced changes in the Democratic representatives. The Republican representatives, however, tend to move closer to the centre – there is now more overlap with the Democrats and the main body of the party can be seen to be more centrist.[18]

Table 1 contains summary statistics for the key variables $Position_{pst}$, $Shock_{pst}$ for all US states, by party. We also show $\Delta Position_{pst}$, the change in $Position_{pst}$ for party p in state s between elections at t and the previous election $t-1$. The Table shows, as expected, that $Position_{pst}$ for the republicans is to the right of that for Democrats. Note however, that the difference between the Democrat and Republican mean values on the $[-1,1]$ scale are small - only - 0.142 - as the endpoints of this scale are determined by the most ideologically extreme candidates in the sample.

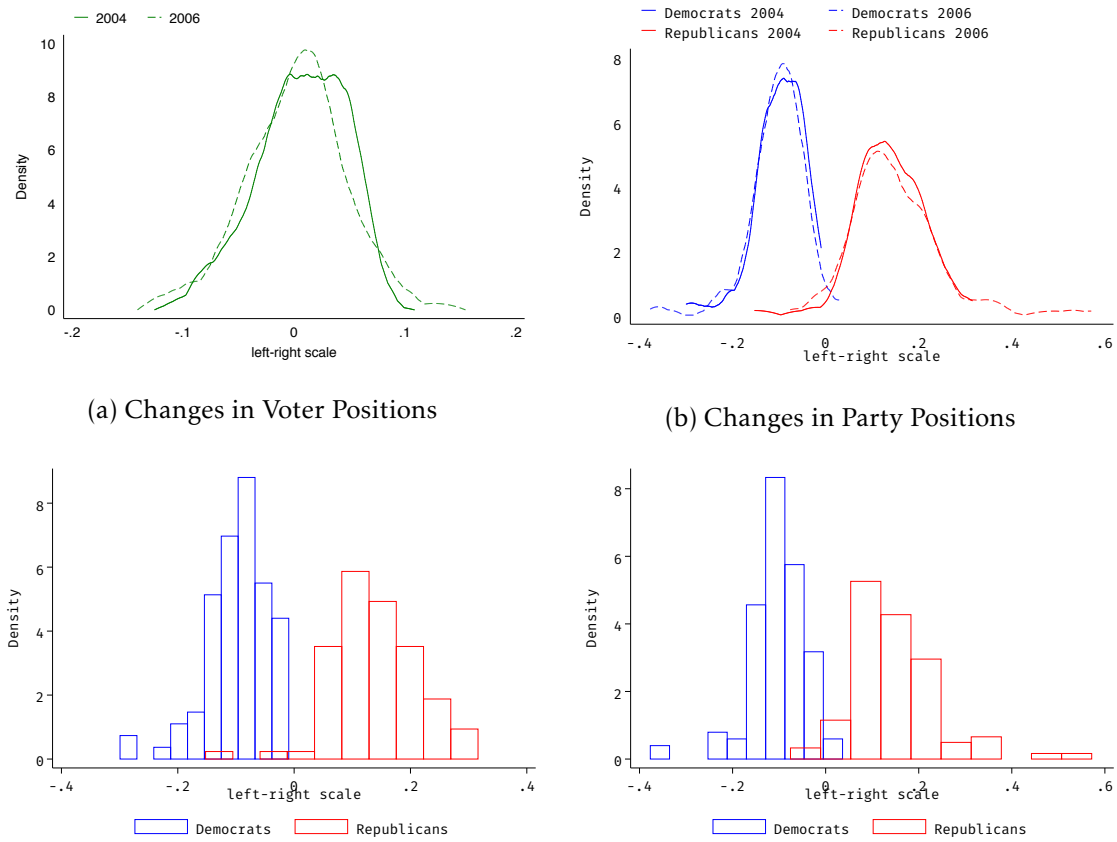
Looking now at the values for $\Delta Position_{pst}$ over the sample period, we see, not surprisingly, that there has been polarization; the Republicans have moved to the right, and the Democrats to the left. Reflecting this, there are also relatively few large party moves with the $90th$ percentile of $\Delta Position_{pst}$ also being 0.02 for the Republican party. Comparison of the 1st and 99th percentiles suggests shocks are symmetrically distributed.

We can also see that, consistent with the literature (see, Erikson et al., 1993), that voter preferences are relatively stable – for example, for voter preferences in districts contested by the Republicans, the $90th$ percentile of the $Shock_{pst}$ distribution is 0.02 compared to a theoretical maximum move of 2, and the corresponding figure for Democrats is 0.018.

Using the same underlying ideology data to measure both party and voter positions is important because it ensures that both $Shock_{pst}$ and $\Delta Position_{pst}$ are defined on the same space and thus directly comparable. However, it is also worthwhile being clear about why, despite some common underlying information, there is no mechanical relationship between them. Consider an individual district; in (13) we estimate the mean ideology of

[18] Notably, however there are a small number of comparatively extreme representatives. This highlights that districts and their representatives are extremely heterogeneous – the variation in the positions of Republicans is much larger than the distance between the two party means. This is why we pay close attention to our measures of the average voter, and party position.

Figure 5: Californian State Legislature Elections 2004 and 2006



(a) Changes in Voter Positions

(b) Changes in Party Positions

(c) Representatives 2004

(d) Representatives 2006

this district as the vote weighted average of the candidates' positions. Yet, if candidates change their positions, in the absence of a change in the preferences of voters, then the vote shares for the parties might plausibly change in an offsetting way so that such that μ_{st} may not change much. For example, suppose both parties were initially located either side of the median voter, and both parties move to the right. Given that the distribution of voter preferences is single-peaked, then support for the Republicans will fall, and that for the Democrats will rise. As shown in Table 2, something like this seems to be occurring; the correlation between $Shock_{pst}$ and $\Delta Position_{pst}$, while positive, is in fact quite small at 0.271.

6 Testing for Asymmetric Adjustment

6.1 Empirical Strategy

Proposition 5 suggests that parties that lost the previous election will respond more to any change in voters' preferences than the winner. The theory also suggests that this

relationship maybe non-linear. We take this prediction to the data by relating the change in the position of party p in state s, and year t, to whether the party won the previous election and what changes there have been in voters' preferences. In other words we estimate an equation of the form:

$$\Delta Position_{pst} = f(Inc_{pst}, Shock_{pst}) + \epsilon_{pst} \tag{16}$$

Specifically, we assume a functional form which is linear in $Inc_{pst}, Shock_{pst}$ and quadratic in the interaction $Inc_{pst} \times Shock_{pst}$ i.e.

$$\begin{aligned} \Delta Position_{pst} = \lambda Shock_{pst} + \gamma_1 Inc_{pst} + \beta_1 Inc_{pst} \times Shock_{pst} + \\ \beta_2 Inc_{pst} \times Shock^2_{pst} + \varepsilon_{pst} \end{aligned} \tag{17}$$

Proposition 5 implies that β_1 is negative.

Give the data at hand, a key challenge in estimating (17) is to adequately control for any common factor, captured by ε_{pst}, that may be jointly driving changes in parties' platforms and changes in voters' preferences. These are likely myriad and will include both local political and economic factors in the districts of individual representatives (see, Healy and Lenz, 2014), the spillover effects of other elections (see, Campbell, 1986), the characteristics of the representatives themselves (see, Buttice and Stone, 2012, Kam and Kinder, 2012), media-bias (see, Chiang and Knight, 2011), or even the weather (see, Gomez et al., 2008). As well as endogeneity due to external events, there is also the possibility of simultaneity due to the persuasive or campaigning efforts of state-parties or individual politicians.

Our identification strategy is simple. Given our data are indexed by state, party, and year we include fixed effects for each of the pair wise combinations of the three. Our preferred model includes $state \times party$ (henceforth, SP), $state \times year$ (SY), and $party \times year$ (PY) fixed effects. In other words, we assume

$$\varepsilon_{pst} = \xi_{sp} + \phi_{st} + \delta_{pt} + \zeta_{pst} \tag{18}$$

where $\xi_{sp}, \phi_{st}, \delta_{pt}$ are SP, SY, and PY fixed effects, and the error term ζ_{pst} is assumed to be $\zeta_{pst} \sim N(0, \Sigma)$ where we allow for Σ to be clustered by both SP and SY. This is because one can imagine that as well as errors being correlated within an individual state party, that state parties' behavior may be correlated across states within an election. For example,that Republicans in say, Arizona, may pay attention to the fortunes of Republicans in New Mexico.

So, we have partialled out all variation associated with particular, states, parties, and years. Moreover, conditional on this we assume that the covariates in (17) are orthogonal

to the error ζ_{pst}. This implies three substantive claims, that conditional on the fixed effects; the change in the median voter is random; which party is incumbent does not alter voters' votes given their preferences; and conditioning on this incumbency that the change in the median voter is still random. It is hard to think of processes which, given these fixed effects, would give rise to some unaccounted for systematic bias in our results.[19]. So, our final specification is given by (17) and (18).

A final concern is that there may be alternative explanations for asymmetric platform adjustment. In particular, one may be concerned that our results reflect incumbency advantage. The recent literature has focused on three key sources of incumbency advantage – that incumbents receive more campaign contributions which improve their chances of re-election; that high quality challengers avoid contesting elections against incumbents meaning incumbents run against relatively poor challengers on average; or that incumbents are themselves higher quality politicians.[20] It is possible that any of these three advantages could cause, in equilibrium, the incumbent to adjust less in response to a voter preference shock; however, there are to our knowledge, no theoretical predictions to this effect in the literature.

Our response to this is as follows. The first point here is that almost all states have term limits during our sample period. As a result, around almost 27% of seats are open i.e. not contested by the incumbent. A second point is that the vast majority of the empirical literature has identified incumbency advantage at the *individual* level, whereas our analysis is at the *party* level, and so we are concerned with the average advantage across individuals in a given party. Our fixed effects will control for this.

For example, suppose it is the case that in a state, one party's representatives are on average is wealthier than the other's. Then, it is quite plausible, that following a shock to preferences, that party may seek to persuade the voters by increased advertising, rather than changing its platform, and so may respond less to the shock. Assuming that this differential does not change much over time, it will be picked up by the state-year fixed effect. Alternatively, to the extent that wealth differences between parties are at the national level, but vary over time, they will be picked up by the party-year fixed effect, and so on.

[19] To be precise our identification assumptions are:

$$E[Shock_{pst}\zeta_{pst}] = E[(Inc_{pst}\zeta_{pst})] = E[(Inc_{pst} \times Shock_{pst})\zeta_{pst}] = 0$$

[20] Uppal (2010) applies the approach of Lee (2008) to provide evidence for state legislatures. He finds that incumbency is associated with an average electoral advantage of around 5.3%, similarly Fowler and Hall (2014) find it to be 7.8%. The results of Fouirnaies and Hall (2014) suggests a substantial portion of this advantage is due to the additional campaign funding received by incumbents. Ban et al. (2016) using term-limits as an instruments suggests that the choice of high quality opponents to avoid competing against incumbents accounts for around 40% of incumbents' advantage. While, Hall and Snyder (2015) using an RDD approach finds much smaller effect of around 5%.

A final concern is the so-called Partisan Incumbency Advantage discussed by Fowler and Hall (2014), which describes the beneficial effect to individual candidates of belonging to the party currently in office, over and above any individual incumbency advantage. If such an advantage exists, it will be a component of Inc_{pst}. This, however, is of limited concern for two reasons. First, Fowler and Hall (2014) shows that this effect is in practice close to zero. Second, even it is present, it should not bias the estimation of the parameters of interest β_1 and β_2.

6.2 Results

We now report estimates of (17). As a first step, column 1 of Table 3 reports results from a simplified version of (17) where $\gamma = \beta_2 = 0$, and in which there are only SP and year fixed effects. We see that, as expected, parties react to movements in the median voter, with the coefficient on $Shock_{pst}$ positive and significant. We also find, as the theory suggests, that parties with a majority react less. This coefficient is negative, significant and in fact larger than that for $Shock_{pst}$. Calculating standardized coefficients, reported in column 2, reveals in fact it is around 80% as large. Here, a one standard deviation move rightwards would move the incumbent party only 0.07 standard deviations rightwards, but a party not in power 0.37 standard deviations to the right. This is clearly as predicted by the theory as it shows that the party that lost (won) the previous election tend to make large (small) policy changes in the pursuit of future power.

Column 3 maintains the restriction that $\gamma = \beta_2 = 0$ but now includes the full battery of fixed-effects. The effect of movements in the median voter is no longer sufficiently precise to be significant, but remains positive. This is because $Shock_{pst}$ will be almost collinear with the state-year fixed effect. Thus, in this specification $Shock_{pst}$ is controlling for any differences in how the shock affects parties, say because they do not contest all districts. The negative coefficient on β_1 is now larger and still significant at the 1% level. The addition of the SY fixed-effects simplifies the interpretation of this coefficient, given a shock, it is now the difference in the response of parties in power from those that are not. This effect may not be linear however, parties may respond disproportionately to smaller or larger shocks.

In column 4 we therefore relax the constraint that $\beta_2 = 0$, but, we find that it is imprecisely measured and not significant at any conventional level. Column 5 reimposes the restriction that $\beta_2 = 0$ but now allows for a direct effect of Inc_{pst}. Given that we include $Inc_{pst} \times Shock_{pst}$ this is equivalent to the effect of Inc_{pst} given no shock. Perhaps unsurprisingly, given the shock will almost always be non-zero, the estimated effect is small although positive and significant at the 1% level. One reason for this is that the average shock is slightly positive. Column 6 reports the unrestricted model, where, β_1, the

coefficient on $Inc_{pst} \times Shock_{pst}$ continues to be large, negative, and precisely estimated, but the coefficients on $Shock_{pst}$ and the quadratic term are still not sufficiently precise. Given the included fixed-effects all of these coefficients are consistent with the theory, although the additional variables make inference more complicated in this model. The positive coefficient on Inc_{pst}, $\gamma = 0.01$ and negative coefficient on its interaction with the shock $\beta_1 = -0.639$ suggest that a move from -0.5 to 0.5 leads to a $0.63 - 0.01 = 0.62$ smaller move by the incumbent party compared to the non-incumbent. The results in column 2 suggest that this will still be positive.

The theory is ambiguous about the sign of any non-linear effects but is clear that there should be a direct linear effect. As a further test, we compare the performance of a model excluding the linear effect, as the lack of a significant coefficient on the quadratic term in column 6 may reflect colinearity between $Inc_{pst} \times Shock_{pst}$ and its square due to the SY fixed effects. The comparatively low R^2 of this regression reveals that this model fits the data considerably less well and $Shock_{pst}$ is now negative and again β_2 is insignificant. Inc_{pst} is now significant again at the 5% level. We interpret these results as reflecting a restricted model that is unable to fit the data. Taken together these results provide strong evidence for the effects of loss-aversion predicted by the theory.

To address any remaining concerns about our identification strategy we also estimate (17) in first-differences using the same set of fixed effects (now trends). We write the model in first differences as:

$$\begin{aligned} \Delta^2 Position_{pst} = \lambda \Delta Shock_{pst} + \gamma_1 \Delta Inc_{pst} + \beta_1 \Delta Inc_{pst} \times Shock_{pst} + \\ \beta_2 \Delta Inc_{pst} \times Shock^2_{pst} + \chi_{ps} + \psi_{st} + \phi_{pt} + \zeta_{pst} \end{aligned} \tag{19}$$

This specification is now a demanding one – the inclusion of time fixed effects in a first-differences model is equivalent to the inclusion of random trends in the levels equation (see, Wooldridge, 2010). Thus, as well as a state-party specific linear trend, we are now also allowing for state specific, and party specific, stochastic trends. The only assumption now necessary is that there is no non-linear state-party time-trend driving our results. It is very unlikely that this would occur. Specifically, interpreting β_1 differently would mean that the fact that a party lost led to voters moving away from that party at the next election, yet voters would not move towards parties that won. This would imply very different preferences than are normally imputed to voters, and be contrary to the canon of models of electoral competition since Downs. The empirical prediction is also contrary to what we observe – as the implied party dynamics are potentially unstable, losing one election would lead to an increased chance of a party losing the next election, and as such we would not expect stable electoral competition. For this reason, we discount this possibility.

The results of (19) are reported in Table (4). We again build up the model step by step. The key result is the same and robust across all specifications: $\beta_1 < 0$. The overall inference is the same as before, parties exhibit loss-aversion. The precise inference is a little more involved – the results suggest that parties in power react less to an increase in the size of a shock than parties out of power. The coefficient is large, negative, and significant at all conventional levels. Given the comprehensive set of fixed-effects that this specification employs we interpret this result as providing clear evidence for the mechanism that we suggest. Otherwise, as before we do not find a significant effect of the shocks themselves, again due to the inclusion of SY fixed-effects. Column 2 reports standardized coefficients as in column 2 of Table 3, again omitting the SY fixed effects. The quantitative interpretation of the results is also consistent with that in Table 3, the effect of additional movement due to an increase in the shock by 1 standard-deviation compared to the previous period is only around 20% as large for the party not in power.

As discussed in Section 5.1 our preferred measure of shocks is the change in the median voter. However, whilst this represents a natural choice for substantive reasons, we may be concerned that this measure, focusing on the median district, disregards important information. We now re-estimate both (17) and (19) using the change in the mean voter as our measure of the shocks. Columns 1 and 2 of Table 5 report specifications equivalent to parsimonious specification in column 3 of Table 3 and the unrestricted specification of column 6. In both cases the change in the mean voter is negative and significant although the coefficient is now around 40% larger. This larger coefficient is in line with our expectations, since as discussed previously, representatives in seats that are uncompetitive may be expected to respond less to changes in the voter preferences, and in some states the median voter may be in a non-competitive district.

Columns 3 and 4 report the results of repeating this analysis for the first-differenced model. In the parsimonious model, the result is again larger, and still significant. Table 6 considers the parallel decision to focus on a party's median representative and re-estimates the model using mean representatives. We can see that in all cases, both in levels and first differences, and both using the change in the mean and the median voter as the shock, β_1 is significant and indeed is often now more precisely measured. Whilst the coefficient on β_2 is always insignificant and its sign varies across specifications. These results suggest that our previous assumptions were, if anything conservative, and provide strong support for the predictions of the theory.

As discussed above, one important advantage of studying state legislative elections is that there is a large sample of elections in an institutionally homogeneous setting. Thus, our preferred sample excludes all elections with multi-member districts.[21] As well as

[21] These are Arkansas, Arizona, Georgia, Idaho, Maryland, North Carolina, North Dakota, New Hampshire, South Dakota, Washington, and West Virginia.

making the states we study as similar as possible, a second advantage of restricting the sample is so that the setting we study empirically is as close as possible to that analyzed theoretically. However, it is nevertheless important to check that our results are not an artefact of this choice. Columns 5 and 6 of Table 5 report the parsimonious and unrestricted versions of our fixed-effects model, and columns 7 and 8 do likewise for the first-differenced model. The coefficients of the fixed-effects specification are largely unchanged suggesting that our results are not being driven by the choice of states. The coefficients for the first-differenced model are slightly larger, and a little more precise. Results, not reported, show that these results are robust to using the median-voter as our shock measure. Taking the results reported in Tables 5 and 6 as a whole, it is clear that the results are not being driven by our modelling assumptions.

7 Testing for Changes in Polarization

We now turn to our second empirical prediction, Proposition 6. This Proposition implies that at an election the gap between two parties Δ_{RL} should be larger if the shock was favorable for the incumbent. Recall that positive (negative) changes in $\Delta\mu_{pst}$ measure rightward (leftward) shifts in voter preferences. So, our measure of favorable shocks for Republicans and Democrats respectively are:

$$F_{Rst} \equiv \max\{\Delta\mu_{Rst}, 0\},\ F_{Dst} \equiv \max\{-\Delta\mu_{Dst}, 0\}.$$

We then estimate the following model:

$$\begin{aligned} \Delta_{RL} &= |Position_{Rst} - Position_{Dst}| \\ &= \alpha_R(Inc_{Rst} \times F_{Rst}) + \alpha_D(Inc_{Dst} \times F_{Dst}) \\ &+ \beta_R(Inc_{Rst} \times F_{Dst}) + \beta_D(Inc_{Dst} \times F_{Rst}) + \varepsilon_{pst} \end{aligned} \tag{20}$$

where now we drop the state–year fixed effects and thus $\varepsilon_{pst} = \xi_{sp} + \delta_{pt} + \zeta_{pst}$.

To interpret this, consider first the variable $Inc_{Rst} \times F_{Rst}$; this records the presence and size of the favorable shock when the Republican party is the incumbent ; by Proposition 6, we expect this to have a negative impact on the dependent variable i.e. $\alpha_R < 0$. By the same argument, we expect $\alpha_D < 0$. Next, the variable $Inc_{Rst} \times F_{Rst}$; this records the presence and size of the unfavorable shock when the incumbent is the Republican; by Proposition 6, we expect this to have a positive impact on the dependent variable i.e. $\beta_R > 0$. By the same argument, we expect $\beta_D > 0$.

The results of estimating (20) are reported in columns 1 and 2 of Table 7. As a first step in column 1, to maximize power, we restrict that $\alpha_R = \alpha_D$ and likewise $\beta_R = \beta_D$.

The results are as predicted: α is negative and β is positive and both are significant. β is slightly larger in magnitude than α and more precisely measured. Column 2 estimates 20 without additional restrictions. We see that, as predicted, both $\alpha_R < 0$ and α_D while $\beta_R > 0$ and $\beta_D > 0$. All four coefficients remain significant although the estimate of α_D is relatively imprecise and only significant at the 10% level. Columns 3 and 4 repeat these two analyses but now the model is estimated in first-differences analogously to 19. The results are, if anything, stronger the coefficients are now larger in magnitude and more precise. The explanatory power of the model is also improved. Taken together the results of all four specifications provide strong evidence for the theory – both suggest that loss aversion means that unfavorable shocks lead to platform convergence.

8 Conclusions

This paper studied how voter loss-aversion affects electoral competition in a Downsian setting. Assuming that voters' reference point is the status quo, we showed that loss-aversion has a number of effects. First, for some values of the status quo, there is policy rigidity both parties choose platforms equal to the status quo, regardless of other parameters. Second, there is a moderation effect when there is policy rigidity; the equilibrium policy outcome is closer to the moderate voters' ideal point than in the absence of loss-aversion. In a dynamic extension of the model, we established that parties strategically manipulate the status quo to their advantage, and we find that this increases policy rigidity. Finally, we made two empirical predictions. First, with loss-aversion, incumbents adjust less than challengers to changes in voter preferences. The underlying force is that the status quo works to the advantage of the incumbent. Second, we showed that following a "favorable" preference shock for the incumbent, the gap between platforms, decreases, whereas the reverse is true following an "unfavorable" preference shock.

We test both of these predictions using elections to US state legislatures. We find robust support for both. The results are as predicted: incumbent parties respond less to shocks in the preferences of the median voter. Also as predicted, "unfavourable" shocks lead to platform divergence.

Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P10	P50	P90	P99
				Republicans						
$Position_{pst}$	214	.137	.043	.041	.215	.052	.073	.148	.187	.202
$\Delta Position_{pst}$	214	.004	.014	-.053	.064	-.03	-.01	.003	.022	.04
$Shock_{pst}$	214	.001	.015	-.048	.046	-.042	-.014	.001	.02	.042
				Democrats						
$Position_{pst}$	214	-.05	.064	-.173	.11	-.167	-.128	-.066	.051	.096
$\Delta Position_{pst}$	214	-.005	.012	-.063	.036	-.046	-.019	-.004	.008	.019
$Shock_{pst}$	214	0	.014	-.039	.051	-.028	-.016	-.001	.018	.035

Table 2: Cross-correlation table

Variables	$\Delta Position_{pst}$	$Shock_{pst}$	$Inc_{pst} \times Shock_{pst}$
$\Delta Position_{pst}$	1		
$Shock_{pst}$	0.271	1	
$Inc_{pst} \times Shock_{pst}$	0.063	0.518	1

Table 3: Fixed Effect Estimates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Shock_{pst}$	0.44***		0.07	0.07	0.10	0.11	-0.29***
	(0.14)		(0.12)	(0.12)	(0.12)	(0.12)	(0.09)
$Inc_{pst} \times Shock_{pst}$	-0.47***		-0.62***	-0.62***	-0.63***	-0.63***	
	(0.15)		(0.08)	(0.08)	(0.08)	(0.08)	
$Inc_{pst} \times Shock^2_{pst}$				0.33		-2.42	-2.38
				(2.81)		(2.96)	(4.57)
Inc_{pst}					0.00***	0.01***	0.00**
					(0.00)	(0.00)	(0.00)
$Shock^S_{pst}$		0.37***					
		(0.12)					
$Inc_{pst} \times Shock^S_{pst}$		-0.30***					
		(0.09)					
R^2	0.092	0.092	0.207	0.207	0.225	0.227	0.082
N	428	428	428	428	428	428	428

All data are for elections to the lower-houses of state legislatures. The dependent variable is the change in a party's platform as measured by that of the median candidate. $Shock_{pst}$ measures the change in the median voter's preferences as defined in Equation 14. Inc_{pst} is a binary variable that is equal to 1 if a party won more than 50% of the seats at the previous election. $Shock^S_{pst}$ and $Inc_{pst} \times Shock^S_{pst}$ are standardised coefficients, and the dependent variable in the associated regression is also standardised. All columns include $State \times Party$ and $Party \times Year$ fixed-effects. Columns 3-7 additionally include $State \times Year$ fixed effects. Standard errors, clustered by both $State \times Party$ and $Party \times Year$ in parentheses. $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: First Differences Estimates

	(1)	(2)	(3)	(4)	(5)	(6)
$Shock_{pst}$	0.07					
	(0.12)					
$Inc_{pst} \times Shock_{pst}$	-0.62***					
	(0.08)					
$Inc_{pst} \times Shock^2_{pst}$	0.33					
	(2.81)					
$\Delta Shock_{pst}$			0.17	0.17	0.22	0.22
			(0.12)	(0.12)	(0.14)	(0.14)
$\Delta(Inc_{pst} \times Shock_{pst})$			-0.68***	-0.67***	-0.67***	-0.68***
			(0.12)	(0.12)	(0.13)	(0.13)
$\Delta(Inc_{pst} \times Shock^2_{pst})$				2.56		-0.79
				(2.58)		(1.96)
ΔInc_{pst}					0.01***	0.01***
					(0.00)	(0.00)
$\Delta Shock^S_{pst}$		0.40***				
		(0.11)				
$\Delta(Inc_{pst} \times Shock_{pst})^S$		-0.34***				
		(0.10)				
R^2	0.207	0.107	0.219	0.221	0.248	0.248
N	428	366	366	366	366	366

The dependent variable is the first difference of the change in a party's plaform except for columns 1 and 2 where it is the change in a party's platform. Δ denotes first differences. All columns include $State \times Year, State \times Party$ and $Party \times Year$ fixed-effects except for column 2 which omits the $State \times Year$ fixed-effects. Other details as for Table 3.

Table 5: Robustness Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Shock_{pst}$ (Mean)	0.09	0.10						
	(0.12)	(0.12)						
$Inc_{pst} \times Shock_{pst}$ (Mean)	-0.70***	-0.70***						
	(0.08)	(0.08)						
Inc_{pst}		0.00***				0.00**		
		(0.00)				(0.00)		
$Inc_{pst} \times Shock^2_{pst}$ (Mean)		0.80						
		(3.33)						
$\Delta Shock_{pst}$ (Mean)			0.13	0.15				
			(0.13)	(0.14)				
$\Delta(Inc_{pst} \times Shock_{pst})$ (Mean)			-0.72***	-0.70***				
			(0.14)	(0.14)				
ΔInc_{pst}				0.01***				0.00***
				(0.00)				(0.00)
$\Delta(Inc_{pst} \times Shock^2_{pst})$ (Mean)				0.57				
				(2.82)				
$Shock_{pst}$					-0.07	-0.06		
					(0.06)	(0.06)		
$(Inc_{pst} \times Shock_{pst})$					-0.54***	-0.54***		
					(0.05)	(0.05)		
$(Inc_{pst} \times Shock^2_{pst})^2$						-2.59		
						(2.84)		
$\Delta Shock_{pst}$							-0.05	-0.04
							(0.04)	(0.05)
$\Delta(Inc_{pst} \times Shock_{pst})$							-0.52***	-0.51***
							(0.08)	(0.07)
$\Delta(Inc_{pst} \times Shock^2_{pst})^2$								-0.41
								(2.18)
R^2	0.198	0.220	0.202	0.236	0.150	0.158	0.143	0.151
N	428	428	366	366	552	552	471	471

(Mean) indicates that the voters' preferences are measured using those of the mean voter instead of the median voter. Columns 5-8 report results expanding the sample to include states which have multi-member districts. Δ denotes first differences. Other details as for Table 3.

Table 6: Party Means

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Shock_{pst}$	0.01	0.05						
	(0.15)	(0.14)						
$Inc_{pst} \times Shock_{pst}$	-0.48***	-0.49***						
	(0.12)	(0.11)						
Inc_{pst}		0.01***				0.01***		
		(0.00)				(0.00)		
$Inc_{pst} \times Shock^2_{pst}$		-3.17						
		(3.64)						
$\Delta Shock_{pst}$			0.09	0.13				
			(0.17)	(0.17)				
$\Delta Inc_{pst} \times Shock_{pst}$			-0.54***	-0.53***				
			(0.16)	(0.16)				
ΔInc_{pst}				0.01**				0.01**
				(0.00)				(0.00)
$\Delta(Inc_{pst} \times Shock^2_{pst})$				0.27				
				(2.93)				
$Shock_{pst}$ (Mean)					0.14	0.14		
					(0.15)	(0.14)		
$Inc_{pst} \times Shock_{pst}$ (Mean)					-0.66***	-0.66***		
					(0.14)	(0.14)		
$Inc_{pst} \times Shock^2_{pst}$ (Mean)						0.34		
						(3.83)		
$\Delta Shock_{pst}$ (Mean)							0.22	0.24
							(0.17)	(0.16)
$\Delta(Inc_{pst} \times Shock_{pst})$ (Mean)							-0.76***	-0.73***
							(0.20)	(0.19)
$\Delta(Inc_{pst} \times Shock^2_{pst})$ (Mean)								3.74
								(3.47)
R^2	0.126	0.149	0.121	0.143	0.150	0.173	0.157	0.185
N	428	428	366	366	428	428	366	366

The dependent variable is the change in party position, or the first-difference of the change in party position in columns 3,4,7, and 8, measured using the position of a party's mean representative. (Mean) indicates that the voters' preferences are measured using those of the mean voter instead of the median voter. Other details as for Table 3.

Table 7: Platform Convergence

	(1)	(2)	(3)	(4)
$Inc_{Dst} \times F_{Dst} + Inc_{Rst} \times F_{Rst}$	-0.34**			
	(0.17)			
$Inc_{Rst} \times F_{Dst} + Inc_{Dst} \times F_{Rst}$	0.53***			
	(0.12)			
$Inc_{Dst} \times F_{Dst}$		-0.57*		
		(0.32)		
$Inc_{Rst} \times F_{Rst}$		-0.15***		
		(0.03)		
$Inc_{Rst} \times F_{Dst}$		0.36**		
		(0.16)		
$Inc_{Dst} \times F_{Rst}$		0.70***		
		(0.15)		
$\Delta(Inc_{Dst} \times F_{Dst} + Inc_{Rst} \times F_{Rst})$			-0.39***	
			(0.11)	
$\Delta(Inc_{Rst} \times F_{Dst} + Inc_{Dst} \times F_{Rst})$			0.49***	
			(0.13)	
$\Delta(Inc_{Dst} \times F_{Dst})$				-0.36**
				(0.15)
$\Delta(Inc_{Rst} \times F_{Rst})$				-0.40**
				(0.16)
$\Delta(Inc_{Rst} \times F_{Dst})$				0.57**
				(0.22)
$\Delta(Inc_{Dst} \times F_{Rst})$				0.41***
				(0.10)
R^2	0.023	0.026	0.058	0.059
N	636	636	552	552

The dependent variable in columns 1 and 2 is the absolute distance between the Republicans and the Democrats, $|Position_{Rst} - Position_{Dst}|$. Columns 3 and 4 report an analagous specification but now in first differences so that the dependent variable is the change in the absolute distance between the parties ($\Delta|Position_{Rst} - Position_{Dst}|$). Inc_{Rst} (alternatively, Inc_{Dst}) is a binary variable that is equal to 1 if the Republican (Democratic) party won more than 50% of the seats at the previous election. F_{Rst} (alternatively, F_{Dst}) report the size of any favourable shock, taking a value of zero if the shock was unfavourable. All specifications additionally include $State \times Party$ and $Party \times Year$ fixed effects. Standard errors clustered by $State \times Party$ and $Party \times Year$ in columns 1 and 2 and clustered by $State \times Party$ only in columns 3 and 4 in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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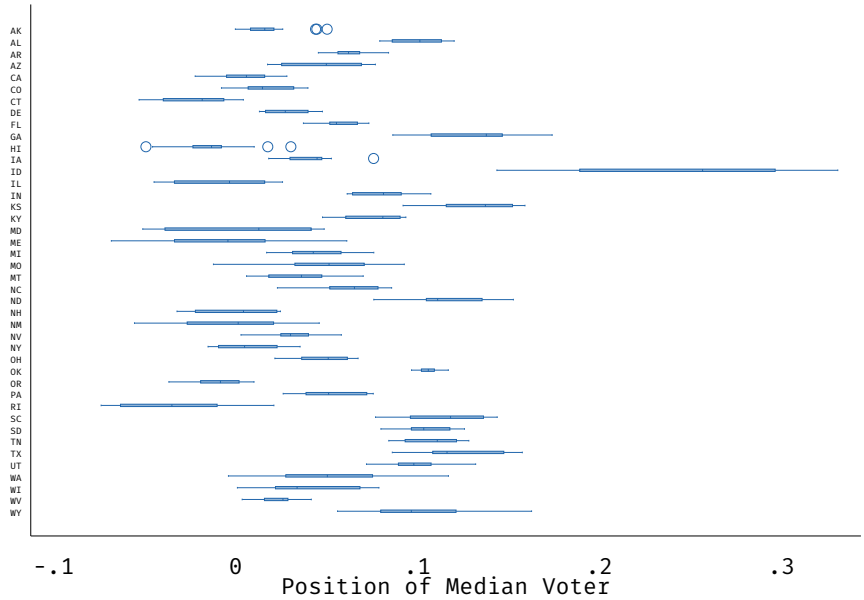
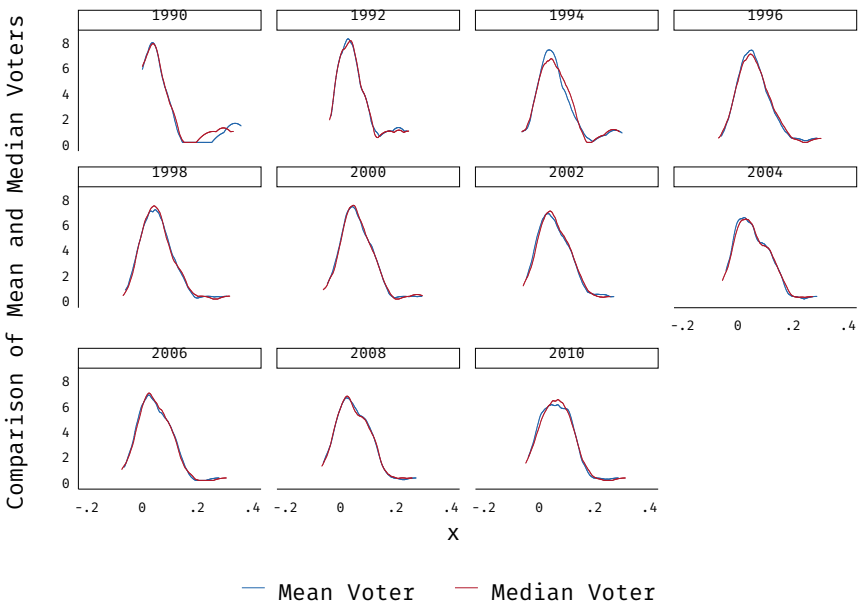
A Appendix

Figure A.1: Distribution of State Median Voters



Each state is represented by a box-plot. The more heavily shaded area represents the inter-quartile range. and the whiskers represent the upper and lower adjacent values. These are the values x_i such that $x_i > 1.5*IQR+X_{75}$ and $x_i < 1.5*IQR+X_{25}$ respectively. Where, x_{75} and x_{25} denote the 75th and 25th percentiles respectively and IQR is the Inter-Quartile Range, $x_{75}-x_{25}$. (see, Tukey (1977)).

Figure A.2: Comparison of Mean and Median Voters



A.1 Proofs of Propositions and Other Results.

Concavity of π_L, π_R in x_L, x_R. W.l.o.g., we consider only π_R. First, from (6), at all points of differentiability

$$\frac{\partial \pi_R}{\partial x_R} = \frac{\partial p}{\partial x_R}(u_R(x_R) + M - u_R(x_L)) + p(x_L, x_R)u_R'(x_R) \tag{21}$$

So, differentiating (21), we get;

$$\frac{\partial^2 \pi_R}{\partial x_R^2} = 2\frac{\partial p}{\partial x_R}u_R'(x_R) + p(x_L, x_R)u_R''(x_R) + \frac{\partial^2 p}{\partial x_R^2}(u_R(x_R) + M - u_R(x_L)) \tag{22}$$

Now, by inspection of (5), plus $u(x) = -x$ when $x > 0$, we can write generally that

$$\frac{\partial p}{\partial x_R} = -(1+\lambda)f(z) < 0$$

where $\lambda = 1$ or $\lambda > 1$, and where $z = u(x_R) + v(x_R; x_S) - u(x_L) - v(x_L; x_S)$. So, from (22), as $u_R'(x_R) > 0$, and also $u_R''(x_R) \leq 0$ from A2, strict concavity follows as long as $\frac{\partial^2 p}{\partial x_R^2} \leq 0$. But differentiating again, and recalling again that $\frac{\partial z}{\partial x_R} = -(1+\lambda)$ from A1,

$$\frac{\partial^2 p}{\partial x_R^2} = -(1+\lambda)^2 f'(z)$$

So, for concavity we just need $f'(z) \geq 0$, which is guaranteed by A2. □

Proof of Lemma 1. (a) To prove uniqueness, let

$$g(x;\lambda) = 0.5u_R'(x) - (1+\lambda)f(0)(u_R(x) + M - u_R(-x)) \tag{23}$$

Then, suppose to the contrary that $g(x;\lambda) = 0$ has two solutions, x^* and $x^{**} > x^*$. Then, as g is differentiable, by the fundamental theorem of calculus,

$$g(x^{**};\lambda) - g(x^*;\lambda) = \int_{x^*}^{x^{**}} g_x(x;\lambda)d\lambda = 0. \tag{24}$$

But, by differentiation of (23):

$$g_x(x;\lambda) = 0.5u_R''(x) - (1+\lambda)f(0)(u_R'(x) + u_R'(-x)) < 0,\ x \in [-1,1] \tag{25}$$

So, $\int_{x^*}^{x^{**}} g_x(x;\lambda)d\lambda < 0$, which contradicts (24).

(b) To prove $x^+ > x^-$, note that from $g(x;\lambda) = 0$,

$$\frac{dx}{d\lambda} = \frac{g_\lambda(x;\lambda)}{-g_x(x;\lambda)} = -\frac{f(0)(u_R(x) + M - u_R(-x))}{-g_x(x;\lambda)} < 0$$

So, as $g(x^-;\lambda)=0, g(x^+;1)=0$, the result follows.

(c) to prove that $x^->0$, note that at $x\le 0, u_R(x)-u_R(-x)\le 0$, so

$$\begin{aligned} g(0;\lambda) &= 0.5u_R'(x)-(1+\lambda)f(0)(u_R(x)+M-u_R(-x)) \\ &\ge 0.5u_R'(x)-(1+\lambda)f(0)M \\ &\ge 0.5u_R'(0)-(1+\lambda)f(0)M \\ &> 0 \end{aligned}$$

where the third inequality follows from concavity of $u_R(.)$, and the last by assumption A3. So, $g(x;\lambda)$ cannot have a negative or zero solution. □

Proof of Proposition 1. (a) Assume a symmetric equilibrium with $x^*\neq|x_S|$. Then starting at this equilibrium, from (5), if $u(x^*)>u(x_S)$, any small change in x_R of Δ generates a change $-\Delta 2f(0)$ in p. Thus, starting at the symmetric equilibrium, the change in π_R is

$$\Delta\pi_R = 0.5u_R'(x^*)\Delta - 2f(0)(u_R(x^*)+M-u_R(-x^*))\Delta$$

So, the symmetric equilibrium x^* must satisfy

$$0.5u_R'(x^*)-2f(0)(u_R(x^*)+M-u_R(-x^*))=0 \tag{26}$$

Because π_R is concave in x_R, by A2, condition (26) is also sufficient for x^* to be the equilibrium. By Lemma 1, (26) has a unique solution $x^*=x^+$. So, this is the equilibrium if $u(x^+)>u(x_S)$ or $x^+<|x_S|$.

(b) Similarly, if $u(x^*)<u(x_S)$, from (5), starting at this equilibrium, any small change in x_R of Δ generates a change $-\Delta(1+\lambda)f(0)$ in p. Thus, starting at the symmetric equilibrium, the change in π_R is

$$\Delta\pi_R = 0.5u_R'(x^*)\Delta - (1+\lambda)f(0)(u_R(x^*)+M-u_R(-x^*))\Delta$$

So, the symmetric equilibrium x^* must satisfy

$$0.5u_R'(x^*)-(1+\lambda)f(0)(u_R(x^*)+M-u_R(-x^*))=0 \tag{27}$$

Because π_R is concave in x_R, by A2, condition (27) is also sufficient for x^* to be the equilibrium. By Lemma 1, (27) has a unique solution $x^*=x^-$. So, this is the equilibrium if $u(x^-)<u(x_S)$ or $x^->|x_S|$.

(c) Now, if $u(x^+)\le u(x_S)\le u(x^-)$, conjecture that the equilibrium is $x_R=-x_L=x_S$. W.l.o.g., to lighten notation, assume that $x_S>0$. Starting at this equilibrium, an increase (decrease) in x_R will decrease (increase) p_R by $(1+\lambda)f(0)$ (resp. $2f(0)$). So, for an

equilibrium we require

$$0.5u_R'(x_S)-(1+\lambda)f(0)(u_R(x_S)+M-u_R(-x_S)) \leq 0 \leq 0.5u_R'(x_S)-2f(0)(u_R(x_S)+M-u_R(-x_S)) \tag{28}$$

Because π_R is concave in x_R, by A2, condition (28) is also sufficient for x_S to be the equilibrium. But, by the definitions of x^+ and x^-, any x_S with $u(x^+) \leq u(x_S) \leq u(x^-)$ or $x^+ \geq |x_S| \geq x^-$ will satisfy (28).

Finally, for $u(x^+) \leq u(x_S) \leq u(x^-)$, suppose that there is some equilibrium $x^* \neq x_S$. If $u(x^*) > u(x_S)$, then it must be that $x^* = x^+$; but this contradicts the assumption that $u(x^+) \leq u(x_S)$. If $u(x^*) < u(x_S)$, then it must be that $x^* = x^-$; but this contradicts the assumption that $u(x^-) \geq u(x_S)$.

(d) Finally, note that from (8), (25) that

$$\frac{dx^-}{d\lambda} = -\frac{f(0)\,(u_R(x^-) - u_L(-x^-) + M)}{-g_x(x^-;\lambda)} \tag{29}$$

Again from (25) , $g_x(x^-;\lambda) < 0$. Also, $u_R(x^-) + M > -u_L(-x^-)$. So, from (29), x^- is decreasing in λ. Moreover, from inspection of (7), x^+ is independent of λ. Thus, the interval $[x^-, x^+]$ is increasing in λ. □

Proof of Proposition 3. (a) In the first period, the R–party maximizes

$$p(x_{L,1}, x_{R,1}; x_S)(u_R(x_{R,1}) + M + \delta V(x_{R,1})) + (1 - p(x_{L,1}, x_{R,1}; x_S))(u_{R,t}(x_{L,1}) + \delta V(x_{L,1})) \tag{30}$$

with respect to $x_{R,1}$. Now, from (10), $V(x_{R,1})$ is differentiable in $x_{R,1}$ except at $\{x^-, x^+\}$. So, moreover, $p(x_{L,1}, x_{R,1}; x_S)$ is differentiable in $x_{R,1}$ except at x_S.

(b) Say that a pair $\tilde{x}^+, \tilde{x}^-$ are *equilibrium cutpoints* if the first period equilibrium has the following structure i.e. if $\tilde{x}^+ < |x_S|$, then $x_{R,1} = -x_{L,1} = \tilde{x}^+$. If $\tilde{x} > |x_S|$, then $x_{R,1} = -x_{L,1} = \tilde{x}^-$. If $\tilde{x}^+ \geq |x_S| \geq \tilde{x}^-$, then $x_{R,1} = -x_{L,1} = |x_S|$. Then, from part (a), as long as V is differentiable at the equilibrium cutpoints, an argument exactly as in the proof of Proposition 1 implies that the first-period equilibrium cutpoints $\tilde{x}^+, \tilde{x}^-$ must solve:

$$0.5u_R'(\tilde{x}^+) - 2f(0)(u_R(\tilde{x}^+) + M - u_R(-\tilde{x}^+) + 0.5V'(\tilde{x}^+) = 0 \tag{31}$$

$$0.5u_R'(\tilde{x}^-) - (1+\lambda)f(0)(u_R(\tilde{x}^-) + M - u_R(-\tilde{x}^-)) + 0.5V'(\tilde{x}^-) = 0 \tag{32}$$

where

$$V'(\tilde{x}^+) = \begin{cases} \frac{\delta}{2}(u_R'(\tilde{x}^+) - u_R'(-\tilde{x}^+)), & x^- < \tilde{x}^+ < x^+ \\ 0 & \text{otherwise} \end{cases} \tag{33}$$

$$V'(\tilde{x}^-) = \begin{cases} \frac{\delta}{2}(u_R'(\tilde{x}^-) - u_R'(-\tilde{x}^-)), & x^- < \tilde{x}^- < x^+ \\ 0 & \text{otherwise} \end{cases} \tag{34}$$

Alternatively, if $V(.)$ is non-differentiable at the cutpoints, i.e. if the cutpoints are x^-, x^+ from (10), V has left- and right hand derivatives:

$$\begin{aligned}
\lim_{x_{R,1}\downarrow x^+} \frac{\partial V}{\partial x_{R,1}}\Big|_{-x_{L,1}=x^+} &= 0 > \lim_{x_{R,1}\uparrow x^+} \frac{\partial V}{\partial x_{R,1}}\Big|_{-x_{L,1}=x^+} = \frac{\delta}{2}(u_R'(x^+) - u_R'(-x^+)) \\
\lim_{x_{R,1}\uparrow x^-} \frac{\partial V}{\partial x_{R,1}}\Big|_{-x_{L,1}=x^-} &= 0 > \lim_{x_{R,1}\downarrow x^-} \frac{\partial V}{\partial x_{R,1}}\Big|_{-x_{L,1}=x^-} = \frac{\delta}{2}(u_R'(x^-) - u_R'(-x^-))
\end{aligned}$$

So the if the cutpoints x^+, x^- are to be equilibrium cutpoints, they must solve the inequalities

$$0.5u_R'(\tilde{x}^+) - 2f(0)(u_R(\tilde{x}^+) + M - u_R(-\tilde{x}^+)) \leq 0 \tag{35}$$

$$\leq 0.5u_R'(\tilde{x}^+) - 2f(0)(u_R(\tilde{x}^+) + M - u_R(-\tilde{x}^+)) + \frac{\delta}{4}(u_R'(x^+) - u_R'(-x^+))$$

$$0.5u_R'(\tilde{x}^-) - (1+\lambda)f(0)(u_R(\tilde{x}^-) + M - u_R(-\tilde{x}^-)) \geq 0 \tag{36}$$

$$\geq 0.5u_R'(\tilde{x}^-) - (1+\lambda)f(0)(u_R(\tilde{x}^-) + M - u_R(-\tilde{x}^-)) + \frac{\delta}{4}(u_R'(x^-) - u_R'(-x^-))$$

These say that a change in either direction away from the cutpoint decreases utility for party R. [Note that a mixed equilibrium is also possible where V is non-differentiable at only one of the cutpoints].

(c) Note from A4 that the last terms in (35), (36) are negative. So, clearly, the inequalities in (35) cannot both be satisfied, and so $\tilde{x}^+ = x^+$ cannot be an equilibrium. However, (36) holds at $x^- = \tilde{x}^-$, so this is a possible equilibrium cutoff. We now show that this is the only equilibrium cutoff x^-. For suppose not i.e. $\tilde{x}^- \neq x^-$. But then, if $\frac{\partial V}{\partial x_{R,1}} = 0$, then from (32), $\tilde{x}^- = x^-$, a contradiction. So, $V' < 0$. But then from (32), $\tilde{x}^- < x^-$, and so from (34), $V' = 0$, again a contradiction.

(d) We show that there is just one equilibrium at $\tilde{x}^+ = \hat{x}^+$. As $x^- < \hat{x}^+ < x^+$, clearly $V' < 0$ at that point, and so any equilibrium cutoff must solve (12). So, $\tilde{x}^- = \hat{x}^+$ must be an equilibrium. Next, assume that there is another equilibrium $x^{+\prime} \neq \hat{x}^+, x^+$. As V is differentiable at $x^{+\prime}$, then $x^{+\prime}$ must be either $\hat{x}^+$ or x^+, contrary to assumption.

(e) To show that $\hat{x}^+$ is decreasing in δ, we totally differentiate (12), and use the fact that the last term in (12) is simply $V'(\tilde{x}^+)$ to get

$$\frac{d\tilde{x}^+}{d\beta} = \frac{0.5\delta V'(\tilde{x}^+)}{-g_x(\tilde{x}^+;\lambda) - 0.5\delta V''(\tilde{x}^+)} \tag{37}$$

where $g_x(x;\lambda)$ is defined in (25). As noted there, $g_x(x;\lambda) < 0$, and moreover, from A4, $V''(x) \leq 0$. So, the denominator in (37) is positive. Finally, from the concavity of $u_L(.)$, $V'(x) < 0$. So, from (37), $\frac{d\tilde{x}^+}{d\beta} < 0$, as required.□

Proof of Proposition 4. (a) Assume $\Delta\mu \leq \Delta\mu_{\min}$. Assume first that R is the incumbent, so that the status quo is x_S. Then, from Proposition 1, if $x_S \in [\Delta\mu + x^-, \Delta\mu + x^+]$, the

equilibrium is $x_R = x_S$, $x_L = -x_S + 2\Delta\mu$. So, we require

$$x_S \in [\Delta\mu + x^-, \Delta\mu + x^+] \Leftrightarrow x_S - x^+ \leq \Delta\mu \leq x_S - x^- \tag{38}$$

But as x_S is an initial equilibrium, from Proposition 1, $x_S \leq x^+$ and so $x_S - x^+ \leq 0$, so $x_S - x^+ \leq \Delta\mu$ always holds. Thus, as $\Delta\mu \leq x_S - x^-$, (38) certainly holds.

Now assume that L is the incumbent, so that the status quo is $-x_S$. Then, from Proposition 1, if $-x_S \in [\Delta\mu - x^+,\ \Delta\mu - x^-]$, the equilibrium is $x_L = x_S$, $x_L = -x_S + 2\Delta\mu$. So, we require

$$x_S \in [\Delta\mu - x^+,\ \Delta\mu - x^-] \Leftrightarrow x^- - x_S \leq \Delta\mu \leq x^+ - x_S \tag{39}$$

But as $-x_S$ is an initial equilibrium, from Proposition 1, $x_S \geq x^+$ and so $x^- - x_S \leq 0$, so $x^- - x_S \leq \Delta\mu$ always holds. Thus, as $\Delta\mu \leq x_S - x^-$, (39) certainly holds.

(b) Now suppose that the shock is large i.e. $\Delta\mu > \Delta\mu_{\max}$. Then, if R won the election, so that the status quo is x_S, from Proposition 1, as $x_S < \Delta\mu + x^-$, the outcome is $x_R = \Delta\mu + x^-$, $x_L = \Delta\mu - x^-$. If L won the election, i.e. is the incumbent, so that the status quo is $-x_S$, then from Proposition 1, as $-x_S < \Delta\mu - x^+$, the outcome is $x_R = \Delta\mu + x^+$, $x_L = \Delta\mu - x^+$.

(c) Now suppose that the shock is intermediate, with $x^+ - x_S < \Delta\mu \leq x_S - x^-$. Then if R won the election, so that the status quo is x_S, by the argument in part (a) of the proof, the outcome is $x_R = x_R = x_S$, $x_L = -x_S + 2\Delta\mu$. On the other hand, if L won the election, so that the status quo is $-x_S$,then by the argument in part (b) of the proof, the outcome is $x_R = \Delta\mu + x^+$, $x_L = \Delta\mu - x^+$.

(d) Now suppose that the shock is intermediate, with $x_S - x^- < \Delta\mu \leq x^+ - x_S$. Then if R won the election, so that the status quo is x_S, by the argument in part (b) of the proof, the outcome is the outcome is $x_R = \Delta\mu + x^-$, $x_L = \Delta\mu - x^-$. On the other hand, if L won the election, so that the status quo is $-x_S$, then by the argument in part (a) of the proof, the outcome is $x_L = x_S$, $x_L = -x_S + 2\Delta\mu$. □

Proof of Proposition 6. From inspection of the results in Proposition (4), the following table can be constructed, where cases (c) and (d) refer to cases in the Proposition, and $I = R, L$ denotes the incumbent:

$\Delta\mu$	I	x_R	x_L	$x_R - x_L - 2x_S$
small	R	x_S	$-x_S + 2\Delta\mu$	$-2\Delta\mu$
small	L	$x_S + 2\Delta\mu$	$-x_S$	$2\Delta\mu$
large	R	$\Delta\mu + x^-$	$\Delta\mu - x^-$	$2(x^- - x_S)$
large	L	$\Delta\mu + x^+$	$\Delta\mu - x^+$	$2(x^+ - x_S)$
case (c)	R	x_S	$-x_S + 2\Delta\mu$	$-2\Delta\mu$
case (c)	L	$\Delta\mu + x^+$	$\Delta\mu - x^+$	$2(x^+ - x_S)$
case (d)	R	$\Delta\mu + x^-$	$\Delta\mu - x^-$	$2(x^- - x_S)$
case (d)	L	$x_S + 2\Delta\mu$	$-x_S$	$2\Delta\mu$

In the case of a small shock, we then see that if R is the incumbent, then $x_R - x_L < 2x_S$, but if R is the incumbent, then $x_R - x_L > 2x_S$. The same is clearly true if the shock is large, as $x^- \leq x_S \leq x^+$. In case (c), we require $-2\Delta\mu \leq 2(x^+ - x_S)$, or $\Delta\mu \geq x_S - x^+$, which is always true, as $x_S \leq x^+$. In case (d), we require $x^- - x_S \leq \Delta\mu$,which is always true, as $x_S \geq x^-$. □

A.2 Equilibrium with a Koszegi-Rabin Reference Point.

We follow Kőszegi and Rabin (2006) in characterizing the voter reference point. From the point of the individual voter, the reference point is stochastic with support (x_L, x_R) and probabilities $1-p$, p. We also assume A1 and A2 throughout, so in particular, $u(x_R) = -|x|$. Also, we assume the following variant of A3 above, which ensures that there is less than full convergence of equilibrium platforms:

A3'. $u_R(0) = -u_L(0) = l'(1) > \frac{(1+\lambda)f(0)}{1+(1+\lambda)f(0)}M$.

(i)The individual voter can choose to vote for party R or party L. We now consider three cases.

Case 1: $u(x_R) > u(x_L)$. Then given the reference point, expected utilities from voting for R, L respectively are

$$\begin{aligned} Eu_R &= pu(x_R) + (1-p)(2u(x_R) - u(x_L)), \\ Eu_L &= p(u(x_L) + \lambda(u(x_L) - u(x_R))) + (1-p)u(x_L) \end{aligned}$$

So, a moderate will vote for R if

$$Eu_R - Eu_L = (2 - p(1-\lambda))(u(x_R) - u(x_L)) \geq \varepsilon$$

So, p is defined by

$$p = F\left((2 - p(1-\lambda))(u(x_R) - u(x_L))\right) \tag{40}$$

Case 2: $u(x_R) < u(x_L)$. Then

$$\begin{aligned} Eu_R &= pu(x_R) + (1-p)(u(x_R) + \lambda(u(x_R) - u(x_L))), \\ Eu_L &= p(2u(x_L) - u(x_R)) + (1-p)u(x_L) \end{aligned}$$

So, a moderate will vote for R if

$$Eu_R - Eu_L = (1 + \lambda - p(\lambda - 1))(u(x_R) - u(x_L)) \geq \varepsilon$$

So, p is defined by

$$p = F\left((1 + \lambda - p(\lambda - 1))(u(x_R) - u(x_L))\right) \tag{41}$$

Case 3. $u(x_R) = u(x_L)$.Then clearly, all gain-loss utility terms disappear, and so a moderate will vote for R if $(u(x_R) - u(x_L)) \geq \varepsilon$. So, in this case, p is defined by

$$p = F((u(x_R) - u(x_L))$$

(ii) Now consider a symmetric equilibrium where $x_R = -x_L = x^* > 0$. From Case 3, in this case, $p = F(0) = 0.5$. It is sufficient to study the behavior of one party, and we choose the R party. So, the effects on R–party welfare of a small increase and decrease in x_R, starting at $x_R = -x_L = x^*$, $p = 0.5$, are

$$\begin{aligned} 0.5u_R'(x^*) + \left(\frac{dp}{dx_R}\right)^+ (u_R(x^*) - u_R(-x^*) + M) &= 0 \\ 0.5u_R'(x^*) + \left(\frac{dp}{dx_R}\right)^- (u_R(x^*) - u_R(-x^*) + M) &= 0 \end{aligned}$$

respectively, where$\left(\frac{dp}{dx_R}\right)^+$, $\left(\frac{dp}{dx_R}\right)^-$ are the right-hand and left-hand derivatives of p w.r.t. x_R at $x_R = -x_L = x^*$, $p = 0.5$. Computing these explicitly from (40), (41), using the fact that $u(x_L) > u(x_R)$ for the right-hand derivative, and vice versa, we get

$$\left(\frac{dp}{dx_R}\right)^+ = \left(\frac{dp}{dx_R}\right)^- = -f(0)\left(1 + \frac{\lambda}{2}\right)$$

So, at equilibrium, the LH and RH derivatives are the same. So, any equilibrium must satisfy

$$g(x^*, \lambda) \equiv 0.5u_R'(x^*) - f(0)\left(1 + \frac{\lambda}{2}\right)(u_R(x^*) - u_R(-x^*) + M) = 0 \tag{42}$$

Following the argument in Lemma 1, given assumptions A1, A2, A3', it is easily established that there exists a unique solution to (42) with $x^* > 0$. Moreover, given A1-A3', $g_x(x^*, \lambda) < 0$,

and by inspection, $g_\lambda(x^*, \lambda) < 0$, so

$$\frac{dx^*}{d\lambda} = -\frac{g_\lambda(x^*, \lambda)}{g_x(x^*, \lambda)} < 0$$

So, there is no policy rigidity, but the policy moderation result continues to hold, as claimed. □