A Behavioral Model of Asymmetric Retrospective Voting

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Abstract

Building on theoretical models of retrospective voting (Alesina and Rosenthal, 1995), and focusing on the principal-agent relationship between voters and politicians (Ferejohn, 1986), the paper proposes a theoretical model that relaxes the commonly made implicit assumption that the effects of positive and negative changes in voters’ (expected) utility are symmetric. Specifically, in line with the literature on prospect theory and the ”negativity bias” in psychology, the model assumes that voters respond more strongly to negative information, e.g. bad economic news, than to positive information. The theoretical model is implemented as an agent-based model, and comparative statics results in terms of (i) selection of quality candidates, and (ii) duration of tenure in office and alternation in government are derived based on Monte Carlo simulations. The results show that while retrospective voting induces higher average levels of government competence, this is conditional on the possibility of retaining high quality types, which in turn is undermined if voters exhibit strongly asymmetric behavior, i.e. fail to punish and reward even-handedly.

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1 Introduction

The recent financial crisis and its aftershocks have not only pushed large parts of the world into recession and cost millions of people their jobs - the aftermath also left incumbent governments crumbling, facing the wrath of their citizens.

The relationship between the state of the economy and the electoral fate of incumbent governments has inspired a large research program in political science. Theoretical models and especially empirical studies of ‘economic voting’ have proliferated since the late 1960s (Nannestad and Paldam 1994, Lewis-Beck and Stegmaier 2000, Hibbs 2006). Their common theme is that voters judge incumbents - at least in part - based on the economic situation. Recessions, high unemployment or spikes in price levels can seal the fate of a previously popular government. Voters are assumed to collectively punish incumbents for bad times and reward them for good times with re-election. This reward and punishment behavior constitutes one possible (minimalist) way in which citizens can hold their leaders accountable (cf. Schumpeter 1942, Barro 1973, Ferejohn 1986, Przeworski 1999 but also Fearon 1999, Anderson 2007).

Research from psychology however also shows that people respond more strongly to losses than to comparable gains (Kahneman and Tversky 1979, Baumeister et al. 2001). In the empirical literature on economic voting it has therefore occasionally been suggested that voters punish more than they reward (Mueller 1970, Bloom and Price 1975, Lau 1982, Claggett 1986, Nannestad and Paldam 1997, 2002).

This paper introduces an agent based model of asymmetric retrospective voting, which - to the best of my knowledge - is the first formal model of retrospective voting to incorporate loss aversion or a negativity bias. Previous theoretical models assume that voters’ response to changes in payoffs or observed incumbent performance is linear and symmetric. This is inconsistent with what psychology, especially prospect theory, tells us about human behavior.

The model therefore relaxes this symmetry assumption. Incorporating negativity bias leads to aggregate level predictions that are prima facie more ‘realistic’ in terms of dynamics and alternation in power, compared to the predictions of previous models. Furthermore, the model produces empirically testable implications: a ‘cost of ruling’ and aggregate-level asymmetry.

2 Theoretical Background

The theoretical literature on retrospective voting provides us with a set of models that describe the principal-agent relationship between voters and politicians and allow us to derive conditions under which voters can hold politicians accountable (Kramer 1971, Nordhaus 1975, Fiorina 1981, Ferejohn 1986, Alesina, Londregan and Rosenthal 1993

While these models differ greatly in their exact implementation of the underlying principal-agent relationship, they all share the assumption of symmetric evaluations. Good performance leads to rewards at the polling booth, bad performance leads to punishment, with voters being even-handed rather than vengeful in their performance evaluations.

At the same time, theoretical and empirical work in psychology and behavioral economics point us in a different direction:

Prospect theory, originally formulated by Kahneman and Tversky (1979), has dramatically changed our understanding of human decision-making. One of the basic tenets of this behavioral model of decision-making under risk is that people systematically differ in their behavior, depending on whether they perceive their choices to be in the domain of gains or in the domain of losses. In short, depending on the location of their reference point, people are more risk-averse (with respect to gains) or more risk-taking (with respect to losses). Furthermore their hypothesized value function is steeper in the domain of losses: In contrast to what expected utility theory would predict, when evaluating choices, we tend to weigh losses heavier than gains of equal size. In other words, “losses loom larger than gains”. Figure 1 displays a hypothetical value function implied by prospect theory

![Figure 1: Value Function implied by Prospect Theory (from Kahneman and Tversky 1979)](image)
This loss aversion resonates with a research program in social psychology on the so-called negativity-bias, or what is sometimes referred to as a “grievance- or valence asymmetry” or the “preferential detection of negative stimuli”, and comprises a body of theoretical claims and compelling evidence for humans’ notoriously lopsided processing of information: We all detect negative stimuli faster (Dijksterhuis and Aarts 2003), pay more attention to negative information (Wason 1959, Fiske 1980, Ito et al 1998) and weigh losses more than gains of equal size (Kahneman and Tversky 1979). In short: ”bad is stronger than good” (Baumeister et al. 2001). The basic effect is easy to understand and presumably deeply rooted in our evolutionary adaptation to an environment in which avoiding a potential threat was more important than a foregone opportunity. When presented with a stimulus of some sort, a sound, a picture, a word, another person, we automatically evaluate whether the stimulus is positive or negative (Bargh et al 1992). Negative stimuli are “stronger” in many respects (Baumeister et al 2001). We tend to detect negative stimuli better than positive stimuli, we devote more attention to negative information, and we are persuaded more easily by bad news than good news (Dijksterhuis and Aarts 2003, Wentura et al. 2000). The empirical support for a broad class of negativity effects is well established, encompassing a range of methods, such as direct behavioral studies, subliminal priming and neurological evidence (Ito et al 1998, Rozin and Royzman 2001, Polls et al 2001, Baumeister et al 2001). The root cause of this behavior can be found in evolutionary psychology. When presented with a stimulus, for example a noise, it can be advantageous to quickly classify the noise into a simple threat/no-threat scheme, which helps avoiding ending up as the main course on a predator’s dinner table or losing a pecking order fight to the moment of surprise. As Dijksterhuis and Aarts (2003) put it: “A quick categorization of stimuli allows for the rapid onset of appropriate behavior (i.e., approach or avoidance).” Digging deep towards the roots of human behavior, McDermott, Fowler and Smirnov (2008) present a model of behavior consistent with what evolutionary biologists call optimal foraging theory and are able to show how prospect theory preferences may be advantageous from an evolutionary perspective.

In sum, the literature in psychology supports the idea that prospect theory type behavior, specifically the observation that “losses loom larger than gains”, is indeed a universal feature of human decision-making, grounded in our evolutionary history.

This paper presents an attempt to modify an existing model of retrospective voting in order to incorporate this well established feature of human decision-making.

Specifically, the paper starts out by implementing an agent-based model that is based on a simplified version of the Ferejohn (1986) model\(^1\). Ferejohn characterizes the interaction between voters and politicians as a principal-agent model in which the government

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\(^1\)Agent based models allow for greater flexibility in modeling decision rules and adaptive behavior compared to analytical models, and are enjoying increasing popularity in political science (cf Taber and Timpone 1996, Fowler and Smirnov 2005, 2007, Bendor et al 2011, Laver and Sergent 2011).
chooses an effort level, and voters, unable to observe the government’s true effort or competence, use a performance based retrospective voting rule. He then derives conditions under which the government will perform in the voters’ interest. The agent-based model presented here implements a modified version of the Ferejohn model. Most importantly, it relaxes the assumption that the effects of positive and negative changes in voters’ utility on their propensity to re-elect the incumbent are symmetric.

In its most general form, retrospective voting models consist of the following setup:

1. Incumbent governments make policy choices or have properties (e.g., types of varying quality) that result in an output of the political system. This output, usually together with some form of exogenous shock, constitutes the policy outcome.

2. Voters observe the outcome associated with the incumbent government and - depending on what decision-making process they use - change their propensity to vote for a given incumbent or an alternative candidate.

Existing models also differ in their assumptions about the relative complexity of the decision-making rules or rationality of the players on both the voter and the candidate side: the spectrum ranges from the oldest, and simplest models of retrospective voting by Kramer (1971), Nordhaus (1975) and Fair (1978), over sanctioning models (Ferejohn 1986) to the competency or “signal-extraction” based “rational retrospective voting” models by Alesina and Rosenthal (1995), and Persson and Tabellini (1990). A contemporary variation may be found in adaptively rational models of retrospective voting, e.g. Bendor, Kumar and Siegel (2010).

The development of explicit models of retrospective voting began with a handful of seminal articles in the 1970s. Gerald Kramer (1971) was the first to write out, and empirically test, a model of how an incumbent government’s track-record with respect to the economy might be related to its vote share. This macro-level relationship between the changing tides of the economy and the vote has remained the core idea in the vast literature on retrospective and “economic” voting. Nordhaus (1975) contributed the idea of a political business cycle, i.e. in order to increase their chances of reelection, governments exploit the voters’ myopia to induce growth artificially via inflation before elections, which is the ‘paid for’ in the post election periods. Fair (1978) provides a generalization of Kramer’s idea and shifts the empirical focus from congressional to presidential elections.

One major achievement of both the Nordhaus (1975) and Fair (1978) articles is that they go beyond the hypothesized macro-level relationship by specifying how to get from individual (micro-level) voter utility functions to a testable statistical model on the macro-level: Voter utility depends crucially on a set of variables capturing the relevant actions of the incumbent during her term in office, the weights associated with these different factors and their lags (discounting) and a “reference level” that needs to be specified. All these factors - incumbent performance, weights and reference levels - are by definition common to all voters, a simplification that will partially be relaxed in the model presented here.
Douglas Hibbs’ excellent review (2006: 568) provides a good summary and explanation of the basic idea and the necessary assumptions.

In a next step, Fiorina’s (1981) book provided a take on retrospective voting as a sanctioning mechanism but focused more on the empirical than the theoretical side. Ferejohn (1986) however takes a closer look at the strategic interaction between politicians and the electorate and sets up a basic principal-agent model, an idea I will return to below.

While the initial articles spawned a massive - almost exclusively empirically oriented - research program into “vote and popularity functions”, the fact that the voters in these classic models don’t behave rationally, i.e. fail to anticipate the politicians’ behavior, rendered the models problematic from the vantage point of many economists after the rational expectations revolution (Lucas 1976, Sargent and Wallace 1975, Nannestad and Paldam 1994).

In a second wave however, Alesina, Londregan and Rosenthal (1993), Alesina and Rosenthal (1995), and Persson and Tabellini (1990) suggested different variations on the retrospective voting theme. They turn away from the sanctioning view, as politicians and voters would anticipate each other’s actions, rendering manipulation impossible. Their model is based on incumbent’s policy choice in an “expectation-augmented Phillips curve”, which is subject to random economic shocks, which in turn are partly a function of incumbent competence. The focus then is on the voters’ problem of extracting the government’s competency signal in a noisy environment. Brief summaries can be found in Hibbs (2006), Alesina, Roubini and Cohen (1997) and Duch and Stevenson (2008). These models constitute the most rigorous and perhaps best-explored class of retrospective voting models, but - being in line with the concept of rational expectations - also put the highest (and perhaps unrealistic) demands on voter’s cognitive capacities.

Dismissing the older sanctioning models solely on the basis of their inconsistency with rational expectations may be desirable from a certain theoretical angle, but seems shortsighted given our knowledge about human behavior and the empirical work that has been accumulated.

The recent economic voting literature (Duch and Stevenson 2008) and models of rational retrospective voting (e.g. Alesina and Rosenthal 1995) have focused predominantly on the selection side, while the question of accountability has been addressed in the empirically oriented political behavior literature - especially with respect to the capacities of the voters - but less so in theoretical models of retrospective voting.

The general idea of treating voters and politicians as a special case of a principal-agent model, as proposed in Ferejohn (1986), provides a good starting point for the development of a behavioral model. Ferejohn provides optimal incumbent and voter strategies in a highly simplified repeated game.

The theoretical model starts from the following premises: There exists an information asymmetry between voters and the politicians in government. Politicians due to choice
or inherent quality, implement policies that affect the voters’ welfare. Voters can (at fixed points) terminate the politician’s tenure/contract, but they cannot easily change the politician’s compensation level. Voters and politicians thus form a special case of a principal agent model. This relationship is additionally characterized by multiple players on both the voter and the politicians’ side and institutional arrangements that constrain the choices of both types of players. Finally, the empirical literature strongly suggest that contracts are renewed contingent on some observable performance criteria.

Given the principal-agent nature of this relationship, voters generally face two types of problems confronting the agent (politician/party) side:

(i) adverse selection, i.e. the question of how to select “types” of politicians with certain desirable characteristics such as competence, honesty or certain policy preferences, while the institutional setup may or may not favor candidates with those characteristics; and

(ii) moral hazard, the incentive of politicians to make policy choices that increase their own utility (however defined) irrespective of their previous voters’ preferences.

The first problem conceptualizes the principal’s problem with respect to the agent as the selection and retention of exogenous quality types, while the second problem concerns the question of how to induce desirable agent behavior, rendering it a choice variable of the agent, e.g. in terms of effort or what policies are implemented.

Practically, this distinction amounts to the treatment of the government player in the agent-based model: the government’s policy choice can either be treated as endogenous and modeled as a strategic choice of a rational (or adaptively-rational, or heuristics-guided) decision-maker; or it can be treated as exogenous, with the government’s type drawn from some distribution.

In order to keep the model as clean and simple as possible, and in line with the more recent literature, the focus of this paper will be on the adverse selection problem conceptualized as the retention of quality candidates.

3 The Model

The model presented here follows Ferejohn’s (1986) seminal contribution but implements a simplified version with adaptive agents. The setup of the model is as follows: There are $P$ parties\(^2\) competing in elections with $N$ voters. Each voter $i$ votes probabilistically using an adaptive rule outlined below. The party that receives the most votes becomes the incumbent government.

Each period, the incumbent government observes a random shock to the system. In the economic voting tradition, this would be the nation’s overall economic performance.

\(^2\)For the simulation results presented here, in order to avoid the question of coalition formation and attribution of responsibility in coalition governments, the number of parties has been limited to two.
Let’s label this random shock \( \theta \), and assume that \( \theta \in \Theta \), where \( \Theta \sim \text{uniform}(0,1) \).

In the next step the incumbent party chooses an action \( \alpha \), which determines the payoff for the incumbent party and the citizens. This can be thought of as either an effort or competence level, and is assumed to be fixed for the party in government, such that \( \alpha_{p,t} = \alpha_{p,t-1} \) if party \( p \) is the incumbent. For the opposition party, a new (potential) competence level is drawn randomly with \( \alpha \in A \), where \( A \sim \text{uniform}(0,1) \).

Since the incumbent party’s action is simply determined by its type, specifying an explicit party utility function is inconsequential in the sense that parties are not engaging in utility maximizing behavior. The effort or competence level is chosen randomly for a new government and fixed until the party is voted out of office. This also means that any eventual higher effort or performance is exclusively a consequence of the elimination of low performance governments by the voters and not a consequence of optimizing or strategic behavior on the part of the incumbent government.

While this assumption could be modified to incorporate other characteristics of the political system such as shirking or other detrimental effects potentially associated with long-term incumbents (and I will return to this question in the discussion), the goal for this paper is to produce a simple model of retrospective voting that focuses on the selection aspect in the principal-agent relationship between voters and politicians. Furthermore, it is easy to imagine that a given incumbent’s quality or competence level is in fact stable.

The random shock and the government’s competence level jointly determine the voters’ payoff for a given time period:

\[
U_{it}(\theta, \alpha) = \theta_t \alpha_{p,G}
\]

The voters cannot observe \( \alpha \) directly, and can therefore not condition their voting decision on actual government competence, but rather have to decide based on observed performance, i.e. \( \theta \alpha \). In order to do so, voters require a benchmark against which to compare observed performance. Existing models usually assume that the underlying distributions from which the random shocks and incumbent quality are drawn, are known to the voters. This assumption makes it easy to derive optimal behavior but also lacks realism. This model does not require the voters to have any outside information about the parameters of the model. They form evaluations based only on observed performance. Performance is - as prospect theory would suggest - evaluated in relation to an internal

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3The distributions of the economic shocks \( \theta \) and party competence levels \( \alpha \) were both normalized to run from 0 to 1, which makes an intuitive interpretation of the induced competence levels and payoffs possible. For reasons of simplicity, a uniform distribution rather than a truncated normal or a more complicated probability function was chosen for the random draws of these parameters. Note that neither party competence levels, nor the reference points converge to one of the boundaries over the simulation runs. Nevertheless, future robustness checks could verify whether assuming different probability distributions has an effect on the results.

4A future extension of this model could explore the effect of varying this assumption, i.e. compare stable against variable competence levels, e.g. by characterizing competence as an autoregressive process and varying the value of the persistence parameter or by treating competence as an adaptive choice process.
reference point \( \tau \) (as in threshold), which is determined endogenously in an adaptive process described below.

If the observed performance \( \theta \alpha \) is greater than the reference point \( \tau \), voters become more likely to vote for the incumbent. If the observed performance is less than the expected performance, voters become less likely to vote for the incumbent. For a detailed introduction of aspiration based adaptive rules, see Bendor et al’s (2011) recent book. In this model, a given voter’s probability of voting for the incumbent government, denoted by \( \pi \), is updated as follows,

\[
\pi_G^t = \begin{cases} 
\pi_G^{t-1} + \lambda \beta \pi_G^{t-1} & \text{if } \theta \alpha \geq \tau \\
\pi_G^{t-1} - \beta \pi_G^{t-1} & \text{if } \theta \alpha < \tau 
\end{cases}
\]

where \( \pi_G^{t-1} \) is last period’s probability of voting for the government party, \( \lambda \) is an asymmetry parameter described in detail below and \( \beta \) is a (fixed) step-size parameter. Note that the denominator above is only introduced to assure that the probabilities of voting for a given party sum to 1. Importantly, the only difference between the updating rules for above and below reference point changes lies in the introduction of the asymmetry parameter, \( \lambda \), which acts as a discount factor for above reference point performance\(^5\).

As we can see, performance can be above or below the reference point \( \tau \). In the symmetric case (\( \lambda = 1 \)), above-expectation performance has the same effect on a voter’s propensity to re-elect the incumbent as below-expectation performance. In the asymmetric case (\( \lambda < 1 \)), below-expectation performance has a stronger effect on voters’ propensity to re-elect the incumbent than above-expectation performance. In the extreme case of (\( \lambda = 0 \)), above-expectation performance has no effect on voters’ propensity to re-elect the incumbent, only worsening conditions induce a behavioral change.

Instead of having a fixed, exogenously determined benchmark level to evaluate performance, voters adjust their reference point dynamically as a weighted-average of last period’s reference point and the deviation of actual performance from expected performance, weighted using a persistence parameter \( \gamma \), which is set at a fixed value for the current model:

\[
\tau_t = (1 - \gamma)\tau_{t-1} + \gamma(\theta \alpha_{t-1})
\]

\(^5\)This functional form, rather than e.g. a multiplier for negative effects, was chosen in order to assure that the parameter space for the asymmetry parameter contains the special cases of symmetric behavior (\( \lambda = 1 \)), the standard assumption and extreme asymmetry, i.e. a zero effect for good news (\( \lambda = 0 \)), and allows for a sweep of the whole parameter space by running simulations with random draws of \( \lambda \) between 0 and 1. There is some evidence in the literature that negative information is weighted about twice as much as positive information (Tversky and Kahneman 1992, Abdellaoui et al. 2007), in this model, this would then correspond to a \( \lambda \) of about 0.5.
Modeling the aspiration adjustment in this form follows Bendor et al (2011). After this step, the votes are cast. Voters vote probabilistically for either the incumbent or the opposition party. The party that obtains a majority of the votes takes office. The (new) opposition party gets a new leadership, i.e. draws a new competence level $\alpha \in A$, and the model starts from the beginning.

Table 1 provides a short stylized outline of the steps of the agent-based model. The complete R code for the model can be found in the appendix.

Table 1: Outline of a single cycle of the asymmetric retrospective voting model

<table>
<thead>
<tr>
<th></th>
<th>Nature draws random shock $\theta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Government party produces overall performance $\theta \alpha$, based on random shock and competence level</td>
</tr>
<tr>
<td>3</td>
<td>Voters receive payoff and adjust propensity to re-elect the incumbent government based on observed performance relative to reference point. Asymmetric evaluations are introduced at this step: Performance can be above or below expectation. In the symmetric case $\lambda = 1$, above-expectation performance has the same effect on re-election propensity as below-expectation performance. In the asymmetric case $\lambda &lt; 1$, below-expectation performance has a stronger effect on voters’ propensity to re-elect the incumbent than above-expectation performance. In the extreme case of $\lambda = 0$, above-expectation performance has no effect on voters’ propensity to re-elect the incumbent, only worsening conditions induce behavioral change.</td>
</tr>
<tr>
<td>4</td>
<td>Voters adjust reference point $\tau$.</td>
</tr>
<tr>
<td>5</td>
<td>Voters vote, majority party takes office.</td>
</tr>
<tr>
<td>6</td>
<td>Opposition party draws new competence level $\alpha$.</td>
</tr>
<tr>
<td>7</td>
<td>Start over.</td>
</tr>
</tbody>
</table>

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6Using a simple weighted-average rule with a single parameter $\gamma$ controlling the degree of persistence to model the aspiration adjustment process follows Bendor et al (2011), who show that it has desirable properties (it is a linear, deterministic, stationary Markov process), and it has been used in other models of endogenous aspiration adjustment (cf Cyert and March 1963, Karandikar et al 1998)
4 Simulation Results

In order to investigate the behavior of the model and its predictions, a large number of simulations were conducted. Typically, for each individual simulation run, the electorate consisted of 1001 voters (to avoid ties) and the election cycle outlined above was run for 1000 time periods, for a total of 1 million simulated elections. In general, the model generates a sequence of elections with results that mirror what can be observed in the real world. The voters vote for different parties, change their vote choice in response to economic shocks, and parties alternate in power. Figure 2 shows a typical simulation run with $\lambda=0.5$, i.e. negative changes being twice as strong as positive changes.

![Figure 2: Party Vote Shares in a Typical Simulation Run](image)

This pattern of changing political fortunes and alternation in government is reassuring from a face validity perspective. The model does not produce degenerate predictions, e.g. one party staying in office indefinitely. Additional simulations with a length of 100,000 election periods were conducted to ensure that the process does not in fact settle to some final static state. At times, high quality incumbents get re-elected a large number of times, but only until a combination of high expectations on the part of the electorate and bad economic times lead to electoral losses removing them from office. After this first look, let’s turn to a more thorough analysis of the model’s predictions. Table 2 provides an overview of the parameter values for the simulation.
Table 2: Simulation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Simulations</td>
<td>1000</td>
</tr>
<tr>
<td>Asymmetry Parameter ($\lambda$)</td>
<td>$\sim$ uniform(0,1)</td>
</tr>
<tr>
<td>Elections per Simulation ($T$)</td>
<td>1000</td>
</tr>
<tr>
<td>Number of Voters ($N$)</td>
<td>1001</td>
</tr>
<tr>
<td>Parties ($P$)</td>
<td>2</td>
</tr>
<tr>
<td>Economic Shock ($\theta_t$)</td>
<td>$\sim$ uniform(0,1)</td>
</tr>
<tr>
<td>Challenger Competence ($\alpha$)</td>
<td>$\sim$ uniform(0,1)</td>
</tr>
<tr>
<td>Adjustment Parameter ($\beta$)</td>
<td>0.5</td>
</tr>
<tr>
<td>Adjustment Parameter ($\gamma$)</td>
<td>0.1</td>
</tr>
</tbody>
</table>

1000 simulations with $0 \leq \lambda \leq 1$ fixed for that simulation run. An additional number of simulations was conducted with $\lambda=0$, $\lambda=0.5$ and $\lambda=1$ to further explore these special cases.

4.1 Retrospective Voting and Accountability

The first and obvious question of course is: Does retrospective voting lead to better governments? Is the simple adaptive voting rule sufficient to select and retain high quality types? Recall that the party competence levels $\alpha$ are drawn randomly from a (0,1) uniform distribution. If the retrospective voting rule described above does not actually lead to better performing governments, then - in expectation - the average government competence level should be 0.5, since $E[A]=0.5$.

The simulation results show that the average government quality markedly exceeds this minimum benchmark. In the symmetric case, i.e. over 100 simulation runs with $\lambda=1$, the average government quality is $\alpha=0.75$ (s.d. = 0.19), which is significantly ($p < 0.01$) higher than the expected value of government quality if the voting rule had no effect. The same holds true for the asymmetric case and all possible values of $\lambda$. See Table 3 below for more detailed results. The presence of a simple retrospective voting rule leads to government competence levels that are higher than what could be expected due to chance.

Why is this the case? While $\alpha$ is not the only factor determining incumbent reelection, it does affect a government’s chances. Higher quality governments are more likely to produce higher performance, and will thus be retained longer, while low quality governments - if elected - are eliminated more rapidly.

4.2 Introducing Negativity Bias

The main focus of this paper is on the effects of introducing negativity bias. Prospect theory suggests that utility is evaluated in relation to a reference point and that below reference point values (losses) are weighted more heavily than gains. Consequently, in
the asymmetric retrospective voting model, an individual, endogenous, dynamic reference point \( \tau \) is introduced and voters evaluate government performance against this yardstick. Losses \( (u_t(\theta, \alpha) < \tau) \) are weighted heavier than gains \( (u_t(\theta, \alpha) \geq \tau) \) by discounting gains with the asymmetry parameter \( \lambda \). In order to investigate the consequences of asymmetric evaluations, for each of the Monte Carlo simulations, a different asymmetry parameter \( \lambda \) was drawn at random from a \( \sim \) uniform(0,1) distribution. By varying \( \lambda \) in this way, we can determine what the consequences of different degrees of negativity bias are; ranging from the special case of symmetric evaluations \( (\lambda = 1) \) over intermediate levels (e.g. \( \lambda = 0.5 \), meaning losses having twice the value of positive news), to the special case of complete discounting of gains, i.e. no change in vote propensities following gains.

What are the consequences of introducing negativity bias into the individual voter decision making process? Three predictions about aggregate level effects can be derived from the model, two of which will be tested in the following empirical papers. The first is that an aggregate level asymmetry in response to shocks arises from individual level negativity bias. The second model prediction is the existence of what has been called a “cost of ruling”, i.e. the erosion of incumbent support over time. The third concerns the relationship between asymmetric evaluations, alternation in power and the selection of high quality types. The following three sections present these results in more detail.

4.3 Asymmetric Response in the Aggregate

Negativity bias in individual level evaluations leads to an aggregate level asymmetry: changes in performance have an asymmetric effect on incumbent party vote share. The easiest way to see this is by plotting the change in incumbent party vote share against the change in economic performance. Figure 3 shows this for one typical simulation run with 1000 elections and a moderate level of negativity bias \( (\lambda = 0.5) \).

The model produces the classic expected relationship between change in economic performance and incumbent vote share, but the response of the electorate is asymmetric. Negative changes are punished more severely than positive changes are rewarded. Incumbents clearly lose when conditions deteriorate, but may not profit from improvements. This prediction of an aggregate level asymmetry in response to changes in economic conditions leads to the main hypothesis to be tested in a subsequent empirical investigation:

**Asymmetry Hypothesis:** Negative (below reference point) changes in economic conditions have a stronger effect on incumbent vote shares in elections (and governmental approval in polls) than positive (above reference point) changes.
4.4 Cost of Ruling

The second prediction that can be derived from the model is the existence of what Nannestad and Paldam (2000) have called the “cost of ruling”: the empirical regularity that on average, incumbent governments lose votes over time.

If voters were even-handed in their assessments of incumbent performance, one would not expect a systematic decline in incumbent vote shares. The model reflects this. In simulations with symmetric evaluations ($\lambda = 1$), the average change in incumbent party vote share is zero. However, as evaluations become more asymmetric, the incumbent party’s average vote share declines up to the point of having to expect an electoral loss of almost 5% in the extreme asymmetry condition ($\lambda = 0$). Table 3 below lists the average cost of ruling for varying levels of asymmetric evaluations. The more biased evaluations become, the higher the cost of ruling. Figure 4 displays the average cost of ruling as a function of the degree of asymmetry ($1 - \lambda$) for all simulation runs.
For even-handed or only slightly biased evaluations, the cost of ruling is essentially zero, but as negativity bias increases, the cost of ruling increases dramatically. An electorate that punishes more than it rewards, will produce incumbents who can expect to lose power quickly.

4.5 Asymmetry, Alternation and Government Quality

The third nexus of results that can be derived from the model concerns alternation in power and average government quality. How often does the party in office change? This question is of course directly linked to the cost of ruling discussed above, since predicting average losses for the incumbent translates into opportunities for the opposition and thus faster turnover.

If evaluations are symmetric, meaning that voters both punish and reward incumbent governments, the incumbent’s ex-ante probability of re-election can reach very high levels. A high quality incumbent facing an even-handed electorate can remain in power for a long
time. As a consequence, over all simulations, we see fewer alternations in government. In
the special case of no negativity bias, the political process can become very static, with
an incumbent being re-elected (almost) indefinitely.

As asymmetry increases - meaning voters pay more and more attention to losses - the
reward aspect of the retrospective voting rule becomes less influential. While voters keep
punishing governments for decreases in utility, there is no possibility to reward and retain
high quality incumbents. As a consequence, as the asymmetry parameter increases, the
number of alternations in power increases.

In the most extreme case of $\lambda = 0$, the political process becomes very volatile. Incum-
bents stand little chance to stay in power for more than a few election periods. There is
no reward for good performance, and at the slightest sign of problems, the electorate will
dispose of the government.

Table 3 shows the proportion of times in which the incumbent stayed the same, or in
other words, an incumbent’s ex-ante probability of re-election for a given degree of asym-
metry. As asymmetry increases, the rate of alternation goes up, meaning the probability
of re-election goes down.

<table>
<thead>
<tr>
<th>Asymmetry $\lambda$</th>
<th>Quality $\bar{\alpha}$</th>
<th>Var.in Quality $SD_{\alpha}$</th>
<th>Worse than chance %</th>
<th>Re-election Probability</th>
<th>Cost of Ruling</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.746</td>
<td>0.032</td>
<td>0.144</td>
<td>0.995</td>
<td>0.00</td>
</tr>
<tr>
<td>0.9</td>
<td>0.746</td>
<td>0.036</td>
<td>0.130</td>
<td>0.995</td>
<td>-0.02</td>
</tr>
<tr>
<td>0.8</td>
<td>0.702</td>
<td>0.042</td>
<td>0.181</td>
<td>0.994</td>
<td>-0.03</td>
</tr>
<tr>
<td>0.7</td>
<td>0.694</td>
<td>0.057</td>
<td>0.188</td>
<td>0.993</td>
<td>-0.04</td>
</tr>
<tr>
<td>0.6</td>
<td>0.672</td>
<td>0.103</td>
<td>0.150</td>
<td>0.985</td>
<td>-0.15</td>
</tr>
<tr>
<td>0.5</td>
<td>0.679</td>
<td>0.177</td>
<td>0.063</td>
<td>0.956</td>
<td>-0.56</td>
</tr>
<tr>
<td>0.4</td>
<td>0.654</td>
<td>0.228</td>
<td>0</td>
<td>0.885</td>
<td>-1.56</td>
</tr>
<tr>
<td>0.3</td>
<td>0.640</td>
<td>0.239</td>
<td>0</td>
<td>0.826</td>
<td>-2.44</td>
</tr>
<tr>
<td>0.2</td>
<td>0.625</td>
<td>0.250</td>
<td>0</td>
<td>0.766</td>
<td>-3.40</td>
</tr>
<tr>
<td>0.1</td>
<td>0.613</td>
<td>0.254</td>
<td>0</td>
<td>0.706</td>
<td>-4.42</td>
</tr>
<tr>
<td>0</td>
<td>0.605</td>
<td>0.257</td>
<td>0</td>
<td>0.674</td>
<td>-4.92</td>
</tr>
</tbody>
</table>

Results are based on 1000 simulation runs with 1000 elections each while varying Asymmetry
$(1 - \lambda)$. Quality is the average (over all simulations) of the mean government quality ($\bar{\alpha}$).
Variability is the average of the standard deviation of government quality. The % worse than
chance column indicates the proportion of simulation runs in which the average government
quality was below what would be expected if governments were drawn randomly. The prob-
ability of re-election is the proportion of cases in which the incumbent was re-elected. And
finally, the "cost of ruling" is the average percentage loss in vote share an incumbent party
incurs.

The failure to retain high quality incumbents as asymmetry increases, of course also
has implications for the average government competence, or to put it differently, for the
average utility voters can expect at a given level of asymmetry.

We established earlier, that the presence of the simple retrospective voting rule leads to government competence levels that are markedly higher than what one would expect due to chance. While the first selection is essentially random, i.e. there is no screening or signaling in the model, accountability is achieved by retaining high quality types and dismissing low quality types.

The average government quality is however strongly affected by asymmetry. As mentioned before, in the symmetric case and for very low levels of negativity bias, high quality incumbents can expect to be re-elected for relatively long periods of time. Voters benefit from these long spells of high competence incumbents. The simulation results show that in the symmetric case, the average government quality is $\alpha=0.75$.

As asymmetry increases however, the process becomes more volatile and voters are unable to retain even high-quality types for extended periods of time. If randomly occurring bad economic times lead to an almost mechanical dismissal of the incumbent government at the earliest occasion, then voters are doomed to frequently replace unlucky but high quality incumbents with low quality challengers.

As a consequence, as negativity bias increases, average government quality decreases. Figure 5 shows the distributions of average government quality over the simulation runs with symmetric evaluations, moderate asymmetry and extreme negativity bias. Average government quality levels for intermediate degrees of asymmetry can also be found in Table 3.

The box-plots also reveal another facet of the relationship between asymmetry and average government quality. While symmetric evaluations yield the highest government competence levels on average, they also come with the largest variance in government competence. The same successful retention mechanism that benefits voters in the case of good types, can also lead to vastly inferior outcomes by failing to dispose of mediocre incumbents. In a non-negligible number of simulation runs, the adaptive retrospective voting mechanism actually performs worse than if government’s were chosen randomly each round. An unlucky combination of a few positive shocks for low quality types and gradually lowered expectations by the electorate can mean ‘getting stuck’ with a low quality government for extended periods of time. Extreme asymmetry on the other hand yields lower average government competence levels due to the inability to retain high quality types in the long-run, but being hypercritical also makes it nearly impossible to get stuck with low quality types for more than one election period. The model here suggests that voters might face a trade-off between higher average yield and risk. A question that may warrant further investigation. Table 3 shows - for different values of $\lambda$ - the average and standard deviation of government quality, as well as the proportion of runs (consisting of 1000 election periods each) in which voters did worse than chance.
5 Discussion

This paper proposed a model of retrospective voting that allows for asymmetric responses to positive and negative changes in utility relative to a reference point. The model, based on a variation of the principal-agent mechanism introduced by Ferejohn (1986), was implemented as an agent-based model and a large number of simulated elections were conducted to analyze the predictions of the model. Several results can be derived based on the simulations.

Firstly, the simplified retrospective voting mechanism is sufficient to induce average levels of government quality that markedly exceed a minimum benchmark. In other words, introducing an accountability mechanism - no matter how imperfect - leads to better governments.

Secondly, introducing negativity bias in individual voter evaluations leads to an aggregate level asymmetry; below-expectation performance has a stronger effect on the incumbent vote share than performance that exceeds expectations.

Thirdly, the model predicts that on average, incumbents face a decline in vote share over their time in office. This theoretical prediction corresponds to the well-known em-
pirical regularity of a “cost of ruling” that can be tested using cross-national election data.

Finally, the degree of asymmetry affects the frequency of alternation in power. As the negativity bias in evaluations increases, the likelihood of incumbents staying in office decreases. In the most extreme case, governments alternate very frequently. On the other end of the spectrum, symmetric evaluations lead to very few alternations in power. As a consequence, there is also a direct relationship between the frequency of alternation in power and government quality. As the degree of asymmetry and therefore the frequency of alternation increases, government quality decreases. Voters are unable to retain quality incumbents. However, as the degree of asymmetry and therefore the frequency of alternation increases, the variance of government quality decreases. Strong negativity bias means high frequency of alternation and no retention of high quality types, but makes it also less likely to “get stuck” with a low quality incumbent. This set of results may warrant future empirical investigations into the relationship between negativity bias, alternation in power and government quality.

While the model generates some interesting predictions, it is also important to consider its limitations. The model simplifies the Ferejohn (1986) model even further and changes the focus from the moral hazard to the selection aspect of the principal agent relationship between voters and candidates. While the behavior of the model mirrors real political systems and generates useful predictions, it of course paints a radically simplified picture of the political process. Voters care only about one issue (the economy) and have shared preferences, making this essentially a valence issue. There are no trade-offs and parties are characterized only by their type, differing in quality but devoid of any other characteristics. In future modeling efforts, it would be interesting to combine the present principal agent model with the aspects of more traditional, e.g. Downsian models of party competition and explore the interaction of quality candidate selection and retention on the one hand and divergent voter preferences in a policy space on the other hand. The model also deviates from both the rational expectations paradigm and classic rational choice assumptions about voter behavior. Expectations are formed in a simple adaptive process and voters are not forward looking and optimizing, but rather retrospective and adaptive, and they exhibit systematic deviations from the standard rational choice model in the form of loss aversion or negativity bias.

These modeling choices are conscious and a best effort to strike a balance between simplicity and realism. Future research could however further explore the parameter space of potential decision rules for all actors. The basic structure of the political process is known, and formal modelers should investigate the implications of varying decision-making mechanisms across the spectrum between a lower bound of random behavior and an upper bound of fully informed, forward-looking, optimizing agents.

Another interesting avenue for future research would be to introduce heterogeneous
agents, i.e. parts of the electorate being myopic nature-of-the-times voters and others more closely resembling the normative ideal of the rational economic man.

In sum, the simple asymmetric retrospective voting model introduced here starts with more realistic assumptions about voter behavior. The limiting symmetry assumption that is common to all retrospective voting models is relaxed and voter’s subjective reference points, a necessary condition for decision-making in line with prospect theory, are formed adaptively - and are therefore endogenous to the model. The simulation runs produce sequences of elections that mirror real political systems in terms of dynamics, vote shares and alternation in office and generates testable empirical implications.
References


H. Clarke & M. Lebo (2003), 'Fractional (co) integration and governing party support in Britain', *British Journal of Political Science* 33(2), 283--301.


C. Taber & R. Timpone (1996), Computational modeling, Sage


R Code for the Asymmetric Retrospective Voting Model

R Code for the Asymmetric Retrospective Voting Model

### MONTE CARLO SIMULATION - Setup

R=1000 ## Number of Monte Carlo Runs
mc_data=array(0,dim=c(R,17)) ## Monte Carlo Data Set, obs= run
## 1: asymmetry parameter
## 2: mean voter utility
## 3: mean party utility

for (r in 1:R) { ## MONTE CARLO LOOP
lambda=runif(1)
voteadjstep=runif(1)
aspadjstep=runif(1)

### THE MODEL

N=1001 # N voters
T=1000 # T time points
P=2 # P parties
partylist=1:P

storage=3+P
pop=array(0,dim=c(N,storage)) # VOTER VARIABLES:
# 1 utility,
# 2 aspiration level,
# 3 party choice,
# 3+1 to 3+P: vote propensities per Party

party=array(0,dim=c(P,5)) # PARTY VARIABLES:
# 1 utility, 2 alpha (effort level),
# 3 vote share

data_s=array(0,dim=c(T,P)) # DATASET:
# first dimension: Time(t=0 to t=T)
# 1 first party share
# 2 second party share
# .. up to P-th party share

data_a=array(0,dim=c(T,P)) # DATASET:
# first dimension: Time(t=0 to t=T)
# 1 first party alpha  
# 2 second party alpha  
# 3 P-th party alpha

data_g=array(0,dim=c(T,4)) # DATASET:  
# government  
# inc vote share  
# change in inc vote share

data_theta=array(0,dim=c(T,1)) # DATASET:  
# theta

data_u=array(0,dim=c(T,2)) # DATASET:  
# first dimension: Time(t=0 to t=T)  
# 1 average voter utility  
# 2 gov party utility

theta=runif(1) # random shock  
party[1:P,2]=runif(P) # initial party alpha level (party in gov effort level)

pop[1:N, 2]=(runif(N)) # initial aspiration level ~Uniform[0,1] for each voter  
pop[1:N, 4:storage]=1/P # initial vote propensity for each party strictly 1/P  
#voteadjstep=.5 # vote propensity adjustment stepsize if not drawn  
#aspadjstep=.1 # aspiration adjustment stepsize if not drawn

gov=1 # set first party to be in gov

### Time Loop

for (t in 1:T) {  
## time loop

theta=runif(1) # economic shock
alpha=party[gov,2] # setting government effort level

party[gov,1]=1-alpha # government party gets income
pop[1:N,1]=alpha*theta # voters get income

### write theta and utilities to data
data_theta[t,1]=theta
data_u[t,2]=party[gov,1]
data_u[t,1]=alpha*theta

### write party effort level a to data
data_a[t,1:P]=party[1:P,2]
### write government party to data
\[ data_g[t,1]=gov \]
\[ data_g[t,2]=alpha \]

### voters update vote propensity:
for (i in 1:N) {
# if performance BELOW aspiration
if (pop[i, 1]<pop[i,2]) {
  proprop=pop[i,(3+gov)]
  # store old Pr(vote=gov)
  pop[i,(3+gov)]=proprop-(voteadjust*proprop)
  # adjust Pr(vote=gov) by step size
  pop[i,4:(3+P)]=pop[i,4:(3+P)]/sum(pop[i,4:(3+P)])
  # set all Pr(vote=i) = Pr(vote=i)/SUM_i[Pr(vote=i)] to preserve SUM=1
}

# if performance HIGHER than aspiration
if (pop[i, 1]>pop[i,2]) {
  proprop=pop[i,(3+gov)]
  pop[i,(3+gov)]=proprop+(lambda*voteadjust*proprop)
  pop[i,4:(3+P)]=pop[i,4:(3+P)]/sum(pop[i,4:(3+P)])
}

### voter update aspiration

### voters make party choice
for (i in 1:N) {
  pop[i,3]=max.col(t(rmultinom(1, size=1, prob=c(pop[i,4:(3+P)]))))
  # probabilistic voting
  #pop[i,3]=which.max(pop[i,4:(3+P)])
  # deterministic voting
}

### parties calculate their vote share
for (p in 1:P) {
}

### incumbent vote share:
\[ data_g[t,3]=party[gov,3] \]
# inc vote share
if (t>1) {data_g[t,4]=party[gov,3]-data_s[t-1,gov]} # change in inc vote share

### party with most votes is next government
gov=which.max(party[,3])
### gov party updates effort level. (perhaps if re-elected, lower effort)
party[-gov,2]=runif(1)  # all BUT the gov parties draw new alpha
party[1:P,2]=runif(P)    # all parties draw new alpha
party[gov,2]=alpha/2    # gov party sets alpha=alpha/2

####### DATASETS #######

#### write vote shares to data
data_s[t,1:P]=party[1:P,3]

} ## end of time loop

mc_data[r,1]=lambda  # Lambda
mc_data[r,2]=mean(data_theta[,1])  # Theta(mean)
mc_data[r,3]=sd(data_theta[,1])    # Theta(sd)
mc_data[r,4]=mean(data_u[,1])     # mean(_U_i_)
mc_data[r,5]=sd(data_u[,1])       # sd(_U_i_)
mc_data[r,6]=mean(data_u[,2])     # mean(_U_pgov)
mc_data[r,7]=sd(data_u[,2])       # sd(_U_pgov)
mc_data[r,8]=mean(data_s[,1])     # mean(party1share)
mc_data[r,9]=sd(data_s[,1])       # sd(party1share)
mc_data[r,10]=mean(data_g[,1])    # mean(party in gov)
mc_data[r,11]=mean(data_g[,2])    # mean(ALPHAgov)
mc_data[r,12]=sd(data_g[,2])      # sd(ALPHAgov)

alt=array(0,dim=c(T,2))    # calculating no of alternations
alt[,1]=data_g[,1]
for (i in 2:T) {
  if (alt[i,1]!=alt[i-1,1]) alt[i,2]=1
}
mc_data[r,13]=sum(alt[,2])  # Alternations
mc_data[r,14]=voteadjstep   # votestep
mc_data[r,15]=aspadjstep    # aspirationstep

mc_data[r,16]=mean(data_g[1:T,3])  # mean incumbent vote share
mc_data[r,17]=mean(data_g[1:T,4])  # mean change in incumbent vote share

cat(paste("Iteration ":r," ",date()," \n"))
flush.console()

} ## END of MONTE CARLO LOOP

write(mc_data, file = "rk_mc_data5.txt", ncolumns = R)

# END