Testing Epistemic Democracy's Claims for Majority Rule

Abstract

While epistemic democrats have claimed that majority rule recruits the wisdom of the crowds to identify correct answers to political problems, the conjecture remains theoretical. This paper illustrates how majority rule leverages the epistemic capacity of the electorate to practically enhance the instrumental value of elections. To do so we identify a set of sufficient conditions that effect such a majority rule mechanism, even when the decision in question is multidimensional. We then look to the case of sociotropic economic voting in U.S. presidential elections to provide empirical support for the tractability of these conditions. We find that absent such an epistemic capacity, as many as eight presidential elections since 1980 might well have been decided differently. By generating clear conditions for the plausibility of claims made by epistemic democrats, and demonstrating their correspondence to empirical data, this paper strengthens the broader instrumental grounds recommending democracy.

Keywords. Democratic theory, epistemic democracy, majority rule, economic voting, plausibility analysis, Condorcet Jury Theorem

1 Introduction

Democratic theory's epistemic turn ought to be exciting for political scientists and political philosophers alike. Beyond the standard endorsements of democracy on procedural, outcome independent grounds, epistemic democracy offers insight into how and why democracy succeeds at getting things "right." Borrowing from Goldman (1999), we'll refer to these sorts of cases as *veritistic* since they get at the truth. In this way, democratic decision making can be recommended not only for fostering autonomy and fairness, but also on these instrumental grounds. Epistemic democrats have pointed toward what we will refer to broadly as *majority rule results*, such as the Condorcet Jury Theorem (CJT) and the Miracle of Aggregation (MA), in order to argue that democracy has a tendency to select the correct candidate or proposal in an election (Landemore (2013); Surowiecki (2004); List and Goodin (2001)). Since free and fair elections have become democracy's sine qua non, these majority rule results provide good grounds for recommending democracy more broadly.

A nagging worry remains that beyond aggregating beliefs, votes also tally people's divergent values. The examples epistemic democrats frequently use are cases where the correctness criteria are uncontested, such as a guilty verdict or an ox's weight. Political disagreements, however, are commonly understood as disputes of value rather than of fact. Critics argue that the machinery of epistemic democracy cannot plausibly endorse electoral outcomes since issues such as gun control, abortion, and civil rights all lack a clear right answer (Anderson (2006); Ingham (2012); Urbinati (2014)).

In this paper we respond to such skepticism and argue that, under certain conditions, democratic elections can be considered veritistic contests, adjudicating which empirical reality obtains, while bracketing the dimensions of value disagreement. The thinking is like this: voters are either better or worse than random at assessing the facts of the matter.[1] Were voters epistemically biased against the candidates that advanced their commitments, the institution would systematically produce 'unwanted effects,' where a voter would be *less* likely to obtain her preferred outcome by voting for it. We provide a set of conditions under which voter competence—even on a single dimension of one's decision function—will stifle such unwanted effects.

[1] The probability that voters' judgements are exactly random is zero.

Since the claim is instrumental in kind—democracy is good in virtue of the outcomes it produces—it is still necessary to demonstrate that the process yields the stipulated outcome, as a matter of fact. Previous treatments of majority rule results don't provide sufficient evidence to support their empirical relevance (Schwartzberg (2015)). And though there are issues on which we imagine consensus exists, such as public health or the competence of political officials (e.g. Page (2007): 256-7; Landemore (2013): 145), there has been no move to identify empirical cases that meet the conditions of majority rule results. By going beyond the formal results to provide an empirical case that tracks the conjectures of epistemic democrats, this paper both makes good on admonishments to demonstrate the plausibility of normative theory (e.g. Rehfeld (2010), Wiens (2015)), while also pointing to the broader purchase of arguments made by epistemic democrats to recommend democracy.

Our plan for this paper is to first explain how majority rule yields veritistic outcomes on a single dimension of a decision function, independent of other contested components. In general, no one issue will determine an election's outcome, regardless of the number of voters, their competence, or the extent of their agreement. Nor do the data allow us to parcel out the credence an individual voter has in some dimension of their decision function from the weight that they assign that dimension. However, insofar as voters agree on the desirability of a particular outcome—though they may disagree on the means to achieve it—a candidate's superiority on that issue increases her chances of winning the election. As such, we demonstrate how democracy can be thought to stifle unwanted effects. We specify three jointly sufficient conditions under which this property holds. Our majority rule result shares core probabilistic commitments with CJT and MA, albeit with slightly stricter assumptions. These strictures allow us to move beyond unidimensional decisions and consider multidimensional cases that better fit empirical data.[2]

Next, we turn to the case of sociotropic economic voting in U.S. presidential elections to illustrate the empirical efficacy of the majority rule result. That voters by and large want economic growth provides a ready case where a decisive majority of voters agree on some value, leaving that facts to be contested. Our empirical analysis here builds on a trove of both theoretical and empirical evidence for the economic voting model (Duch and Stevenson (2008), Lewis et al. (2009)). Beyond their personal economic well-being, voters select the U.S. president with an eye to recent economic trends. We recruit these findings in

[2]While we formally compare the our result to CJT in section 6.2, we are not merely rearticulating it. The majority rule result requiring agents with accuracy ≥ 0.5.

the service of our point here: that given the electorate's preference for economic growth, their epistemic capacities advantage the better candidate.

This serves as an empirical example of the epistemic quality of the majority rule result. Here, insofar as people substantively agree on a particular value (economic growth), and are in a position to judge that fact (whether the economy has grown), the election can be thought to be biased in favor of the "better" candidate—the one voters themselves would have chosen given full information. Though this effect needn't be decisive, we estimate that the magnitude of the effect is sufficient to have affected the outcome of between three and eight presidential elections since 1980. The formal proof of our result and technical discussion of the models are reserved for the appendix.

2 Evaluating Democracy's Truth-Tending Properties

While there are many instances where it is difficult to determine what a community should do or which values it ought to endorse, cases of broad normative agreement leave only the facts of the matter to be contested. Consider a multidimensional decision illustrated by voters' choices in the 2012 U.S. Presidential election. Along one dimension Alice and Bernice fundamentally disagree about the access women ought to have to abortions. On account of Alice's pro-life values, she is inclined to vote for Mitt Romney. Bernice, on the other hand, is pro-choice and feels strongly that President Obama should be reelected. Along another dimension, however, both Alice and Bernice agree that the government should maximize the number of Americans carrying health insurance. Given that they both endorse this same value, cashed out using the same metric, their disagreement can be construed as partly factual in kind (Page (2007): 258)—which candidate will in fact lead more Americans to be insured? If Alice and Bernice are each better than random at determining the fact of the matter, we then have reason to think that the candidate more adept at implementing healthcare policy has his chances of winning boosted. Holding their disagreement about abortion constant, a candidate's fitness on the second dimension enhances his electability.

Modeling votes in a two party majoritarian election as binary random variables allows us to formally establish the link between voters' normative agreement on some element in the decision space and electoral outcomes. Assumption one instrumentalizes voters' agreement on the issue:

Assumption 1. *Every voter is at least as—and some more—likely as otherwise to select a candidate if she believes that the candidate is superior to her rival on*

Scenario			
A		B	
Wins	Loses	Wins	Loses
$p_{12} = .3$	$p_1 = 0$	$p_{12} = 0$	$p_1 = 0$
$p_{13} = .3$	$p_2 = 0$	$p_{13} = 0$	$p_2 = 0$
$p_{23} = .3$	$p_3 = 0$	$p_{23} = 0$	$p_3 = 0$
$p_{123} = 0$	$p_\varnothing = .1$	$p_{123} = .8$	$p_\varnothing = .2$
$Pr(Vote) = .6$		$Pr(Vote) = .8$	
$\mathbb{E}[\#Votes] = 1.8$		$\mathbb{E}[\#Votes] = 2.4$	
$Pr(Win) = .9$		$Pr(Win) = .8$	

Table 1: An example of higher expected vote counts, but lower probability of winning

that issue.

The second assumption characterizes voters' competence: that their beliefs correspond to reality.

Assumption 2. *Each voter is more likely to believe a candidate is superior when she actually is.*

Were this otherwise, the instrumental value of the contest would be at best null and at worst would hazard producing unwanted effects, whereby voting for a candidate A in virtue of some criterion c_i would diminish the chances that c_i would be realized (e.g. more wide-spread healthcare in this case).

Assumptions 1 and 2 help determine expected vote totals:

Proposition 1. *Under assumptions 1 and 2, a candidate's superiority to her rival on that issue increases her expected vote total.*

Typically, increasing a candidate's expected vote total implies increasing her probability of winning the election. However, in some circumstances that relationship breaks. For instance, consider a small numerical example with three voters in Table 1. In the table, $p_{\boldsymbol{v}}$ denotes the probability that voters $\boldsymbol{v}$ (and only $\boldsymbol{v}$) vote for a candidate. For instance, so p_{12} is the probability that voters 1 & 2 vote for her, and voter 3 votes for her opponent; p_1 is the probability that only voter 1 votes for her. $p_\varnothing$ is the probability that none of the voters votes for her. With 3 voters, there are $2^3 = 8$ possible outcomes, which we have arranged in two columns by whether she wins or loses the election. The table enumerates two hypothetical scenarios A and B.

In scenario A, the probability she wins the election is $Pr(Win) = .3{+}.3{+}.3 = .9$. The probability voter 1 votes for her is $p_1{+}p_{12}{+}p_{13}{+}p_{123} = 0{+}.3{+}.3{+}0 = .6$.

The same calculation holds for voters 2 and 3—this is denoted by $Pr(Vote) = .6$. Her expected vote total is $\mathbb{E}[\#Votes] = .6 \times 3 = 1.8$. In scenario B, all three voters vote in lock-step; with .8 probability they vote for the candidate, and with .2 they vote against. Hence, the probablity each individual votes for her is $Pr(Vote) = .8$, and the probability she wins is likewise $Pr(Win) = .8$. Her expected vote total is now $\mathbb{E}[\#Votes] = .8 \times 3 = 2.4$. Here is the paradox: in scenario B, each voter is (marginally) more likely to vote for her, and her expected vote total is greater, yet she's less likely to win!

The paradox in Table 1 is due to dependence between the votes: when she wins, she wins by more than necessary. Another assumption is necessary to avoid this paradox, and move from Proposition 1 to actual electoral outcomes. The simplest (if, perhaps, the strongest) such assumption is independence:

Assumption 3. *Votes are mutually independent, conditional on candidates' true superiority.*

Taking assumptions 1–3 together, we have the following proposition:

Proposition 2. *Under Assumptions 1, 2, and 3, a candidate's superiority to her rival on an issue increases her probability of being elected.*

Our claim is this: in a binary election (even when the decision function is multidimensional) where independent and minimally competent voters seek to select the candidate that maximizes a shared value, the majority rule result comes to recommend democracy on veritistic grounds.[3]

Though the result is easiest to see in the case of consensus, where everyone agrees to some value, it's not limited to such cases. The claim here is *insofar as people agree*, the outcome of the election can be thought to be truth-tracking by epistemic means. Consider the consensus within a majority: a simple majority of Americans want more people to carry health insurance. Here the process can be thought to be veritistic when the majority agrees to the value of some issue and has the capacity to select the candidate that is in fact better on that issue—having the capacity to effect said outcomes. Insofar as this majority wants to elect the candidate that will increase healthcare coverage, the better candidate on this issue will have her chances of victory boosted, inhibiting unwanted effects.

Importantly, they need not possess epistemic access to the policy mechanisms for the election's result to maintain a veritistic quality—say, whether single-payer is superior to market-based exchanges. It need only be the case that the

[3]The technical restatement of this proposition and its proof are provided in the appendix, Section 6.1.

outcome be the intended one. And sure, just because a candidate's superiority on *some* issue that a majority agrees to enhances her chances of victory, it doesn't mean that the effect is necessarily decisive. That being said, we show here that the effect of sociotropic economic voting in U.S. presidential elections has had consistent and measurable effects on (popular) electoral outcomes.

2.1 Interactions Between Issues

An anonymous reviewer pointed out that universal agreement on an issue need not imply assumption 1. To see why, imagine that the preference for higher health-care coverage rates is universal in the electorate. However, a portion of the electorate (called "anti-taxers") prefers lower taxes, and cares more about taxes than about healthcare coverage. Finally, say candidates who are better fit to achieve higher health-care coverage tend to be less likely to lower taxes. Then, the probability that an anti-taxer votes for a candidate will be *anti*-correlated with her ability to increase health care coverage rates. Seen from another angle, anti-taxers tends to vote against their own preference for health-care coverage, because of their weightier preference for low taxes. In the world of competing priorities, decisions need not always follow preferences.

It would be prepostorous to claim that electoral outcomes tend to follow voters' shared preferences, without regard to the weight of those preferences. Indeed, it would be hard to recommend any electoral system in which that were the case, in which electoral outcomes were driven primarily by consensus on issues of secondary importance to voters, rather than by the issues the voters cared most about.

That being said, conflicting preferences, such as health care coverage and low taxas, present a challenge to the assumption 1. As stated, it demands an issue on which voters' preferences both align, and are strong enough to outweigh competing concerns. Such issues may in fact exist—the case of economic voting in the following section may be an example. However, a modification of the assumptions and propositions broadens their applicability. For instance, say that a candidate is more likely than her rival to raise taxes; the probability that an anti-taxers will vote for her, say $Pr_{at}(V|Tax)$, will be quite low. However, if she is *also* more likely than her rival to increase healthcare coverage, that probability increases, however slightly: $Pr_{at}(V|Tax, HC) > Pr_{at}(V|Tax)$. If assumptions 2 and 3 also hold conditional on tax policies, then Propositions 2 does, too—also conditional on tax policy (see Dietrich and Spiekermann, 2013, for a similar argument).

In general, say there exists a set of facts, $\mathcal{F}$ such that assumption 1 holds

conditional on $\mathcal{F}$. Then the following proposition holds:

Proposition 2′. *If Assumptions 1, 2, and 3 hold conditional on $\mathcal{F}$, then a candidate's superiority to her rival on an issue increases her probability of being elected, conditional on $\mathcal{F}$.*

Taking a more expansive view of the conditioning set $\mathcal{F}$ allows us to conceptualize the model in terms of counterfactuals. Voters first learn all they need to (or want to or can) know about the two candidates in a race, then arrive at subjective conclusions as to each candidate's fitness on a range of relevent issues, then finally decide how to cast their votes. If the set $\mathcal{F}$ is sufficiently inclusive, Proposition $2'$ could be understood as describing difference in the probability of a candidate's election between a scenario in which she is superior to her rival on an issue of broad consensus, to one in which she is inferior on that same issue, holding constant her position on all other relevant issues.

3 The Empirical Plausibility of Democracy's Truth-Tending Properties

The propositions above outline epistemic considerations relevant to majoritarian voting, stipulating conditions under which a candidate's fitness on some issue increases the probability of her being elected, mediated by voters' beliefs. The practical relevance, however, hinges on whether the conditions actually obtain. To establish this we need to identify a case that tracks how people evaluate some particular and salient dimension of their voting decision. As such, we now turn to the case of sociotropic economic voting in U.S. presidential elections.

Though economic voting is not a part of every election (Stein (1990); Nadeau and Lewis-Beck (2001):171), U.S. presidential elections do appear to turn on economic performance (Miller and Wattenberg (1985), Fiorina (1978); Lockerbie (1992); Lanoue (1994); Lewis-Beck and Stegmaier (2000); Nadeau and Lewis-Beck (2001); Markus (1988)). Voters hold the president responsible for not only their own financial well-being, but also for the health of the domestic economy more broadly—referred to as "sociotropic" economic voting (Kinder and Kiewiet (1981)). Moreover, it is likely that the president has some control over macroeconomic outcomes (Blinder and Watson (2014)). Sociotropic economic voting trends reveal that people widely want the economy to grow and reflect on economic trends in order to select candidates with policies better suited to maintain growth (Duch and Stevenson (2008): 14). We look to economic voting, in part, because of the theory's robustness. Both Duch and Stevenson (2008)

and Lewis et al. (2009) review the sizable literature on the matter and argue forcefully that there exits a strong causal relationship between economic performance and people's assessment of whom to vote for president. It is this broad theoretical and empirical support for economic voting that allows us to make inferences from the linear model we deploy, moving beyond assignments of mere correlation.

While any number of criteria plausibly affect people's judgement about the economy (e.g. inflation, unemployment, trade deficits), the annual change in real disposable income (ΔRDI—average income, less taxes) highlights a broad agreement that exists and informs voters' decisions of whom to vote for. ΔRDI is an attractive metric not only because it corresponds to an objective measure of economic performance, but also as people plausibly have epistemic access to it. People can look around and assess the after-tax money that they and those around them have earned in recent years. Voters need not diligently read the Wall Street Journal or watch CNBC to know whether the economy around them appears to be growing or shrinking.[4] As evidence for this claim, we show that RDI growth is an important predictor of individual votes, even after controlling for several canonical variables.[5]

3.1 Empirical Results

To understand the influence of macroeconomic performance on voters' beliefs and choices, we take a cue from Nadeau and Lewis-Beck (2001) and fit a logit model to American National Election Survey (ANES) data.[6] Our models (Table 1) provide evidence that ΔRDI predicts voters' choices as mediated by their beliefs, and corroborates earlier studies which have shown that ΔRDI is a strong predictor of the votes for U.S. president.[7]But when the model also accounts for respondents' subjective economic beliefs (models (2)–(4)), the magnitude of

[4]While wages have largely stagnated over the last four decades, the CBO shows slight growth in even the bottom quartile. Even so, since our inquiry is primarily interested in sociotropic rather than pocketbook voting, we believe that this phenomenon does not undermine the strength of our findings (Congress (2011)).

[5]Though ΔRDI serves as a particularly attractive metric, the results are consistent for others like GDP growth, too.

[6]While our models rely on the substantive theory behind those in Nadeau and Lewis-Beck (2001), the fresh analysis allows us to fix some methodological concerns as well as direct attention to the specific ways in which beliefs mediate between voters' observations and decisions (votes). The technical discussion is provided in the appendix.

[7]An increase of one in unit ΔRDI increases the odds of a respondent voting for the incumbent by a factor of about 5–36%, adjusting for voters' perceptions of their individual financial situations, their race, their state, and their party identification, as well as the election year. This is an approximate 95% confidence interval.

ΔRDI's coefficient diminishes to near zero and becomes statistically insignificant. Consistent with Nadeau and Lewis-Beck's account, ΔRDI's impact on votes is mediated by a person's subjective economic beliefs. The level of ΔRDI affects subjects' perceptions of the economy, which in turn affects their voting decisions.

As in Nadeau and Lewis-Beck's model, subjective measures have a large, positive association with ΔRDI. People's assessment of the national change in income levels appears to make up a sizable part of what the retrospective and prospective variables measure. We find that retrospective and prospective assessments of the economy are correlated with ΔRDI at a level of 0.30 and 0.15, respectively. This is consistent with Nadeau and Lewis-Beck's finding that when *retrospective* is regressed on ΔRDI the R^2 value is 0.77 and $R^2 = 0.39$ when *prospective* is regressed on ΔRDI, indicating that people's economic beliefs indeed correspond to empirical fact (Nadeau and Lewis-Beck (2001): 161, 174). These results are consistent with earlier findings that voters reflect on economic performance to select policies that favor growth, thereby lending support to the epistemic quality of democratic elections. To wit, the size of the effect here is large. Were voters to assess economic progress merely at random the popular presidential vote might well have flipped as many as eight elections in our dataset (1980–2012).[8]

3.2 Epistemic Heterogeneity in the Model

The conditions of the majority rule result regard *individual* level properties while models (1)–(4) estimate *aggregate* association between people's beliefs of economic progress and actual economic growth. Results in Table 1 suggest that voters *as a whole* are both more likely to vote for the incumbent party the

[8] We look at the problem like this: Voters' beliefs about economic growth vary from election to election, a function of the information they possess. What if their beliefs were generated random, however? We assess that question in two ways. First, what if instead of varying beliefs from year to year, voters merely stuck to the mean belief for all years? The mean is just the expectation that one would pull without knowing anything about the local empirical reality—a baseline or default. Were the actual values for *retrospective* to be swapped for the variable's mean value across all years the magnitude would have been large enough to alter the popular vote totals in 1980, 1992, and 2008. (Conforming perfectly to magnitude of the economic downturns in and around those years.) Second, what if instead of varying beliefs from year to year, voters somehow adopted beliefs one standard deviation from the mean? Since standard deviation is a measure of the expected variation from the mean, if voters' beliefs were just random they *could* fall anywhere, but on average within one standard deviation. In that case the magnitude of the effect would have been sufficiently large to swing the popular vote in every election *retrospective* was measured, namely 1980–2012. The results and corresponding code are posted online: `http://bit.ly/2zsTVlj`.

	Dependent variable:			
	vote			
	(1)	(2)	(3)	(4)
Δ RDI	0.200**	−0.003	0.166	0.010
	(0.074)	(0.085)	(0.100)	(0.089)
finances	0.303**	0.162**	0.274**	0.154**
	(0.025)	(0.032)	(0.032)	(0.033)
incumbentParty	−0.521**	−0.522**	−0.373*	−0.497**
	(0.126)	(0.139)	(0.164)	(0.146)
retrospective		1.019**		0.950**
		(0.058)		(0.062)
prospective			0.441**	0.259**
			(0.040)	(0.042)
incumbentParty:race	0.748**	0.635**	0.575**	0.574**
	(0.054)	(0.061)	(0.062)	(0.064)
incumbentParty:partyID	0.824**	0.819**	0.829**	0.800**
	(0.011)	(0.014)	(0.014)	(0.014)
Constant	−0.451*	0.029	−0.539*	−0.024
	(0.218)	(0.220)	(0.258)	(0.231)
Observations	20,168	13,988	12,815	12,746
Log Likelihood	−7,664.552	−4,890.587	−4,653.145	−4,508.239
Akaike Inf. Crit.	15,345.100	9,799.174	9,324.290	9,036.478
Note:				*p<0.05; **p<0.01

Table 2: Results from four multilevel logistic regressions described in equations (4) and (5). ΔRDI is the percent change in national real disposable income per-capita from the previous year; incumbentParty is equal to 1 when Democrats are incumbent and -1 when Republicans are; finances is equal to 1 when respondents answer that their family's financial situation is better than a year ago, -1 when worse and 0 when the same; prospective is 1 when respondents answer that they expect the economy to improve in the following year, -1 when they expect it to get worse and 0 if they expect it to stay the same; retrospective is 1 when respondents answer that they believe the economy improved in the previous year, -1 when they believe it got worse and 0 if they believe it stayed the same; race is equal to 1 if the respondent is non-white and 0 if the respondent is white; partyID is a five-point scale for party identification: positive for Democrats, negative for Republicans; 3 for strong, 1 for weak or leaning, and 0 for apolitical. Models based on ANES data from presidential elections from 1956–2012 (1) or 1980–2012 (2)–(4) (as ANES only began collective data for *retrospective* and *prospective* in 1980).

higher ΔRDI (model (1)) and more likely to vote for the incumbent party when they believe the economy is growing (models (2)–(4)). This is consistent with findings from the economic voting literature that voters as a whole select the candidate they believe is more apt to sustain growth. It's conceivable, though, that a substantial portion of voters are systematically mistaken regarding economic growth, believing the economy is growing when it is shrinking and vice versa. Such voters would violate assumption 2 and, if their number sufficient, undermine the majority rule result.

While the data don't allow us to track individual competencies, we can look at subgroups within the population to assess whether any are systematically confused. Interacting ΔRDI and *retrospective* with a variety of respondents' demographic features (finances, party identification, race, age, class, education, gender, marital status and urbanism), no combination thereof produced a negative correlation between our two variables of interest. That is, no subgroup we looked at was systematically worse than random at knowing whether the economy was growing or shrinking.

Another worry is that it's *possible* that the result is produced by a preference of a minority of electors rather than a majority.[9] We try to get a handle on this by estimating the number of those who want the economy to contract by looking at the proportion of survey respondents answering that "the economy was doing much better" given a value of ΔRDI in the bottom quartile. This puts the number at 1.2% (with a 95% confidence interval ranging form 0.9-1.5%), but that is likely a large overestimate. The fact that surveys don't even ask respondents whether they wish the economy would contract is possibly the best evidence of the ubiquity of the assumption. Given this, it is just not possible for the observed effect to be due to a minority of mistaken voters who want the economy to shrink.

[9]More precisely, the worry is as follows: The proposition claims that insofar as people agree and both know something about economic progress and vote with regard to economic progress, the majority rule result can be thought to obtain. We then specify that the argument is not that everyone need agree that positive ΔRDI is a good, but insofar as the majority believe it to be a good, our evidence demonstrates that they have the capacity to select the better candidate in this regard. What we want to show here is that the outcomes of our empirical model are the result of the majority getting it right (they want the economy to grow, they believe it is growing, and it is in fact growing), rather than a minority getting it wrong (they want the economic to shrink, they believe it is shrinking, and it is in fact growing).

4 Critiques

There are, however, standing critiques of the economic voting literature. Christopher Anderson, for instance, doubts the link between economic performance and electoral outcomes (Anderson (2007): 272), particularly given the myriad of other metrics that might motivate voters' decisions (ibid.: 274). Furthermore, he along with Bryan Caplan call into question whether the information voters do have allows them to make such inferences about the economy (Anderson (2007): 279-281; Caplan (2006): chapter 3).

We needn't suppose that most voters *directly* observe ΔRDI in order for them to care about its performance, however. ΔRDI might well serve as a proxy for voters observations of local and national economic trends. For instance, percent change in ΔRDI is correlated with percent change in GDP (ρ =0.71) and inversely correlated with the change in unemployment (ρ =-0.43).[10] Yet ΔRDI is also something that voters can plausibly look around and observe—Are those I see taking home more or less pay than in past? Have their consumer habits changed? Are they tightening their belts? This contention is consistent with our finding that ΔSDI (state-level real disposable income) also has a marginally significant effect (at a 10% level) on presidential vote share, loosely suggesting that people make political inferences using both national and regional economic signals (though the former is clearly more pronounced). But we also have good theoretical reasons to think that voters have access to rich empirical knowledge. Arthur Lupia and others have written that voters can key-in to sophisticated information using proxies and shortcuts which allow them to make refined decisions (Kinder and Kiewiet (1981): 130-1; Lupia and McCubbins (2000); Lupia (2006)). And while Bartels (1996) shows that uniformed voters are different from their informed peers, it does not directly contest our finding here that voters are dispositionally better than random (at assessing economic growth, at least).

Meanwhile Caplan's strongest counterexamples indicate that voters are woefully ignorant about economic mechanisms such as whether "technology is displacing workers" (Caplan (2006): 65). As mentioned above, however, it is not necessary for voters to have access to the causal mechanisms that produce some outcome for elections to be thought veritistic. The question of whether RDI is growing at a normal clip is such a question that regards performance rather than policy, and which economists and lay-voters both do a fairly good job of

[10] Data Source: FRED, Federal Reserve Economic Data, Federal Reserve Bank of St. Louis: `http://research.stlouisfed.org/fred2/graph/?g=DQL` accessed 06/20/2014. Estimates are based on quarterly data from 1960–2014.

assessing (Caplan (2006): 78). Whether take-home income has risen or fallen is something that people realistically have access to. The 0.68 correlation between RDI in successive years indicates a rather low epistemic burden to predicting growth for the coming year. Just knowing the previous year's RDI provides a good deal of predictive power absent any sophisticated training. Indeed, even Achen and Bartels (2016), who are not kind to epistemic interpretations of democracy, carve out an exception for economic voting (ibid.: 97-8). Given this, we believe that it is perfectly plausible that voters have the requisite information and capacity to incorporate the fact of economic growth into their decision of whom to vote for.

5 Discussion

When political theorists argue that majority rule results, such as the Condorcet Jury Theorem or Miracle of Aggregation, pertain to politics they do so assuming there exist cases in which these results plausibly obtain. We point out that such instrumental claims are weak absent a compelling example. This paper empirically tests the claims of epistemic democrats while responding to skeptics such as Anderson (2006), Ingham (2012), and Urbinati (2014) who argue that we can't possibly think about elections having veritistic results, since voters are disagreeing on matters of value, not fact. We bracket that worry by focusing attention on a dimension of the vote on which the vast majority of voters agree, leaving the facts to be contested.[11] We show that given independent and minimally competent voters a majority rule mechanism can be understood to bias an election in favor of the better candidate, non-trivial given that most decisions entail a bundle of considerations.

The case of sociotropic economic voting in U.S. presidential elections offers an instance where a widely held value significantly affects an election's outcome, thereby plausibly meeting these conditions. In this binary contest, the data indicate that voters select candidates with an eye to the annual change in real disposable income, among other considerations. The broad agreement here comes to recommend the election's result by nudging the outcome in favor of the candidate that voters themselves would have chosen given full information. What's more, it provides evidence that people's votes are conditioned by epistemic means—that the effect of economic growth on electoral outcomes is mediated by people's beliefs on how the economy is fairing. Indeed we estimate

[11] For a discussion of how we extend our claim to the majoritarian case, please refer back to section 2.

that absent this effect between three and eight elections since 1980 might well have been different (as far as the popular vote, anyway).

To examine the plausibility of these claims we offer a series of linear models of voters' decisions in U.S. presidential elections. Here voters observe national economic conditions, which inform their beliefs about the economy's performance. Those beliefs, in turn, affect their choices. The coefficient on ΔRDI is substantial and significant only when economic beliefs are excluded from the model. Once included, the subjective measures soak up its explanatory role, illustrating the role of beliefs in affecting political outcomes. Voters who believe that the economy has or will grow are more likely to vote for the incumbent party. And insofar as voters value economic growth, the majority rule mechanism operates to inhibit unwanted effects (where voters would be less likely to obtain the outcome they value in virtue of voting for it).

Holding all other aspects of the vote constant, the majority rule result, articulated in Propositions 1 and 2, formally captures how voters can be thought accurate with respect to a particular dimension of the vote. Assumption 1, that voters are as good or better than random at selecting the superior candidate, is tricky to substantiate with direct observational evidence. Our subgroup analysis, however, goes some distance to allay worries, as we fail to find *any* subgroup for which ΔRDI and the variable *retrospective* are anti-correlated.

Section 3.1 directly grounds Assumption 2, that voters' are as or more likely than random to select a candidate they believe to be better on the issue. Model (1) finds a positive association between economic performance, captured by the variable ΔRDI, and votes for the incumbent. When subjective sociotropic measures are included in the regression, as in models (2)–(4) the objective measure (ΔRDI) takes a near-0 coefficient, leading us to conclude that economic policy primarily figures into individual votes by way of their subjective beliefs, thereby illustrating the *epistemic* valence to democracy. Controlling for Party-ID and an individual's finances, the vote comes to select candidates with policies that promote widespread economic growth.

Finally, Assumption 3 is a simplifying condition primarily intended to streamline the proof. Indeed we know that votes are not cast independently (e.g. Sinclair (2012)), though it is hard to know the size of the effect of dependence. We put forward what can be considered the least complicated assumption and leave it to future work to identify circumstances where dependent voting would undermine our results. It is unlikely that our findings disappear given small amounts of dependence. And as Dietrich and List (2004) points out, independence is most plausible when we have reason to think that voters are encountering heteroge-

neous information, as would be the case in a nation-wide presidential election with comparably high turnout. [12] Propositions 1 and 2 outline common assumptions to gain traction on how democracy can leverage the wisdom of the crowds and facilitate matching the theory's correspondence to data.

Beyond the support of claims made by epistemic democrats, this paper shows the purchase of testing theoretical conjectures against empirical data. Whenever we make instrumental claims in politics, we do so conditional on a certain state of the world being the case. More needs to be done to determine that empirical conditions are indeed satisfied if we are to give proper weight to these arguments. We hope to have offered one such effort here.

6 Appendix

6.1 Proof of Proposition

In order to demonstrate our claim that *in a binary election where votes are independently cast and, in part or whole, seek to select the candidate that maximizes a shared value, majority rule results recommends democracy on veritistic grounds*

We are interested in the electability of a particular candidate in a binary election. Let $E = 1$ if she is elected, and 0 otherwise. Let $\mathcal{E}$ denote the electorate and let $i = 1, 2, 3, ... \in \mathcal{E}$ denote voters in the electorate. Let $V_i = 1$ if voter i votes for the candidate, and 0 otherwise. Say $E = 1$ if and only if the proportion of votes for a candidate from $\mathcal{E}$ exceeds a threshold α, typically $1/2$. In other words,

$$E = 1 \text{ iff } \sum_{i \in \mathcal{E}} V_i > n\alpha \tag{1}$$

where $n = |\mathcal{E}|$, the number of voters in $\mathcal{E}$. Let $a_x = 1$ denote the truth of a fact x that sways voters to vote for the candidate (for instance, she is better than her rival at increasing RDI). For clarity, we will drop the x subscript, so $a = 1$

[12] Indeed, Dietrich and Spiekermann (2013) doubles down on this line of critique. Our application of independence avoids their worries in two ways, however. First, the motivation for their critique lies in CJT's asymptotic property, absent from our majority rule result. Second, they are concerned for probabilistic dependence in virtue of citizen's common evidential support for their votes. However the account that our findings support is that voters each look around and judge the health of the economy from their own observations—a contention supported by the correlation between state-level real disposable income growth and votes. In our model voters are not backing out ΔRDI from a (common) proxy, rather each directly observes the data for themselves, that is whether they and those around them have greater take-home pay than in the past.

denotes $a_x = 1$. Let $A_i = 1$ if voter i believes a. Finally, let $\mathcal{F}$ be a (possibly empty) set of conditioning facts, as discussed in Section 2.1.

Then consider the following assumptions:
For all $i \in \mathcal{E}$:

1 $Pr(V_i = 1|A_i = 1, \mathcal{F}) \geq Pr(V_i = 1|A_i = 0, \mathcal{F})$; stated otherwise, A affects all voters' choices in the same direction.

2 $Pr(A_i = 1|a = 1, \mathcal{F}) \geq Pr(A_i = 1|a = 0, \mathcal{F})$; stated otherwise, that voters are better than random at judging a.

3 For all $j \neq i$, $V_i \perp\!\!\!\perp V_j|a, \mathcal{F}$

4 $Pr(V_i = 1|A_i, a, \mathcal{F}) = Pr(V_i = 1|A_i, \mathcal{F})$

Finally, the inequalities in both 1 and 2 must be strict for some non-empty subset of $\mathcal{E}$.

Proposition. *If assumptions 1, 2, and 4 hold, then*

$$\mathbf{E}\left[\sum_{i\in\mathcal{E}} V_i \middle| a = 1, \mathcal{F}\right] > \mathbf{E}\left[\sum_{i\in\mathcal{E}} V_i \middle| a = 0, \mathcal{F}\right] \tag{2}$$

If assumption 3 also holds, then

$$Pr(E = 1|a = 1, \mathcal{F}) > Pr(E = 1|a = 0, \mathcal{F}) \tag{3}$$

Note that when $\mathcal{F}$ is the empty set, this is equivalent to Propositions 1 and 2. When $\mathcal{F}$ is not empty, this is equivalent to a generalization of Proposition 1 and to $2'$.

Proof. Under assumptions 1, 2, and 4 we have (letting all probabilities be conditional on $\mathcal{F}$)

$$\begin{aligned}
&Pr(V_i = 1|a = 1)\\
=&\,\mathbf{E}\, Pr(V_i = 1|a = 1, A_i)\\
=&Pr(V_i = 1|A_i = 1)Pr(A_i = 1|a = 1) + Pr(V_i = 1|A_i = 0)Pr(A_i = 0|a = 1)\\
=&Pr(A_i = 1|a = 1)\{Pr(V_i = 1|A_i = 1) - Pr(V_i = 1|A_i = 0)\} + Pr(V_i = 1|A_i = 0)\\
\geq&Pr(A_i = 1|a = 0)\{Pr(V_i = 1|A_i = 1) - Pr(V_i = 1|A_i = 0)\} + Pr(V_i = 1|A_i = 0)\\
=&Pr(V_i = 1|A_i = 1)Pr(A_i = 1|a = 0) + Pr(V_i = 1|A_i = 0)Pr(A_i = 0|a = 0)\\
=&Pr(V_i = 1|a = 0)
\end{aligned}$$

Where the inequality is a result of assumptions 1 and 2, and is a strict $>$ for some members of the population. Then

$$\mathbf{E}\left[\sum_{i\in\mathcal{E}} V_i \middle| a=1\right] = \sum_{i\in\mathcal{E}} Pr(V_i=1|a=1) > \sum_{i\in\mathcal{E}} Pr(V_i=1|a=0) = \mathbf{E}\left[\sum_{i\in\mathcal{E}} V_i \middle| a=0\right]$$

proving (2).

$V_i|a=1$ is stochastically greater that $V_i|a=0$. Therefore, under assumption 3, $\sum_{i=1}^{n} V_i|a=1$ is stochastically greater than $\sum_{i=1}^{n} V_i|a=0$ (Shaked and Shanthikumar, 2007). Therefore, $Pr(E=1|a=1) = Pr(\sum_{i=1}^{n} V_i > n\alpha|a=1) > Pr(\sum_{i=1}^{n} V_i > n\alpha|a=0) = Pr(E=1|a=0)$, as in (3). □

6.2 A Comparison with CJT

The propositions described informally in Section 2 and formally in this appendix build on prior theoretical work in epistemic democracy, perhaps most famously the Condorcet Jury Theorem (CJT). In this section we will briefly compare and contrast our proposition with the CJT. We will argue that our proposition may be thought of as a generalization of the CJT to the multidimensional case.

The CJT may be stated as follows (e.g. Boland, 1989):

Proposition (CJT)**.** *A decision-making body is comprised of $n \geq 3$ voters who cast votes $V_i, \ldots, V_n \in \{0,1\}$. The group's decision $E=1$ if and only if $\sum_i V_i > n/2$ and $E=0$ otherwise. If:*

1. *There is a unique correct decision $a \in \{0,1\}$*
2. *$p_i = Pr(V_i = a|a) = p > 1/2$ for all i (Competence) and*
3. *$V_i \perp\!\!\!\perp V_j|a$, $i \neq j$ (Independence)*

Then $Pr(E=a|a) > p$ and $Pr(E=a|a) \to 1$ as $n \to \infty$

Our proposition extends the CJT to multidimensional political contests. Skeptics of claims advanced by epistemic democrats argue that there is no obvious means to evaluate which candidate is right or better. We respond to this worry by constraining our analysis to a particular dimension of voters' decision functions, insofar as voters agree. The "correct" decision a is the one that conforms with the consensus value. Thus the superior alternative (that which voters value) is also the correct alternative (that which

would in fact bring about the ends that voters value). The formal statement $Pr(V_i = 1|A_i = 1) > Pr(V_i = 1|A_i = 0)$ means that voter i's perception of candidate 1's superiority on the particular issue in question increases the chances he'll vote for her; to state it for all voters i is to say that they all agree on the issue's choice-worthiness.

Focusing on one dimension among (possibly) many that influence votes (V) required two additional modifications to the CJT. First, we introduced the "individual belief" variable A_i encoding i's belief about which candidate is superior on the issue in question. In the classic CJT setup, voters are assumed to vote for the option they believe is best (see Austen-Smith and Banks (1996), however), so $V_i \equiv A_i$, necessarily. However, in a political election i may believe candidate 1 to be superior to 0 on the issue in question, so $A_i = 1$, but believe candidate 0 to be superior on other issues, so that $V_i = 0$. Call candidate 1 "Caroline" and candidate 0 "Denise."

Secondly, we have weakened the relationship between truth a and, respectively, beliefs A, votes V, and the outcome E. In place of the CJT assumption 2 that voters are more likely to pick the correct alternative, we assume that a fact's veriticity makes voters more likely to believe it. So, say $a = 1$, entailing that candidate Caroline is superior on the issue in question. However, perhaps because of voter i's prejudice or confusion, he is unlikely to acknowledge Caroline's superiority under most any circumstances. That said, the probability he assigns to Caroline being superior on the issue is still higher *than it would have been* were Denise to have been better along this dimension—say, $Pr(A_i = 1|a = 1) = 0.02$ rather than $Pr(A_i = 1|a = 0) = 0.01$. Voter i would violate assumption 2 of the CJT, since $p < 1/2$, but does not violate our assumption 2. Conversely, $p > 1/2$ as in the CJT implies that $Pr(A_i = 1|a = 1) > 1/2 > Pr(A_i = 1|a = 0)$, so our assumption 2 is strictly weaker.

That said, Dietrich (2008) shows that for CJT to hold, we must merely have $\bar{p} = \sum_i p_i/n > 1/2$.[13] This assumption is neither strictly weaker nor stronger than ours. On the one hand, if, say, as above $Pr(A_i = 1|a = 1) = 0.02$ and $Pr(A_i = 1|a = 0) = 0.01$, but this time for all voters i, our assumption would be satisfied, but Dietrich (2008) would not. On the other hand, it is possible for some subset of the electorate to violate our assumption but be outweighed by the remainder of the electorate, so $\bar{p} > 1/2$. In any event, simply substituting $\bar{p} > 1/2$ into our proposition would not suffice, since a small group of mistaken voters might undermine the result if they assign particularly high weight to the

[13] Boland (1989) shows that for $Pr(E = a|a) > \bar{p}$ to hold in finite samples, we must assume $\bar{p} > 1/2 + 1/2n$.

issue.

Our result (2) in section 6.1 is weaker as well—indeed, it ought to be. If broad agreement holds for only one of many issues, it would be troubling to state that $Pr(E = 1|a = 1) \to 1$ as the electorate grows, implying that all other issues—legitimate, if ambiguous—become irrelevant. Instead, as in the case with belief, we merely show that a candidate's superiority on the issue increases her probability of being elected, relative to what it would have been had she instead been inferior. That is, we claim that superiority on an agreed-upon issue boosts a candidate's chances, but provides no guarantees.

Additionally, unlike the CJT, our result holds for finite samples.

Finally, our independence assumption is the same as CJT's. This suggests that relaxations of independence in the CJT case (e.g. Boland et al. (1989)) may work in our case as well.

6.3 Modeling Choices: Logit Model

Our models are based roughly on those presented in Nadeau and Lewis-Beck (2001). In particular, they estimated the following model:

$$\begin{aligned} vote_{ind,elec} = \alpha + \beta_1 RDI_{elec} + \beta_2 Finances_{ind,elec} + \beta_3 IncumbentParty_{elec} \\ + \beta_4 PartyID_{ind,elec} + \beta_5 Race_{ind,elec} + \epsilon_{ind,elec} \end{aligned}$$

where $vote_{ind,elec}$ is an individual's vote, coded as 1 if she voted for the incumbent party, and 0 otherwise. RDI_{elec} is the percent change in RDI per capita from the previous year, $Finances_{ind,elec}$ is an individual's assessment of his own personal finances, compared to the previous year (1 denotes "better," 0 "the same," -1 "worse"). $IncumbentParty_{elec}$ codes whether the Democratic or Republican party was the incumbent in the election. $PartyID_{ind,elec}$ is a five-point scale that codes to what extent the voter's party identification agrees with the incumbent party (3: strongly agrees, 2: weakly agrees, 0: indifferent, -2 weakly disagrees, -3: strongly disagrees) and $Race_{ind,elec}$ is an indicator for race, also aligned with incumbent party (if the incumbent party is Republican, 1 indicates 'white' and 0 'nonwhite,' with the opposite if the incumbent party is Democratic). The parameters α and β_k, $k = 1, ..., 5$ are estimated with ordinary least squares, and $\epsilon_{ind,elec}$ is a regression error.[14]

We model each individual's vote as a separate coin-toss. These coins, though,

[14]The individual-level data in the model came from the American National Election Survey (ANES) time series Studies (2010b) and the RDI data is from the National Bureau of Economic Research.

are not "fair," in the usual sense: we assume that each voter has a different probability of voting for the incumbent party. The probability each voter chooses the incumbent party is modeled as a function of several factors, including ΔRDI and, in some versions of the model, their subjective beliefs regarding the state of the economy. In particular, the logit of the probability is a linear function of these factors.[15]

Our model has two layers, the first one models an individual's probability of voting for the incumbent party:

$$logit(Pr(vote_{ind,elec} = 1)) = \alpha + \nu_{elec} + \eta_{state} + X_{ind,elec}\beta \tag{4}$$

where $X_{ind,elec}$ is a vector of all of the individual level regressors for voter *ind* in election *elec* and $logit(Pr(vote_{ind,elec} = 1))$ is the logit of the probability that voter *ind* votes for the incumbent party. In some models $X_{ind,elec}$ includes sociotropic measures: "retrospective" codes whether voters believe the economy has improved over the past year, and "prospective" codes voters' beliefs regarding whether the economy will improve in the coming year. These metrics are important because they give us a handle on the effect beliefs have on votes. The model also allows the states voters reside in, η_{state}, to idiosyncratically influence their voting decisions, with the random intercept $\eta_{state} \overset{iid}{\sim} N(0, \sigma_s)$.

In the second level of the model, ν_{elec} is a random effect for the election,

$$\nu_{elec} = \gamma_1 \Delta RDI_{elec} + \gamma_2 incumbentParty_{elec} + \zeta_{elec} \tag{5}$$

where $\zeta_{elec} \overset{iid}{\sim} N(0, \sigma_e)$. Here voters' choices are affected, on an election-to-election basis by ΔRDI and the incumbent party, in addition to idiosyncratic factors. The variance parameters σ_e and σ_s are estimated from the data, along with the coefficients α, β, γ_1, and γ_2. Since voters in each election are not independent of each other, we include random effects for each election. Including a random election effect ν_{elec} models that dependence and corrects the overly-optimistic standard errors in Nadeau and Lewis-Beck (2001).

Since each election has its own idiosyncrasies—for instance, the Vietnam war and Lyndon Johnson's surprising decision not to run in 1968, or the fallout from the Lewinsky scandal in the 2000 election—the error term from each election must be independently modeled. We account for this by explicitly modeling the multilevel structure in the data with a mixed-model, measuring some variables at the voter level and others at the election level (e.g. Raudenbush and Bryk, 2002). We also included state random effects, to account for state-level idiosyncrasies

[15] If the probability of voting for the incumbent party is p, the logit is $log(p/(1-p))$.

that are stable over time.[16]

Another issue with the Nadeau and Lewis-Beck (NLB) model is its use of OLS to model binary outcomes. Since binary outcomes are restricted to be either one or zero, the regression errors ϵ are necessarily heteroskedastic, which can also bias standard error estimates. Some linear probability modeling techniques can overcome this difficulty (see, e.g. Agresti, 2002, sec. 4.6), but another issue remains: the fitted values of a linear probability model might fall outside of the range 0–1, which hinders their interpretation. Indeed, when replicating NLB's specification, we found that greater than 10% of the fitted values fell outside this range. We avoided these problems by modeling the data to fit a logistic regression.

We further expanded on NLB's model in two different ways. First, the model in NLB was fit using years 1956–1996, which we extended through 2012, using, in part, the ANES 2012 time-series file Studies (2010a). We chose to use individual-level data post-1976 because our scientific question fundamentally regards individual voting decisions as a function of their beliefs. As such we gain substantive purchase on our research question by omitting these aggregate level data and restricting our attention to those years where the variables "retrospective" and "prospective" were captured. By including four more presidential elections than Nadeau and Lewis-Beck (2001), those from 2000–2012, we could also mitigate the consequences of omitting elections from 1956–1976. Second, while their model used an aggregate sociotropic metric for economic voting, we included individual-levels where possible, which conveniently allows us to skirt any worries associated with the ecological fallacy. These sociotropic measures take two forms: The "retrospective" measure is a voter's answer to the question: "Would you say that over the past year the nation's economy has gotten better, stayed (all yrs. exc 1984: about) the same or gotten worse?" while the "prospective" measure is subjects' answer to the question: "Do you expect the economy to get better, get worse, or stay about the same?" (1: better, -1: worse, 0: same). Model (1) draws from data on presidential voting from 1956–2012. Models (2)–(4), which include belief variables, are fit to data from presidential elections from 1980–2012, since the ANES only began measuring individual's beliefs of sociotropic economic performance following the 1976 election.[17]

[16] An alternative approach is to use cluster-robust standard errors (see Freedman, 2006). Doing so, in our model, gave broadly similar results.

[17] The lack of data regarding individual beliefs about economic performance led Nadeau and Lewis-Beck (2001) to fit their models to an aggregate sociotropic measure, which they termed the "National Business Index," computed using data from a separate survey (page 162). We included the retrospective and prospective belief measure both alone individually (Models 2

For the sake of simplicity, the results in Table 1 came from a "complete case analysis" of the data, which dropped any case with any missing regressors. However, in a supplemental analysis we accounted for item-level non-response with multiple imputation (Rubin, 2004). With the `R` package `mice` (van Buuren and Groothuis-Oudshoorn, 2011), we created five datasets, with missing values for the regressors randomly imputed. Next, we used the package `lme4` (Bates et al., 2014) to fit mixed-effects models in each imputed dataset, and combined the results to yield estimates very similar to those in Table 2. This relaxes the strong assumption that item-level nonresponse is entirely random, replacing it with an assumption that nonresponse is random after accounting for the observed regressors.

Aside from computational tractability, one of the advantages of the multilevel logistic regression model is that it allows us to independently assess the respective relationships between votes and each variable on the right-hand side. In particular, each coefficient can be interpreted as the relationship between its corresponding variable and votes, after modeling the effects of all of the other variables in the model. For instance, let $\hat{\gamma}_1$ be the estimated coefficient on ΔRDI in Model 1 found in Table 1. One way of interpreting this result would be that, everything else (in the model) being equal, when ΔRDI increases by 1 percentage point, one may expect the logit of the probability of a voter choosing the incumbent party to increase by about $\hat{\gamma}_1$.

Regarding epistemic heterogeneity, since each wave of the ANES survey selects a different set of voters, the ANES data don't allow us to identify the individuals who systematically misjudge the economy, and thereby directly rule out such a possibility. However, the ANES data do allow us to identify the correlations between ΔRDI and voters' perceptions of the economy within demographic sub-groups. A demographic whose members' retrospective judgement of the economy correlate negatively with ΔRDI may indicate a problem. To attempt to identify such a sub-group, we fit a multilevel linear model to the data, predicting *retrospective* as a function of ΔRDI. The model included interactions between ΔRDI and a thick set of probative variables including personal finances, incumbent party, race, and party ID (variables incorporated in models (1)–(4)), in addition to social class, education, gender, Hispanic identification, marital status, urbanism, and state. This test seeks to find exceptional cases, subsets of the population that systematically misjudge the health of the economy. Though it is large, we needn't worry that the model is overfit, since the setup here is meant to serve as a conservative test, identifying subgroups that

and 3) and coupled (Model 4).

could challenge our conjecture. The estimated slope of the relationship between *retrospective* and ΔRDI for each survey respondent is the sum of the ΔRDI main effect and the interaction coefficients corresponding to that respondent's demographic information. Calculated thusly, no respondent's estimated slope was negative—for every subgroup we identified, higher ΔRDI was associated with higher retrospective judgements of the economy.

To test the possible heterogeneity of values held among the electorate we estimate the conceivable size of such a minority that might unwittingly vote for the right candidate given mistaken beliefs by asking whether there exists some subset of the sample that prefers a shrinking economy. To do this we fit another large interaction model: this time, a multilevel logit model model predicting votes as a function of ΔRDI interacted with all of the same probitive covariates as above. Again, no respondant's estimated ΔRDI slope was negative—for every subgroup we identified, higher ΔRDI was associated with a higher probability of voting for the incumbent.[18]

A final caveat is that, though ANES is a nationally representative survey, our coefficient estimates are design consistent for the subjects in the study who voted or reported their votes. Due to the difficulty of fitting a multilevel model with survey weights (Gelman, 2007), we fit an unweighted model, which limits the external validity of its estimates. That being said, our attempts to fit weighted models in Stata (StataCorp, 2013) with the `gllamm` function (Rabe-Hesketh et al., 2004) yielded broadly similar results.

We examined several alternative model specifications, as a robustness check. The results of our multiple-imputation model, our mediation model, robustness checks and residual plots, along with the code to produce them, are available at `http://tinyurl.com/EpDemSupplement-pdf`.

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[18] A full report of the model results is available as an online supplement.

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