Adverse Selection in Distributive Politics[*]

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December 16, 2018

Abstract

Many policy reforms involve gains for some voters at a cost borne by others, and voters may be asymmetrically informed about who gains and loses. This paper shows that the interaction of distributive politics and asymmetric information generates an *adverse selection effect*: when an uninformed voter contemplates many other voters supporting a policy, she suspects that she is unlikely to benefit from it. This suspicion induces voters to reject policies that would be selected if all information were public. We identify a form of "negative correlation" that is necessary and sufficient for this electoral failure.

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1 Introduction

A central objective of democracy is to select policies that best reflect the preferences and information of the electorate. Yet, a recurring theme of academic and political discourse is the degree to which economic inequality and political polarization impede democracies from achieving that goal. A rich literature in distributive politics has sought to understand why elections may not select policies that maximize social welfare or are in the interests of the majority.[1]

This paper introduces a new dimension to this discussion, namely asymmetric information about the distributional consequences of economic policies. We show that asymmetric information can generate a novel *adverse selection* effect, which induces voters to select policies that do not reflect their collective preferences and information. This effect amplifies the forces identified in the prior literature, and provides a potential contributory explanation for electoral failures in distributive politics.

How the story of adverse selection unfolds in politics is familiar from its role in market exchange (Akerlof, 1970; Milgrom and Stokey, 1982), where the willingness of others to part with an object indicates that it may not be so valuable after all. In politics, we find that when there are competing interests, asymmetric information causes a political agent to be suspicious of policies that are supported by others. Just as adverse selection may undermine markets, we find that it can undermine democratic institutions.

We believe that adverse selection is a useful framework to understand recent political discourse. Surveys of households in the US and Europe consistently show significant declines of trust in government, large corporations, financial institutions, and media organizations (Pew Research Center, 2015; Harrington, 2017). A common narrative attributes this mistrust to a growing suspicion among voters that elites manipulate economic and democratic institutions to extract economic gains for themselves. In European countries, this suspicion for the national government is found to be highly correlated with support for populist parties (Pew Research Center, 2017), and attributed to large shocks to economic inequality and job security (Dal Bo, Finan, Folke, Rickne, and Persson, 2018). Mainstream political leaders themselves have raised the concern that inequality may foster mistrust. For instance, President Obama in his farewell address cautions that:

> *But stark inequality is also corrosive to our democratic ideal. While the top one percent has amassed a bigger share of wealth and income, too many families, in inner cities and in rural counties, have been left behind—the laid-*

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[1]For example, see Fernandez and Rodrik (1991), Alesina and Rodrik (1994), Persson and Tabellini (1994), Dixit and Londregan (1995), Jain and Mukand (2003), Strulovici (2010), and Ray and Esteban (2017) for a survey on the impact of polarization on development, growth, and conflict.

off factory worker; the waitress or health care worker who's just barely getting by and struggling to pay the bills—convinced that the game is fixed against them, that their government only serves the interests of the powerful—that's a recipe for more cynicism and polarization in our politics.

We illustrate the scope for adverse selection using a simple model of an election where asymmetrically informed voters choose between policies that affect them unequally. For example, this choice may be a trade reform, which opens new markets for exporting firms but threatens the prospects in other sectors. Or it may involve changes to immigration, education, or public health policy, or reflect budgetary decisions on how to spend on infrastructure. Voters are ex ante uncertain about who gains from which policy, and about the magnitudes of the gains and losses, and obtain private information about these important variables.

To fix ideas, let us call one policy a *status quo*, and think about the *winners* and *losers* of the other policy, a *reform*, relative to that status quo. Suppose that the reform has a positive (ex ante) expected payoff for each voter. Consider the reasoning of a particular voter—say Alice—who has obtained no private information about how she fares from the reform. Based on her prior belief, she knows that her ex ante odds of benefiting from the reform are good. But she has to consider ex interim what it means *for her* when the proposal passes the collective choice procedure. She knows that the policy passes *only* when others support it, and that others might support the reform because they have received private information that indicates that they benefit from the reform. Is it good or bad news for Alice that others support the reform?

On one hand, the more people who have learned that they gain from the reform, the more likely it is that the reform generates many winners. This is good news for Alice. In a pure common value environment—where all voters experiences gains and losses in unison—this is the only effect, which would cause Alice to view the reform positively. But when distribution is at stake, there is an important countervailing force: for any given number of winners, Alice's odds of being a winner are reduced when others learn that they are winners. This *crowding-out effect* appears particularly salient in say trade reforms when Alice knows that all regions and sectors are unlikely to benefit from trade. Contingencies such as these—when good news for others is, on the whole, bad news for Alice—are those that we model and define as *negative correlation*.

We view negative correlation to arise in settings where concerns about the crowding-out effect of a policy dominate the positive news of learning that there are many winners. For instance, payoffs are negatively correlated if there is a fixed fraction of winners from the reform, as in Fernandez and Rodrik (1991) and Jain and Mukand (2003), or the policy

choice is a redistribution from some segments of the population to others (Dixit and Londregan, 1995). Even if, with significant probability, all voters are winners together, the crowding-out effect may still be significant. Our main result shows that negative correlation and asymmetric information together generate sufficient adverse selection for elections to fail.

> **Theorem 1.** *If payoffs are negatively correlated, there is a strict equilibrium that selects the ex ante inferior policy with high probability, which would be rejected if all information were public.*

The intuition for why elections fail is the adverse selection logic discussed earlier, where a voter is tempted to reject a policy because the support of others "contaminates" it from her perspective. This strategic logic is extremely simple, as we illustrate using examples in Section 1.1. It is easiest to show this logic through a pivotal voter model, which we do in Example 1 with 5 voters. But as we show in Example 2, a similar reasoning applies at a group-level, even if no individual voter conditions on being pivotal. In that example, when competing *groups* of voters consider what policies they should support, each group becomes concerned by adverse selection. Finally, Example 3 illustrates how this reasoning connects to classical models of adverse selection in markets, by building the bridge between voting with competing interests and trading with someone in a market.

While we find it useful to frame our analysis in terms of the choice between a status quo and a policy reform, our results do not unidirectionally predict a status quo bias. Instead the logic of adverse selection applies whenever voters are reasoning about the policies others are supporting. It is entirely possible and consistent with this logic that an uninformed voter may infer from others' *lack of* support for a reform that she is better off from pursuing it. For example, if she perceives the opposition for a reform to come from an entrenched elite, it is their *resistance* that may motivate her to support it. Accordingly, adverse selection provides a potential contributory explanation for *both* status quo biases and the demand for populist and excessive reforms in highly unequal democracies, and highlights a thread that connects these apparently disparate behaviors.

The result above establishes that negative correlation is sufficient for adverse selection to cause electoral failures. Conversely, our second result shows that negative correlation is also necessary.

> **Theorem 2.** *If payoffs are not negatively correlated, all equilibria select the ex ante efficient policy with high probability, which would be accepted if all information were public.*

In particular, Theorem 2 applies when the good news of learning that the policy generates many winners outweighs the bad news of learning that other slots for winners have been occupied. When there are transfers that significantly redistribute gains from winners to compensate losers, payoffs are not negatively correlated. In such cases, Theorem 2 shows that voters do not draw such adverse inferences from the support of others for a policy.

To formalize the logic of adverse selection as cleanly as possible in these two results, our analysis focuses on environments where information is scarce: most voters are unlikely to be privately informed. Our reasons are twofold. First, it illustrates the adverse selection force most starkly to perceive matters through the eyes of uninformed voters. For such voters, the "contamination effect" is the strongest, just as adverse selection has the strongest effect on an uninformed trader in the lemon's problem (Levin, 2001). Qualitatively similar results apply even when all voters obtain some private information.

Second, and more importantly, we view this case to be empirically relevant for distributive politics. Since the policies being decided upon are contentious and polarizing, the sources of information that voters may consult are likely to be one-sided and originate from interested parties. Moreover, the issues being decided are difficult to learn about: most policy choices have complex aggregate and distributional consequences, on which even economists lack a consensus. Insofar as voters access only a limited number of information sources (Prat, 2017; Kennedy and Prat, 2017), it would be difficult for most voters to obtain reliable information about how they are affected by the policy choice.

While the goal of our modeling exercise is to formalize the logic of adverse selection as cleanly as possible in a simple setting, we find that its logic applies more broadly. Our results extend to environments where there is uncertainty about the population size. Moreover, the logic applies in cases where voters are ex ante asymmetric, and "elite" voters may have a higher chance of being winners or of being informed than non-elite voters. In fact, ex ante asymmetry between elites and non-elites amplifies the adverse selection logic of our baseline model. Qualitatively similar results apply, under stronger conditions, if voters do not have a precise sense of what it means to be pivotal. In all of these cases, the basic logic remains: when a voter considers a policy that is supported by others, she is torn between the good news of the policy generating many winners and the concern that she may be crowded out from being a winner. We view this to be a genuine friction in collective choice.

Of course, in formalizing this logic, we omit a number of important considerations from this stylized model. Even so, the forces we identify may still be at work, influencing outcomes directionally through the channel of adverse selection. After expositing our model and main results in Sections 2 and 3, we turn to this directional analysis in

, and we view these comparative statics predictions to be an important feature of our analysis. We describe these predictions below.

By reducing the possibility of an electoral failure to a condition on primitives, namely negative correlation, we can use that condition to compare policies by their susceptibility to adverse selection. For these predictions, we focus on a tractable subclass of our model, where uncertainty is only about the number and identity of winners. First, we compare policies that involve greater polarization between winners and losers—measured as the ratio of the loss incurred by losers relative to the gains that accrue to winners—and show that such policies have greater potential to generate negatively correlated payoffs. We then formalize a measure of the degree to which a voter feels crowded out when she learns that others are winners. Formally, we order probability distributions over the number of winners by their potential to generate negatively correlated payoffs. We show that this order is complete, transitive, and is represented using the ex interim expectation of the number of winners. Moreover, we show that this order is implied by the familiar likelihood ratio dominance order.

Finally, we show that the *kind* of information received by voters mitigates or exacerbates the issue of adverse selection. If all the information that is provided is of aggregate outcomes—say GDP or economic growth—without identifying distributional consequences, then payoffs are never negatively correlated. By contrast, if the information that is provided is purely distributional, then payoffs are necessarily negatively correlated for at least some configuration of payoffs for a winner and loser. We view this contrast to complement analyses of the market for news. Theoretical and empirical analyses of the media (Martin and Yurukoglu, 2017; Perego and Yuksel, 2018) have shown how competitive media outlets may have a motive to provide information that polarizes rather than unifies voters. Our analysis illustrates a pernicious "downstream" effect of such information provision on voting behavior.

A summary of the above predictions is that payoffs are more likely to be negatively correlated if (i) the reform exacerbates economic inequality; (ii) it is likely, from an ex ante perspective, that there will be a large number of both winners and losers; and (iii) the political debate in the build-up to the election focuses on the distributional rather than aggregate consequences of the reform. It appears to us that these ingredients are often present in policy debates over issues at the forefront of distributive politics.

Outline of the Paper: We illustrate the key ideas of our paper in Section 1.1. Section 1.2 clarifies the nature of our contribution in the context of related work in distributive politics and information aggregation. We present our framework in Section 2

and our main results in Section 3. Section 4 describes comparative statics results to understand features that amplify or dampen adverse selection. Section 5 shows that the logic of adverse selection continues to apply even if voters are heterogeneous in that some "elite" voters are more likely to benefit from the reform than "non-elites." Section 6 describes additional extensions, and Section 7 concludes. All omitted proofs are in the Supplementary Appendix.

1.1 Examples

We use three examples to convey the logic of adverse selection in distributive politics. Example 1 illustrates this reasoning using a simple majority-rule election with five voters. Example 2 shows how similar behavior emerges in a model with competing groups, where like the ethical-voter model (Coate and Conlin, 2004; Feddersen and Sandroni, 2006b), each voter does what is in the interest of her group.[2] Example 3 draws the connection between this inefficiency in collective choice to adverse selection in markets.

All of these examples feature only distributional uncertainty (pertaining to the identity of winners), and have no uncertainty about the fraction of voters who gain from the reform. Our general framework, exposited in Section 2, permits both aggregate and distributional uncertainty, as well as uncertainty about the size of the electorate, and encompasses a broader class of information structures.

Example 1 (Negative correlation)**.** Five voters choose between autarky and free trade using simple-majority rule. Each voter's payoff from autarky is normalized to 0. Relative to autarky, three voters are "winners" from free trade, each obtaining a gain of 1, and the other two are "losers," each obtaining a payoff of -1. Voters are exchangeable and so each permutation of winners and losers is ex ante equally likely.[3]

If the identity of the winners were commonly known, every equilibrium in weakly undominated strategies would select free trade because each of the three winners would vote for it. At the other extreme, if it were commonly known that every voter is uninformed, free trade wins again: each voter expects to be a winner with probability $\frac{3}{5}$, yielding an ex ante expected gain from free trade of $\frac{1}{5}$. Thus, both with complete and no resolution of uncertainty, free trade defeats autarky in a majority-rule election.

Our interest is in settings where voters may privately learn how they fare under free trade. Suppose that a voter learns her payoff from free trade (becomes "informed") with

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[2]The ethical-voter framework was originally designed to handle costly voting, but can be applied even if voting is costless (Feddersen and Sandroni, 2006a).

[3]Our analysis focuses on this ex ante symmetric case for simplicity; in Section 5, we show that our main result extends and is amplified in settings where voters are ex ante asymmetric.

probability $\lambda > 0$ and otherwise remains uninformed, and that this random process is independent across voters. Adhering to our motivation that information is scarce, we study equilibrium behavior when λ is small.

We construct a strict equilibrium in which autarky wins with high probability when voters have private information.[4] In this equilibrium, each voter who is informed votes for her preferred outcome—free trade for a winner and autarky for a loser—and all voters who remain uninformed vote for autarky. To see why this is a strict equilibrium, consider the incentives of an uninformed voter, Alice. Her vote influences her payoff only when it breaks a tie: of the other voters, exactly two vote for free trade. Because all uninformed voters are voting for autarky, Alice infers that the two voting for free trade must be informed winners. Since there can be only three winners, the odds that Alice is a winner drops in this contingency from the ex ante probability of $\frac{3}{5}$ to $\frac{1}{3-2\lambda}$, which is below $\frac{1}{2}$ so long as $\lambda < \frac{1}{2}$.[5] Thus, if information is scarce, Alice recognizes that a vote for free trade influences the outcome only when free trade is unfavorable to her, and consequently, votes in favor of autarky. As a result, autarky wins the election with a probability of at least $(1-\lambda)^3$, which is significant when λ is small.

The reason that an uninformed Alice votes for autarky, despite viewing free trade to be superior ex ante, is that she infers that her vote matters when others are supporting trade. In this contingency, she ascribes sufficiently high probability to being "crowded out" from the benefits of free trade herself that it is no longer attractive for her. It is this kind of adverse-selection reasoning that our model formalizes.

The equilibrium that we have constructed is symmetric, strict, and in pure-strategies. Therefore, it cannot be ruled out by any standard equilibrium refinement and is robust to perturbations of the game. In this example, another equilibrium also exists: if all uninformed voters vote for free trade, an uninformed voter has an even stronger motive to support free trade conditioning on being pivotal. While this "good equilibrium" exists in this example, it does not always do so in our general model; for certain cases, the perverse equilibrium is the unique strict equilibrium in symmetric strategies (Proposition 10 in Section 6). Even when another equilibrium exists, we see a potential instability introduced by negative correlation—elections may succeed or fail depending on how voters expect others to behave—that contrasts with successful information aggregation results that apply across all equilibria (Feddersen and Pesendorfer, 1996, 1997).

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[4]An equilibrium is strict if each voter has strict incentives to follow the prescribed strategies. Accordingly such equilibria are in weakly undominated strategies.

[5]The probability that Alice is a winner conditional on being pivotal is $\frac{3(1-\lambda)^2}{3-2\lambda}\left(\frac{1}{3}\right) + \frac{4\lambda(1-\lambda)}{3-2\lambda}\left(\frac{1}{2}\right) + \frac{\lambda^2}{3-2\lambda}(1)$, where she is considering the conditional likelihood that that both, one, or neither of the other voters voting for autarky are uninformed.

This distinction is the core of our results: we show that when preferences are negatively correlated, and information is scarce, then there always exists an equilibrium in which the perverse outcome materializes (Theorem 1); if preferences are not negatively correlated, *every* equilibrium implements, with high likelihood, the policy that would obtain if all information was public (Theorem 2).

Example 2 (Ethical Voters). The above example, and our general model, involves contingent reasoning based on being pivotal. We now consider an example, where the same force can influence behavior in an ethical voter framework where no voter anticipates being pivotal, but groups of voters nevertheless condition on this prospect.

A continuum of voters is divided into three equally sized groups— agriculture (A), manufacturing (M), and services (S)—and votes are aggregated using simple-majority rule. Members of each group obtain a payoff from autarky that is normalized to 0, but trade liberalization has differential effects depending on which group faces the threat of import substitution. There are three ex ante equally likely states of the world $\{\omega_A, \omega_M, \omega_S\}$, where ω_G denotes the state in which group G is threatened and the other groups benefit from trade. In that state, members of group G each obtain a payoff of $-3/2$, and members of the other groups obtain a payoff of 1. Each voter votes ethically in the sense of Coate and Conlin (2004) and Feddersen and Sandroni (2006b): holding fixed the behavior of members of the other group, members of each group follow the rule that maximizes the payoffs of that group.

As in Example 1, free trade wins both under complete and no resolution of uncertainty (the ex ante payoff is $1/6$). Now suppose that the groups are asymmetrically and privately informed. We assume that each group privately learns the true state of the world with probability λ and remains uninformed otherwise.[6] Now there exists a consistent ethical profile in which each group benefits from voting for autarky whenever uninformed: holding fixed this behavior, the likelihood that one's group is a winner conditioning on another group being in favor of the policy is $\frac{\lambda}{2\lambda - \lambda^2}$, which is less than $\frac{3}{5}$ whenever $\lambda < \frac{1}{3}$. At those interim odds, an uninformed group is better off with autarky, and hence, autarky wins with probability $1 - \lambda^2$.

Each group supports autarky because it fears that if the group were to support free trade when uninformed, free trade wins in those contingencies where they are more likely to face import substitution. We see here that the optimal ethical rule involves contingent reasoning that generates an adverse selection effect, even though no individual voter conditions on her vote being pivotal. This example illustrates how asymmetric

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[6]Since voters in each group share common interests, we implicitly assume that information gained by a voter in a group G is freely shared with other members of her group.

information fosters suspicion amongst competing groups who attempt to infer who is gaining from the reform. When policy choices create polarization across groups, the members of a group may dislike policies supported by members of other groups.

Example 3 (Connection to No-Trade Theorems). Our final example connects the voting examples above to the familiar force of adverse selection in markets (Akerlof, 1970; Milgrom and Stokey, 1982). In trading decisions, the choice to trade matters only when one's partner is also willing to trade. If that trading partner has information that indicates that it is in her interests to sell an asset or object, it may not be beneficial to buy that object. Thus, the partner's willingness to trade diminishes the motive to trade.

We show that the adverse selection effect in distributive politics is similar by considering an environment strategically identical to a standard bilateral trading game. Suppose Alice and Bob are voting on whether to adopt a safe action or a risky action. Each obtains a payoff of 0 from the safe action, and from the risky action, one voter obtains a payoff of -1, and the other obtains a payoff of 2. Ex ante, each voter is equally likely to be the winner. The risky action is adopted if and only if Alice and Bob *unanimously* vote in favor of it; thus, Alice's vote is relevant only when Bob choses the risky option.

Suppose that each voter learns the identity of the winner from the risky action with probability λ and is uninformed otherwise. Then, for every $\lambda > 0$, there exists a strict equilibrium in which each uninformed voter votes for the safe action. In this strategy profile, Bob only votes for the risky action when he is the winner, and so an uninformed Alice would be supporting the policy only on those occasions where she is guaranteed to lose. Thus, her strict best-response is to vote for the safe action. For $\lambda > \frac{1}{2}$, this is the unique equilibrium. Analogous to adverse selection in a trading game, an uninformed Alice fears that the risky action is chosen only when she would be losing.

1.2 Related Literature

Distributive Politics: Distributive politics has motivated a vast literature in economics and political science. Our central contribution is to illustrate how adverse selection generates a force towards political failures when policies affect both aggregate welfare and its distribution.

An important precedent for our work is Fernandez and Rodrik (1991)'s argument for why electorates resist reform. They show that a policy that would win an election ex post—if all voters knew their payoffs from the policy—might fail ex ante. The wedge that they describe is decision-theoretic: the median voter is unwilling to bear the risks of policy reform even if she knows that a strict majority of voters benefit from such reform.

Our result shows that asymmetric information amplifies and strengthens this effect: even if the median voter prefers the policy reform ex ante and is willing to bear the risk, she may not do so ex interim when she recognizes that the support of others for this policy diminishes her chance to be a beneficiary. As in their work, a transfer from winners to losers would mitigate the electoral failure; however, as illustrated by Acemoglu (2003) and Jain and Mukand (2003), such transfer schemes may not be credible.

Our findings also resonate with the idea that voters fear losing control when the gains of others are not correlated with their own gains, and therefore insufficiently experiment with reforms. Strulovici (2010) illustrates how this logic emerges in a dynamic environment with *public* information where the choices of other voters reduces one's incentive to learn, even if voters' payoffs are independent. By contrast, learning and dynamics are not at issue in our setting: instead, the conflict is generated through (and requires) the combination of *private information* and negatively correlated payoffs.[7] Thus, his analysis illuminates our understanding of status quo biases whereas our analysis is actually neutral on whether electorates should exhibit a status quo or pro-reform bias. Adverse selection can generate either tendency because an uninformed voter may infer from others' support for a policy—independent of whether that policy is a reform or a status quo—that she should vote for the other policy.

A prior literature, dating back to the work of Olson (1965), Tullock (1983), and the "Virginia school" of political economy, has connected asymmetric information to distributive politics. Some of this work highlights how small groups that have high stakes from the policy choice may be best informed and able to lobby policymakers. Coate and Morris (1995) studies how reputational considerations may lead to inefficient decision making and Esteban and Ray (2006) illustrate how asymmetric information introduces the potential for signal-jamming. Our paper complements this literature by identifying a different channel through which asymmetric information generates electoral failures.

While we use a strategic voter model to frame our results, the adverse-selection logic applies to issues of conflict and competition within groups (as illustrated in Example 2). A rich literature highlights how polarization and inequality across groups lead to political and economic failures, conflicts (Esteban and Ray, 2008, 2011), and segregation (Bowles, Loury, and Sethi, 2014). We complement this literature by identifying how elections may suffer from adverse selection and the politics of suspicion when policies are polarizing.

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[7]Our condition of negative correlation is reminiscent of his notion of "adversity," where a voter anticipates that reforms are more likely to be chosen when she is a loser than when she is a winner. The conditions lack a precise connection because negative-correlation is a condition on primitives, not equilibria, whereas adversity is a condition on endogenous objects in an equilibrium.

Informational Approach to Elections: We compare equilibrium outcomes of elections in which voters are privately informed with a benchmark in which all information is public, as in the work pioneered by Austen-Smith and Banks (1996) and Feddersen and Pesendorfer (1996, 1997). Our main difference is that voters neither share common values nor have aligned ex interim preferences, and that payoffs may be negatively correlated.

We are not the first to investigate how misalignments might cause electoral failures; see Kim and Fey (2007), Gul and Pesendorfer (2009), Bhattacharya (2013), and Acharya (2016). But our results emphasize a different set of intuitions than this prior literature.[8] The logic of our paper is that of adverse selection: analogous to a no-trade theorem, an uninformed voter draws strong negative conclusions about the policy reform when she conditions on being pivotal and views the support of others as contaminating the policy. By contrast, the prior literature studies the distinct phenomenon of confounded learning that occurs when types have opposing ordinal preferences, which makes the mapping from payoff-relevant states to vote-shares non-invertible.[9]

Apart from modeling a different friction in collective choice, we use the logic of adverse selection to generate new comparative statics predictions on the role of aggregate and distributional uncertainty (as well as aggregate and distributional information), and formalize how voters may feel crowded out by the support of others.

To model adverse selection and potential payoff correlation, we depart from the standard model in which payoffs and types are conditionally independent. Recent papers on Bayesian persuasion in committees and multi-agent environments (Bardhi and Guo, 2017; Chan, Gupta, Li, and Wang, 2017; Mathevet, Perego, and Taneva, 2018) have shown how correlating information may be effective at persuading groups, although these papers have studied environments that differ from ours. Our goal here is not to study persuasion but Theorem 1 indicates that when payoffs are negatively correlated, voters can be persuaded to reject ex ante optimal policies with probability arbitrarily close to 1 in a strict equilibrium. Adverse selection and suspicion facilitate persuasion of groups.

Our results apply both in cases where the size of the electorate is fixed or is uncertain. When the population size is uncertain, we find that a voter attributes high probability to the election being small when she conditions on being pivotal. Because of this property, our results involve assessing whether payoffs are negatively correlated only for the smallest

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[8]The literature has also revealed many other reasons for informational inefficiency that are complementary to those we study, e.g., because voters wish to influence subsequent policy choices (Razin, 2003), there is aggregate uncertainty about the distribution of preferences (Feddersen and Pesendorfer, 1997) or the precision of information (Mandler, 2012), or the number of voters is correlated with the payoff-relevant state (Ekmekci and Lauermann, 2016a,b).

[9]The conclusion is similar to confounded learning that occurs in herding models (Smith and Sørensen, 2000) when there are opposed types.

possible electorate size. This property of believing that the election is small, conditional on being pivotal, is similar to the "participation curse" that Ekmekci and Lauermann (2016a,b) derive in pure common-value elections.

Our approach takes information as given and investigates the subsequent voting behavior. Perego and Yuksel (2018) adopt a complementary approach in investigating the incentives of media providers. They find that greater competition leads media providers to provide less information on issues of common interest and more information on issues where voters' preferences are polarized, and that this specialization leads to worse collective decisionmaking. We view their results and approach to complement those in Section 4.3 where we highlight how payoffs may be negatively correlated when information is distributional but not when it pertains to aggregate payoffs. Their analysis indicates how competition in the media market may exacerbate rather than mitigate the forces that we study in this paper.

2   Model

2.1   The Environment

Each of a finite population of voters, $\mathcal{N} = \{1, \ldots, n\}$, votes for one of two policies—a status quo policy Q and a reform R—and these votes are aggregated by a threshold-voting rule. The number of voters, n, is potentially uncertain and not necessarily commonly known by the voters. The reform R is implemented if at least τ fraction of the votes are cast for R, where $0 \leq \tau \leq 1$, and thus, in a population of size n, R is implemented if it receives at least $\lceil \tau n \rceil$ votes (where $\lceil \cdot \rceil$ is the ceiling function).

Each voter's (ex post) payoff from Q being selected is normalized to 0. The (ex post) payoffs from R being selected are uncertain: nature chooses a payoff profile v from $\mathcal{V}^n$, where v_i specifies voter i's payoff from R being chosen, and $\mathcal{V} \subseteq \mathbb{R}$ is a finite set of possible ex post payoffs. Before casting a vote, each voter i obtains private signal s_i that can convey information about the payoff profile, and is drawn from $\mathcal{S} \equiv \{s^0, s^1, \ldots, s^K\}$. Uncertainty is described by a joint probability distribution P on $\Omega \equiv \{(n, v, s) : n \in \mathbb{N}, v \in \mathcal{V}^n, s \in \mathcal{S}^n\}$. We use capital letters to denote random variables on Ω, and lower-case letters to denote their realizations. For a state $\omega = (n, v, s) \in \Omega$, let $N(\omega) = n$, $S(\omega) = s$, $S_i(\omega) = s_i$, $S_{-i}(\omega) = s_{-i}$, $V(\omega) = v$, and $V_i(\omega) = v_i$ denote the random variables describing, respectively, the population size, signal profile, voter i's signal, the signal profile of voters other than i, the payoff profile, and voter i's payoff

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from R being chosen.[10] For a non-null event $E \subseteq \Omega$, $V_i(E) \equiv \sum_{\omega \in \Omega} V_i(\omega) P(\omega|E)$ denotes voter i's conditional expected payoff from R being chosen when she knows event E.

We impose four assumptions on the primitives of the model (Ω, P, τ). The first assumption is that voters are ex ante symmetric.

Assumption 1. *Voters are exchangeable: $P(n, v, s) = P(n, \tilde{v}, \tilde{s})$ for every permutation $(\tilde{v}, \tilde{s})$ of (v, s).*[11]

The assumption that voters are ex ante symmetric streamlines the exposition and allows us to focus exclusively on the conflict generated by asymmetric information rather than heterogeneous preferences. But, of course, for many applications of this logic, one would like to see the results applied to a setting where voters are heterogeneous. In Section 5, we show that the same results apply even if voters are voters are ex ante heterogeneous, in that some "elite" voters are more likely to benefit from the reform than "non-elites," and that this heterogeneity strengthens the forces in our baseline model.

Our second assumption distinguishes signal s^0, which we describe as an *uninformative signal*, from the remaining signals $\mathcal{M} \equiv \mathcal{S} \backslash \{s^0\}$, which we describe as *informative*.

Assumption 2. *There is an uninformative signal, and informative signals are sufficient:*
  (a) **Uninformative signal:** *For all $(n, v, s) \in \Omega$ with $s_i = s^0$, $P(s_i) > 0$ and $P(n, v, s) = P(n, v, s_{-i}) P(s_i)$.*
  (b) **Informative signals:** *For all $(n, v, s) \in \Omega$ with $s_i \neq s^0$, $V_i(n, s) > 0$ if and only if $V_i(s_i) > 0$.*

Assumption 2(a) asserts that there is a strictly positive probability that each voter receives the "null" signal s^0, and that signal conveys no information about the population size, the payoff profile, and the signals received by other voters. Assumption 2(b) speaks to the informativeness of the other signals, $\mathcal{M} \equiv \{s^1, ..., s^K\}$: if a voter obtains an informative signal, then her own information is a sufficient statistic for the entire signal profile in determining her ordinal ranking between Q and R. A special case of Assumption 2 is where each informed voter observes directly her payoff from R, as considered in the examples in Section 1.1 and some of the prior literature (Feddersen and Pesendorfer, 1996). More generally, Assumption 2(b) does not imply that informed voters observe or are all that well-informed (in an objective sense) about their payoffs from R, but simply that

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[10]Given any random variable X on Ω, we denote by $\{x\} \equiv \{\omega : X(\omega) = x\}$ the event where x is realized for X, omitting the brackets when it is clear that x is an event. In particular, s_i^k is the event $\{\omega : S_i(\omega) = s^k\}$.

[11]We say that $(\tilde{v}, \tilde{s})$ is a permutation of (v, s) if there is a one-to-one mapping $\psi : \mathcal{N} \to \mathcal{N}$ such that $(v_i, s_i) = (\tilde{v}_{\psi(i)}, \tilde{s}_{\psi(i)})$ for all $i \in \mathcal{N}$.

such individuals are well-informed *relative* to the electorate, insofar as learning others' signals does not flip their (interim) ordinal rankings of Q and R.[12]

We partition the set of informative signals, $\mathcal{M}$, into "good" and "bad" news. Signals $\mathcal{G} \equiv \{s^k \in \mathcal{M} : V_i(s^k) \geq 0\}$ convey *good-news* about the reform: a voter who receives signal $s_i \in \mathcal{G}$ expects that she will benefit from R being chosen. Likewise, signals $\mathcal{B} \equiv \{s^k \in \mathcal{M} : V_i(s^k) < 0\}$ convey *bad-news* about R and that the voter is better off with Q. For a signal profile s, $M(s)$ is the number of informed voters, and $G(s)$ is the number of voters who received good news.

Assumption 3. *Ex interim payoffs satisfy non-redundancy and no ties:*
  (a) **Non-redundancy***: If $P(n) > 0$, then $P\left(\frac{G}{n} \geq \tau \mid n\right) > 0$.*
  (b) **No ties:** *If $P(E) > 0$, then $V_i(E) \neq 0$.*

Assumption 3(a)-(b) are bookkeeping assumptions that simplify our exposition without playing a substantive role. Assumption 3(a) guarantees that under public information, it is possible for R to win; this assumption is not necessary for our results, but the environment would be uninteresting if it fails. Assumption 3(b) allows us to avoid tie-breaking rules.

Our fourth assumption describes the uncertainty about the population size. Our results apply to elections where the size of the electorate is commonly known, if it is uncertain and drawn from a finite-support, or if it is drawn an unbounded distribution whose tail vanish sufficiently fast. For concreteness, we specify a particular distribution corresponding to a minimum-size $n_0 \geq 2$ plus an increment that is distributed Poisson.[13] Let N denote the random variable for population size.

Assumption 4. *We assume the following about the distribution of population size:*
  (a) **Lowest Population Size***: The random variable N takes a minimum value of $n_0 \geq 2$, where $\lceil \tau n_0 \rceil < \lceil \tau (n_0 + 1) \rceil$.*
  (b) **Poisson Distribution***: $N - n_0$ is distributed Poisson with mean μ, where $\mu \geq 0$.[14]*

Assumption 4(a) guarantees that the minimal possible population size involves at least $n_0 \geq 2$ voters, which is necessary for our notion of payoffs being "negatively correlated"

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[12]Indeed, our analysis in Proposition 7 corresponds to a case where no voter is objectively all that well-informed about her ex post payoffs.

[13]The Poisson-population model for voting was proposed by Myerson (1998, 2000), and features in a number of recent papers (Krishna and Morgan, 2011; Ekmekci and Lauermann, 2016a). Whenever there is uncertainty about the population size, a voter's *subjective perception* of the number of voters differs from the objective distribution. Appendix A.1.2 describes the formal properties of the marginal distribution over population size and the appropriate subjective perspective adopted by each voter that we use to establish our results.

[14]Hence, $P(n = n_0 + z) = \frac{\mu^z e^{-\mu}}{z!}$ for all $z \in \mathbb{N} \cup \{0\}$. We follow the convention that $0^0 \equiv 1$. Hence, when $\mu = 0$, the population size is n_0 with probability 1.

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(Definition 1 on p. 17) to be well-defined. Furthermore, it assumes that the level of support needed for R to pass with n_0 voters is not the same as that needed to pass with $n_0 + 1$ voters, which simplifies exposition. Assumption 4(b) assumes that the population-size is the sum of n_0 and a Poisson random variable. In the Appendix, we specify conditions on a general class of distributions on population-uncertainty under which our results follow; in particular, in Lemma 1, we show that our results apply so long as $\lim_{n \to \infty} \frac{P(n+1)}{P(n)} \leq \frac{1}{4}$.

A Decomposition: Assumptions 1 and 2(a) permit a decomposition of P into the probability that a voter obtains the uninformative signal s^0 and a probability distribution over all other primitives. This decomposition permits us to meaningfully vary the probability of being informed while holding everything else fixed.

We use λ to denote the probability that a voter obtains an informative signal.[15] The primitive probability distribution P can then be viewed as a member of a family indexed by $(\tilde{P}, \lambda)_{\lambda \in (0,1)}$, where, for every event $\{n, s\} \subseteq \Omega$, $\tilde{P}(s) = P(s)\lambda^{-n}$ if $s \in \mathcal{M}^n$, and $\tilde{P}(s) = 0$ otherwise. While λ parameterizes the probability that a voter is informed, $\tilde{P}$ is a joint distribution over $\tilde{\Omega} \equiv \{(n, v, s) \in \Omega : s \in \mathcal{M}^n\}$. The distribution P corresponds to the unique element of the family $(\tilde{P}, \lambda)_{\lambda \in (0,1)}$ where $\lambda = 1 - P(s_i^0)$. This decomposition is described and established in Appendix A.1.3.

2.2 Strategies and Equilibrium

We consider symmetric Bayes-Nash equilibria in which each voter plays weakly undominated strategies. Henceforth, we refer to these weakly undominated symmetric equilibria simply as *equilibria*.[16]

We contrast our setting with a *public information environment*, where the population size and the entire signal profile s is observed by each voter. The following result summarizes equilibrium existence in these two environments, and additional properties that hold in the public information environment.

Proposition 1. *The private information environment has an equilibrium. The public information environment has a unique equilibrium, which is strict and symmetric.*

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[15]This parameter is identical across voters (because of Assumption 1) and population sizes (because of Assumption 2(a))

[16]In such an equilibrium, the voting behavior of informed voters is straightforward: if voter i obtains good news ($s_i \in \mathcal{G}$), she votes for R; if she obtains bad news ($s_i \in \mathcal{B}$), she votes for Q.

2.3   Discussion

Below, we clarify some of the details of our model.

Status Quo and Reforms: The sense in which Q is a status quo is that the payoffs from that policy are normalized to 0, and it is relative to this normalization that the payoff from the reform R is assessed. While we find it convenient to frame our notation and analysis in these terms, our results themselves have no bearing on status quo or pro-reform biases (and all of our results apply *mutatis mutandi* with the notation reversed).

Information Structure: Our analysis focuses on the behavior of uninformed voters both to cleanly illustrate the scope for adverse selection and because we view information to be scarce in distributive politics. It is not crucial to our results that uninformed voters are completely uninformed; because the equilibrium we study in Theorem 1 is strict, perturbing the model so that uninformed voters are slightly informed would not change our results. Assumption 2(b) guarantees that informed voters have a weakly dominant action and therefore permits us to maintain our focus on the behavior of uninformed voters. Previous work, e.g. Feddersen and Pesendorfer (1996), has made a similar (but stronger) assumption—namely that informed voters learn their cardinal payoffs from policies perfectly—for the same purpose. Relative to that stronger assumption, the additional generality afforded by Assumption 2(b) is useful for our analysis of the differential impact of aggregate and distributional information in Section 4.3. In particular, our assumption is compatible with environments in which all voters, including informed ones, have scarce information. Assumption 2(b) stipulates that for an "informed" voter, learning the information of others does not change her interim ordinal ranking of Q and R.

3   Distributive Politics and Negative Correlation

This section describes our two main results. Section 3.1 develops the benchmarks corresponding to the ex ante optimal policy and the electoral outcome if all information were public. Section 3.2 defines negative correlation and shows that negative correlation is sufficient to generate electoral failures; Section 3.3 shows that it is also necessary.

3.1   Benchmarks: Ex Ante Optimal and Public Information

To compare behavior against a simple public information benchmark, we assume that R is the ex ante superior policy for every population size.

Assumption 5. *When a voter learns only the population size, then R is the superior policy: $V_i(n) > 0$ for all n.*

We now consider the public information benchmark where the population size and entire signal profile s is observed by each voter. When information is scarce, the public information benchmark selects R with high probability in the unique equilibrium.

Proposition 2. *For every $\varepsilon > 0$, there exists $\tilde{\lambda} > 0$ such that, for all $\lambda < \tilde{\lambda}$, R wins with probability exceeding $1 - \varepsilon$ in the unique equilibrium of the public information environment.*

3.2   Negative Correlation Fosters Electoral Failures

We begin by describing an (interim) expected payoff that is important for our definition of negative correlation. Instead of defining negative correlation for each possible size of the electorate, it suffices for our results to do so only for the smallest possible size, n_0. For every κ in $[0, 1]$, let

$$V^G(\kappa) \equiv V_i(N = n_0, S_i = s^0, M = G = \lceil \kappa n_0 \rceil - 1). \tag{1}$$

This term is the expected payoff for voter i when (i) she conditions on the population size being n_0, (ii) she receives the uninformative signal s^0, (iii) $\lceil \kappa n_0 \rceil - 1$ other voters receive good news, and (iv) all others receive no information. Because voters are exchangeable, a voter subscript is unnecessary for $V^G(\kappa)$. Assumption 3(a) guarantees that $V^G(\kappa)$ is well-defined because the relevant conditioning event has positive probability.

The threshold $\lceil \kappa n_0 \rceil - 1$ puts the proportion of voters who obtain good information to be just one vote shy of a κ fraction. Learning that so many voters obtain information does not change voter i's belief about R (because of Assumption 2(a)) but learning that they all obtained good news is potentially informative. In particular, it conveys the good news that there are at least $\lceil \kappa n_0 \rceil - 1$ winners but also the bad news that of the realized number of winners, $\lceil \kappa n_0 \rceil - 1$ of those "slots" have been occupied by others. These two different features push in opposite directions—one bearing on aggregate considerations and the other bearing on distributional considerations—and evaluating whether the bad news effect dominates at the voting rule τ characterizes negative correlation.

Definition 1. *Payoffs are τ-**negatively correlated** if $V^G(\tau) < 0$.*

Being τ-negatively correlated implies that when an uninformed voter considers the prospect that the number of voters who have received good news is just one voter shy of a τ proportion, and only those voters receive information at all, her expected payoff

from R would be strictly negative if the population size were n_0. In this contingency, learning that $\lceil \tau n_0 \rceil - 1$ voters are winners contaminates the reform R sufficiently from an uninformed voter's perspective that she would prefer Q in this contingency.[17]

Using this definition, we describe our main result.

Theorem 1. *Suppose payoffs are τ-negatively correlated. Then, for every $\varepsilon > 0$, there exists $\tilde{\lambda} > 0$ such that for all $\lambda < \tilde{\lambda}$, there exists a strict equilibrium in which Q wins with probability exceeding $1 - \varepsilon$.*

This result asserts that when payoffs are τ-negatively correlated, Q wins with high probability if the probability with which an individual voter obtains information is low. This outcome contrasts with collective choice when information is public (where R is selected with high probability, as described in Proposition 2). The source of this electoral failure is that asymmetric information generates an adverse selection effect in distributive politics, and that effect can induce a voter to reject policies that she dislikes when supported by others. When an uninformed voter conditions on being pivotal, she infers that others support R, and in this contingency, R no longer is her best option.

We make a few notes about this result. Because the equilibrium is strict, it survives all well-known refinements and is robust to perturbations of the environment. For example, furnishing uninformed voters with a small amount of additional information—so that their ex interim beliefs diverge (slightly) from their prior beliefs —would not preclude the behavior described in Theorem 1. Moreover, it is straightforward to see that augmenting the voting game with the possibility for abstention does not eliminate this equilibrium; conditional on all others voting, it remains a strict equilibrium to also do so. Furthermore, since the size of the electorate may be arbitrarily large, this electoral failure is compatible with scenarios in which collectively, there are many informed voters.

Our result leaves room for the possibility of equilibria that are better for uninformed voters. Such equilibria need not exist: we discuss in Section 6 conditions under which they do, as well as conditions under which the equilibrium that we describe in Theorem 1 is the unique strict symmetric equilibrium. Regardless, the negative result contrasts with the positive result that we derive in Theorem 2 when payoffs are not negatively correlated; in that case, all equilibria are guaranteed to select R with high probability. Therefore, even if other equilibria exist, voter coordination may be vital when payoffs are negatively correlated. In such cases, the potential multiplicity, and the significant difficulties in coordinating large groups of voters, opens the door for electoral failures.

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[17]Formally, negative correlation is a property of the (interim) expected payoff generated by the joint distribution P but is independent of λ, the probability with which a voter obtains information. Thus, holding fixed a probability distribution on ex post profiles, whether expected payoffs are negatively correlated depends on the information structure, but not on the likelihood that a voter becomes informed.

The remainder of this subsection sketches the argument for Theorem 1, with the formal proof in the Appendix. The argument uses the logic of adverse selection directly: an uninformed voter votes against R because she recognizes that it passes only if it has the support of others. The sketch also illustrates why the result applies both to a fixed population size n_0 and a population size with uncertainty.

Sketch of the Proof: Our proof is constructive in that we specify a strategy profile, establish that it is a strict equilibrium, and show that it selects Q with high probability.

Step 1. Consider the strategy profile where each uninformed voter votes for Q, and each informed voter chooses her weakly dominant action. We claim that this strategy profile is a strict equilibrium when λ is sufficiently small.

To see why, suppose that an uninformed voter conditions on being pivotal. She recognizes that relative to the realized population size n, the fraction of votes for R is $\lceil \tau n \rceil - 1$. All of these votes must be from voters who are informed winners, whereas all remaining votes for Q may be from either uninformed voters or informed losers. An uninformed voter's best-response is unclear at this stage because we have not assumed that the voter knows the realized population size and Definition 1 references only conditional payoffs when the population size is n_0. So we tackle the issues introduced by population-uncertainty in two sub-steps.

(i) Suppose that it is commonly known that the population size is n_0. When information is scarce, an uninformed voter anticipates that most votes for Q are being cast by voters who are uninformed rather than informed losers. Conditioning on this event, her ex interim payoff from R approximates $V^G(\tau)$, which is strictly negative by Definition 1. Therefore, her strict best response is to vote for Q.

(ii) This sub-step proves that conditioning on being pivotal, an uninformed voter places high probability on the population size being n_0: given the strategy profile and scarcity of information, it is more likely that a voter is pivotal in a smaller election than in a larger election.[18] Therefore, the strict incentives to vote for Q described in (i) apply even when the voter is uncertain about the size of the electorate.

Step 2. When the probability of being informed is low, the fraction of voters who are uninformed is likely to be high. Because each uninformed voter votes for Q, it wins with high probability.

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[18] Albeit in a different model, Ekmekci and Lauermann (2016a) highlight how this is a general feature of a responsive equilibrium and call it the "participation curse."

3.3 A Converse Result: Necessity of Negative Correlation

We show that τ-negative correlation is also necessary for the existence of an equilibrium that selects Q when information is scarce. Specifically, we establish that if payoffs are not τ-negatively correlated, then all equilibria select R with high probability.

Our argument requires an additional assumption on interim payoffs stated below.

Assumption 6. $V^G(\cdot)$ *satisfies positive-connectedness: if* $V^G(\kappa) > 0$ *and* $V^G(\kappa') > 0$ *for* $\kappa' > \kappa$, *then* $V^G(\kappa'') > 0$ *for every* κ'' *such that* $\kappa \leq \kappa'' \leq \kappa'$.

This assumption equates to "single-crossing from above," where $V^G(\kappa)$ can cross 0 from above only once. Assumptions 5 and 6 together imply that $V^G(\cdot)$ crosses 0 at most once, and from above. We view this condition to be intuitive: if the conditional likelihood favors R when there is a proportion κ of winners other than voter i, and when there is a proportion $\kappa' > \kappa$ of winners other than voter i, then voter i must also prefer R when there is an intermediate proportion of winners. Indeed, all of the examples in the paper satisfy this condition; however, Assumption 6 is not implied by our other assumptions.[19]

We show that when payoffs are not τ-negatively correlated, every (pure and mixed) equilibrium of the private information environment coincides with the unique equilibrium of the public information environment with high probability.

Theorem 2. *Suppose Assumption 6 is satisfied. If payoffs are not τ-negatively correlated, then for every* $\varepsilon > 0$, *there exists* $\tilde{\lambda} > 0$ *such that for all* $\lambda < \tilde{\lambda}$, *$R$ wins with probability at least* $1 - \varepsilon$ *in every equilibrium.*

The argument for Theorem 2 is involved because it applies across all equilibria, but its intuition connects once more to adverse selection. When payoffs are not τ-negatively correlated, we establish that the strategy profile considered in Theorem 1 is no longer an equilibrium: even if all of the votes for R are from those who obtain good news, that is not enough bad news to make an uninformed voter prefer Q. Thus, the strategy profile where every uninformed voter votes for Q is not an equilibrium. The single-crossing condition (Assumption 6) ensures that when one has uninformed voters, in addition to informed winners, voting for R, these additional votes do not contaminate R and deter an uninformed voter from supporting R. This is then sufficient to ensure that there are no equilibria in mixed strategies where the status quo wins with probability exceeding ε when information is scarce.

In combining Theorems 1 and 2, we see that electoral outcomes depend starkly on whether payoffs are negatively correlated: in the former case, there exists an equilibrium

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[19]An example is available upon request.

in which Q is selected with high probability, whereas in the latter case, all equilibria select R with high probability. Therefore, it is important to investigate features of an economic environment that exacerbate or mitigate τ-negative correlation. We turn to this question in the next section.

4   When are Payoffs Negatively Correlated?

The goal of this section is to study features that make payoffs more or less negatively correlated. We derive these predictions in a tractable subclass of the model that decouples aggregate and distributional uncertainty. Suppose that the reform R generates *winners* and *losers*; each winner obtains $v_w > 0$ and each loser obtains $-v_l < 0$.[20] Uncertainty is about the number and identity of winners: the number of winners is denoted by the random variable η (*aggregate uncertainty*), and the identity of winners is determined by a random vector ρ (*distributional uncertainty*) where ρ_i denotes the priority of voter i in being a winner (a lower ρ_i indicating a higher priority). Voter i is a winner if and only if $\rho_i \leq \eta$, and so her payoff from the reform depends on the realization of both aggregate and distributional uncertainty. We denote by W_i the event that voter i is a winner, and by L_i its complement. The information structure remains as in Section 2.

This model is a special case of Section 2, where P is now a joint distribution on the number of winners, the priority ranking, and voters' information, and we assume that Assumptions 1–3 are satisfied. For expositional clarity, we assume that the population size is fixed at n_0 and commonly known (although this is unnecessary for the analysis). Thus, it simplifies notation to write the minimum *number* of votes needed for R to win in a population size of size n_0 as τ_0, defined as

$$\tau_0 \equiv \lceil \tau n_0 \rceil. \tag{2}$$

4.1   Polarization Ratios

The reform R is ex ante optimal when $P(W_i)v_w - (1 - P(W_i))v_l > 0$, where $P(W_i)$ is the ex ante probability that voter i is a winner.[21] This inequality can be re-written as

$$\frac{P(W_i)}{1 - P(W_i)} > \frac{v_l}{v_w}. \tag{3}$$

---

[20]We treat each as an ex post payoff, but it may be an expected payoff conditional on being a winner or loser drawn independently from everything else in the game.

[21]Since voters are exchangeable, $P(W_i) = \sum_{\eta=1}^{n_0} \frac{P(\eta)\eta}{n}$.

We describe the RHS of the above inequality as the *polarization ratio*, which specifies the cost incurred by each loser relative to the gain that accrues to each winner. The LHS is the ex ante likelihood ratio of being a winner.

The condition of τ-negative correlation compares the polarization ratio with a conditional likelihood ratio. Let $P(W_i|\tau_0 - 1)$ denote the probability that i is a winner conditional on herself being uninformed and knowing that there are exactly $\tau_0 - 1$ informed voters, all of whom have good news. Payoffs are τ-negatively correlated if and only if

$$\frac{P(W_i|\tau_0 - 1)}{1 - P(W_i|\tau_0 - 1)} < \frac{v_l}{v_w}. \tag{4}$$

Comparing (3) and (4), we can find payoffs such that (i) the reform is ex ante optimal, and (ii) payoffs are τ-negatively correlated if and only if

$$P(W_i|\tau_0 - 1) < P(W_i). \tag{5}$$

In other words, for a voter i who receives no information, the prospect that exactly $\tau_0 - 1$ other voters are informed and received good news diminishes her chances of being a winner relative to her prior belief.

It follows directly from (4) that increasing the polarization ratio makes a policy reform more susceptible to negative correlation (and hence a proof is omitted).

Proposition 3. *If (P, v_w, v_l) generates τ-negatively correlated payoffs, then for every (v_w', v_l') such that $\frac{v_l'}{v_w'} > \frac{v_l}{v_w}$, (P, v_w', v_l') also generates τ-negatively correlated payoffs.*

Figure 1 illustrates this perspective on τ-negative correlation. For a reform R with gains and losses of (v_w^R, v_l^R), one represents the reform by its coordinates (v_w^R, v_l^R). The polarization ratio of the reform is the slope of the ray that connects the origin to (v_w^R, v_l^R). We compare this ray with rays A and B. The steeper ray (ray A) has a slope equal to the LHS of (3) and the other, ray B has the slope equal to the LHS of (4). We see that the ray for reform R is sandwiched between these two rays which implies that R is both ex ante optimal and generates τ-negatively correlated payoffs. This is the region of interest for our analysis. By contrast, if the polarization ratio is sufficiently low, as in reform R', then the reform is ex ante optimal, and payoffs are not τ-negatively correlated. If the polarization ratio is sufficiently high, as in R'', then Q is ex ante optimal and payoffs are τ-negatively correlated. This is the region of interest where the logic of Fernandez and Rodrik (1991) directly applies. As seen in the picture, changing a policy reform by increasing the gains of winners at the expense of a disproportionately higher cost
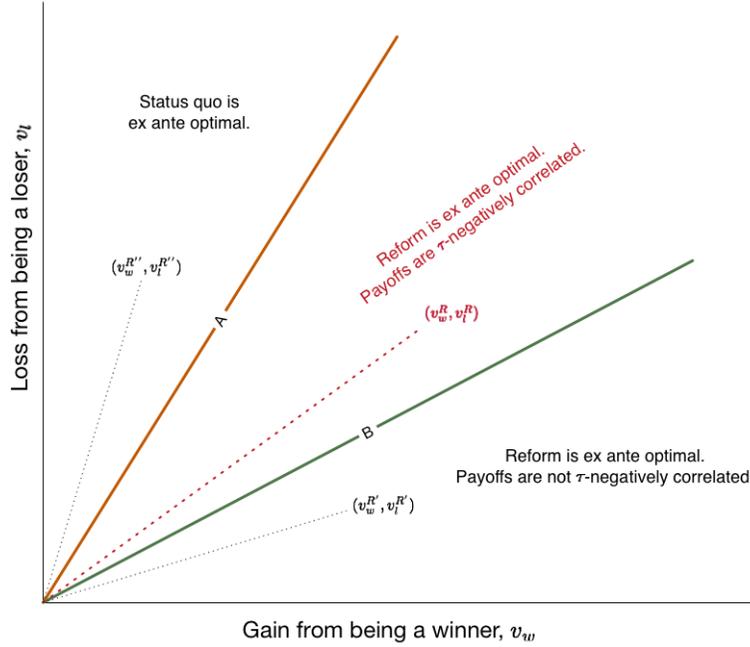
Figure 1: Polarization Ratios and Negative Correlation.

to losers, as in going from R' to R may cause the payoffs to be τ-negatively correlated. Conversely, were redistribution from winners to losers possible, such redistribution would necessarily lower the polarization ratio, and thereby make the policy choice less prone to negatively correlated payoffs.

4.2 Crowding Out: A Stochastic Order

The preceding discussion fixed the distribution P and compared polarization ratios. We now compare distributions to measure the degree of "crowding out" that a voter anticipates from learning that others are winners. This crowding-out effect measures the degree to which the bad news of learning that other "winner-slots" have been occupied counteracts the good news that there are many winners. Returning to Figure 1, these changes influence the slope of ray B without changing that of ray A, thereby expanding or contracting the region in which ex ante optimal policies are τ-negatively correlated. Below, we define the appropriate stochastic order, derive an intuitive representation, and relate it to the likelihood ratio dominance order.

For this analysis, we assume that an informed voter directly observes whether she is a winner or loser. We say that $P' \succeq_{\tau\text{-}nc} P$ if for every (v_w, v_l), whenever (P', v_w, v_l) generates τ-negatively correlated payoffs, so does (P, v_w, v_l). Accordingly, $\succeq_{\tau\text{-}nc}$ is an order on distributions that reflects "resistance to τ-negative correlation." A priori, it

is unclear whether such an order is complete and transitive. Below, we prove both that it is, and that it has an intuitive representation. This representation involves the conditional expectation of the number of winners from R (denoted by η), conditioning on the important interim event that there are $\tau_0 - 1$ winners (and no other informed voters).

Proposition 4. *The binary relation $\succeq_{\tau\text{-}nc}$ is complete and transitive. Moreover, $P' \succeq_{\tau\text{-}nc} P$ if and only if $E_{P'}(\eta|M = G = \tau_0 - 1) \geq E_P(\eta|M = G = \tau_0 - 1)$.*

Proposition 4 asserts that distribution P' is more resistant to τ-negatively correlated payoffs than P if, upon conditioning on $\tau_0 - 1$ voters obtaining good news and all others remaining uninformed, one expects more winners with a prior P' than with a prior P. This representation captures how with P', learning that others are winners is better news than with P because P' has a higher (conditionally) expected number of winners.

Our second result relates $\succeq_{\tau\text{-}nc}$ to the familiar likelihood ratio dominance order. Say that $P' \succeq_{LR} P$ if for every z and z' in $\{0, \ldots, n_0\}$ where $z' > z$,

$$\frac{P'(\eta = z')}{P'(\eta = z)} \geq \frac{P(\eta = z')}{P(\eta = z)}. \tag{6}$$

We establish the following claim.

Proposition 5. *If $P' \succeq_{LR} P$, then $P' \succeq_{\tau\text{-}nc} P$ for every τ.*

Hence, shifts in the distribution over the number of winners that improve it in the sense of likelihood-ratio dominance are guaranteed to make collective choice more resistant to negative correlation (regardless of the voting rule).[22] The channel conveys a clear economic logic: shifting mass to a higher number of winners (in an MLRP-way) reduces the crowding-out effect from learning that others are winners.

4.3 Aggregate Versus Distributional Information

Finally, we compare collective choice when voters obtain only aggregate information about the policy choices to collective choice when only distributional information is obtained. For example, contrast the following messages:

- *Free trade promotes economic growth.*
- *The corporate elite gains from free trade before ordinary citizens see any gains.*

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[22] As our proof makes clear, all that is necessary is that the inequality in (6) holds for all values of z that weakly exceed $\tau_0 - 1$.

We view the former as describing implications for the aggregate number of winners, η, without offering information about distributional consequences, whereas the latter conveys information primarily about the priority ranking, ρ. Below, we show that the first kind of information does not foster negative correlation but the second does.

We first consider the case in which all information that voters obtain is potentially informative about aggregate ex post payoffs, but is completely uninformative about its distribution. Formally, for every signal profile s, the expected payoffs of any two voters conditioning on s are identical; in other words, information does not discriminate between voters. We show that in this case, (5) cannot be satisfied, leading to the following result.

Proposition 6. *If voters' signals are informative only about aggregate consequences, payoffs are never τ-negatively correlated.*

In this case, information that is good news for others—e.g., there are many winners—is also good news for an uninformed voter. Thus, even if opening trade barriers is polarizing, when voters do not obtain any information about the identities of winners and losers, then payoffs cannot be τ-negatively correlated for any voting rule τ.[23]

When all information is purely distributional, the opposite holds.

Proposition 7. *If informative signals reveal a voter's priority but are uninformative about the number of winners, payoffs are τ-negatively correlated for some (v_w, v_l).*

When information is about distributional and not aggregate consequences, then information that is good news for other voters—them having a higher priority—is bad news for oneself. In this case, the inequality in (5) is always satisfied, and so there are polarization ratios that ensure that payoffs are τ-negatively correlated.

We view these conclusions to be germane to discussions of the role of media in politics, particularly given the motives of media providers to provide polarizing information (Martin and Yurukoglu, 2017; Perego and Yuksel, 2018), and the degree to which news is segregated (Prat, 2017; Kennedy and Prat, 2017). Our analysis suggests that the market for news has important downstream implications for collective choice.

5   Asymmetric Voters: Elites and Non-Elites

We have illustrated how asymmetric information can generate an adverse selection effect that impedes elections from selecting the right policy. To isolate the role of asymmetric

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[23]As seen in the proof, Proposition 6 applies to the general framework described in Section 2.

information, we have considered a case where the only difference between voters is infor-mational. But, of course, in many of the cases where one may wish to apply this model, voters are not symmetric. Instead, one may envision a significant degree of socioeconomic differences across voters that influence how they fare from R, and that these differences are well known to all the voters ex ante. We show that our results apply even if voters are heterogeneous, and in such heterogeneities may actually amplify the scope for adverse selection.

We extend the analysis of Section 2, but fixing the population size at n_0. We no longer impose the condition that voters are exchangeable (Assumption 1). Instead, any two voters may differ in their ex ante probabilities of gaining from the reform R. In our analysis below, we show that if voters can be decomposed into "elites" and "non-elites" where the elite voters are a minority (relative to the voting threshold τ), then adverse selection may still induce an electoral failure through the strategic thinking of non-elite voters. To describe the appropriate generalization of τ-negative correlation once voters are heterogeneous, given a non-empty set of voters H, let $M(H)$ denote the random variable describing the number of informed voters in H.

Definition 2. *Payoffs are **majority-τ-negatively correlated** if there exists a binary partition of the electorate, $\{\mathcal{E}, \mathcal{NE}\}$ such that the following are true:*

(a) *Elites are a minority:* $|\mathcal{E}| < \tau_0$.

(b) *Elites do not fear the support of others:* $V_i(s^0, G = M = M(\mathcal{NE}) = \tau_0 - |\mathcal{E}| - 1) > 0$ *for every i in $\mathcal{E}$.*

(c) *Non-elites do fear the support of others:* $V_i(s^0, G = M = M(\mathcal{NE}) = \tau_0 - |\mathcal{E}| - 1) < 0$ *for every i in $\mathcal{NE}$.*

Let us describe Definition 2 in words. We partition the set of voters into $\mathcal{E}$ and $\mathcal{NE}$, which we interpret as elites and non-elites respectively. Condition (a) asserts that the elites are a minority of the electorate relative to the voting rule τ_0. Condition (b) states that elite voters are unconcerned by adverse selection and vote for R even after conditioning on the support of others. By contrast, condition (c) states that non-elites *are* concerned by adverse selection: knowing that all elites vote for R, each views her chances to be a winner to be low when sufficiently many non-elite voters $(\tau_0 - |\mathcal{E}| - 1)$ obtain good news. The combination of (b) and (c) implies that elites are more likely to benefit from the reform. When the set of elites $\mathcal{E}$ is empty, the condition of majority-τ-negative correlation collapses to our baseline definition of τ-negative correlation (Definition 1).

Definition 2 is compatible with many cases where voters are heterogeneous. A salient example is where the priority of every elite voter always exceeds that of every non-elite

voter. In this case, for an elite voter, there is no negative effect from learning that non-elites have received good news; on the contrary, if a single non-elite voter gains from the reform, then every elite voter is guaranteed to do so. By contrast, non-elites are crowded out from being winners both by elites and other non-elites: if a non-elite voter conditions on non-elites gaining from the reform, because she knows that elites are certainly gaining from R, she assesses her chances of being a winner to be low.

This logic of adverse selection generalizes to the case where voters are heterogeneous, and thus, we prove a result analogous to Theorem 1.

Proposition 8. *Suppose payoffs are majority-τ-negatively correlated. Then, for every $\varepsilon > 0$, there exists $\tilde{\lambda} > 0$ such that for all $\lambda < \tilde{\lambda}$, there exists a strict equilibrium in which Q wins with probability exceeding $1 - \varepsilon$. In this equilibrium, uninformed voters in $\mathcal{E}$ vote for R and uninformed voters in $\mathcal{NE}$ vote for Q.*

The key idea is that elite voters, unconcerned by adverse selection, vote for R even when they are uninformed. But elites are a minority group relative to the voting threshold τ_0, and therefore the support of non-elites is needed. An uninformed non-elite voter then worries about being crowded out, recognizing that her vote matters only when other non-elites are in support of R.

Not only are our results compatible with this form of heterogeneity, but the presence of elite voters actually amplifies the adverse selection effect for non-elites. More specifically, we show that as one increases the number of elite voters, non-elite voters are even more concerned about adverse selection. This is a subtle effect that operates only if there is both aggregate and distributional uncertainty.

To illustrate this amplification effect cleanly, we specialize the environment so that as we vary the number of elites, everything else is being held fixed in the model. Similar to our framework in Section 4, we assume that each winner obtains $v_w > 0$ and each loser obtains $-v_l < 0$. Each voter has a priority ρ_i, and is a winner if and only if the number of winners, η, is no less than her priority; recall that a lower ρ_i indicates a higher priority. We partition the set of voters into elites and non-elites and assume that voters within each group are exchangeable and that each elite voter has a higher priority than each non-elite voter. Payoffs are majority-τ-negatively correlated if condition (c) in Definition 2 is satisfied (condition (b) being satisfied automatically). For a voter i, W_i denotes the event where i is a winner under the reform, and $\tilde{E}$ denotes the event that voter i is uninformed and $G = M = M(\mathcal{NE}) = \tau_0 - |\mathcal{E}| - 1$. As we showed in Section 4.1,

$V_i(\tilde{E}) < 0$ if and only if

$$\frac{P(W_i|\tilde{E})}{1 - P(W_i|\tilde{E})} < \frac{v_l}{v_w}. \tag{7}$$

Thus, a way to measure the degree to which changing the number of elites affects the susceptibility to adverse selection is to see how the conditional probability $P(W_i|\tilde{E})$ for a non-elite voter changes with the number of elites $|\mathcal{E}|$. We find a clear monotone effect.

Proposition 9. *For each non-elite voter i, $P(W_i|\tilde{E})$ is decreasing in the number of elites.*

Proposition 9 implies that as one increases the number of elites, $|\mathcal{E}|$, one decreases the conditional probability that a non-elite voter is a winner. Through (7), this decrease expands the range of polarization ratios for which payoffs are majority-τ-negatively correlated. Therefore, increasing the number of elites amplifies the concern for adverse selection on the part of a non-elite voter.

The logic relies on both distributional and aggregate uncertainty. To see the intuition, we consider the distributional and aggregate uncertainty that an uninformed non-elite voter, say Alice, faces when conditioning on the event $\tilde{E}$. For the distributional uncertainty, an increase in the number of elites is irrelevant because it does not matter for Alice whether a winning spot is taken by an uninformed elite or by an informed non-elite. In terms of aggregate uncertainty, however, an increase in the number of elites implies that the occurrence of event $\tilde{E}$ now conveys worse news about the number of winners. The reason is that, when Alice learns that another voter favors the reform, it is now more likely that this voter is an uninformed elite rather than an informed non-elite who learned that she is a winner. Accordingly, there is less good-news conveyed from the support of others for the reform.

6   Additional Results

We briefly describe some additional results and intuitions.

Other Equilibria: Our negative result proves the existence of a symmetric strict equilibrium in which the electorate selects the wrong policy when payoffs are negatively correlated. In some cases, an alternative equilibrium exists (e.g., in Example 1), but in general, it may not. For instance, in Example 3, there are parameter ranges where the equilibrium that we study is unique.[24]

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[24]The setting that we model is not a common interest problem, even for uninformed voters, and therefore, the arguments of McLennan (1998) do not immediately apply. Because voters have different

Even if a better equilibrium exists, the contrast between our negative and positive results remains: when payoffs are τ-negatively correlated, then voter coordination may be essential to evade the strict symmetric equilibrium that induces electoral failures, whereas if payoffs are not τ-negatively correlated, voter coordination may be unnecessary (insofar as all symmetric weakly-undominated equilibria succeed).[25]

Continuity properties of stable equilibria indicate that a better equilibrium for uninformed voters exists when $\lambda \approx 0$. Consider the Bayesian game defined when $\lambda = 0$ in strategic form. There exists an equilibrium of this game in the hyperstable set (as defined by Kohlberg and Mertens 1986) in which all uninformed voters vote for R. Their results indicate then that a nearby equilibrium exists when $\lambda \to 0$.[26] However, we do not know whether this equilibrium always exists alongside the equilibrium that we construct in Theorem 1; it is possible that there are values of λ for which the equilibrium that we construct in Theorem 1 exists and this alternative equilibrium does not.

Under certain conditions, we show that the equilibrium that we construct in Theorem 1 is unique within the class of strict symmetric equilibria. Fix the population size of the electorate to be n_0, and analogous to our definition of $V^G(\kappa)$ in (1), define

$$V^B(\kappa) \equiv V_i(N = n_0, S_i = s^0, M = B = \lceil (1 - \kappa)n_0 \rceil). \tag{8}$$

The expression is an uninformed voter's expected payoff when she is uninformed, $n_0 - \lceil \kappa n_0 \rceil$ receive bad news, and all others are uninformed. We prove the following claim.

Proposition 10. *Suppose $V^B(\tau) < 0$. Then, for every $\varepsilon > 0$, there exists $\tilde{\lambda} > 0$ such that for all $\lambda < \tilde{\lambda}$, Q wins with probability exceeding $1 - \varepsilon$ in every strict equilibrium.*

In conjunction with Theorem 1, Proposition 10 implies that when payoffs are both τ-negatively correlated and $V^B(\tau) < 0$, not only is there a strict equilibrium in which

Q wins, but this is the unique strict equilibrium. The condition that $V^B(\tau) < 0$ is compatible with payoffs being τ-negatively correlated; jointly, this uniqueness result holds when payoffs are τ-negatively correlated but not too negatively correlated.

Comparison of voting rules: If Assumption 6 is satisfied, then payoffs are τ-negatively correlated implies that they are also τ'-negatively correlated for $\tau' > \tau$. Thus, leaning the voting rule in favor of the ex ante optimal policy, R, by reducing τ has the direct effect of making it easier for R to win, and the indirect effect of reducing the adverse inferences that a voter draws from there being $\tau - 1$ other voters with good news. That indirect effect can lead payoffs to not be τ-negatively correlated, ensuring that R wins with high probability in every equilibrium.

Two notes of caution are in order in interpreting this ex ante comparison of voting rules. First, our goal is to conduct a positive analysis of how adverse selection can induce electoral failures rather than derive the optimal institutional structure given the presence of adverse selection. Second, in practice, there may not be a well-defined ex ante stage at which all voters are uninformed and are involved in designing institutional rules. Once some voters are informed and others are not, voters may cease to share the same interim ranking over voting rules.

Correlation of Information and Interests: We have assumed that a voter's information is independent of her interests. But voters often share the concerns that the political and economic elites support reforms because they are privy to their details. This concern motivates a setting where those who gain from R are those who may learn about a reform at all, leaving all others in the dark. In this case, "no news" is actually "bad news" because it raises the likelihood that one is better off with Q. We analyze this setting formally in the Supplementary Appendix (Appendix A.4) and show that it amplifies the potential for electoral failures.

Strategic versus pivotal reasoning: We view the strategic thinking captured by our model—namely, the concern of adverse selection—to be germane to distributive politics. The pivotal voter model transparently exhibits that form of thinking, but as we illustrated in Example 2, similar incentives emerge in other models of voting behavior. A feature of the pivotal-voter model is that voters condition on the exact threshold needed for R to win, and in practice, voters may view their actions to be payoff-relevant even if they do not condition on that exact threshold. Our results extend to this case under slightly stronger assumptions: suppose that the a voter believes that the voting threshold is somewhere between $[\underline{\tau}, \overline{\tau}]$. If payoffs are $\underline{\tau}$-negatively correlated, and the single-crossing

condition (Assumption 6) is satisfied, then no voter has an incentive to depart from the equilibrium that we constructed in the proof of Theorem 1. Thus, even under a more vague consideration of how one's vote influences the electoral outcomes, an uninformed voter's concern about adverse selection remains strategically relevant.

7 Conclusion

This paper develops a framework to investigate the impact of asymmetric information on distributive politics. Voters often have influence on distributive issues, either in the context of direct democracy or when selecting candidates who adopt different stances on these policies. We find that asymmetric information coupled with distributive politics generates an adverse selection effect that leads voters to reject policies that are ex ante preferable, and would have been preferred if all information were public.

The strategic force is that of "suspicion": an uninformed voter understands that other voters are self-interested and thus, policies that are likely to command near-majority support may not be in her interest. Our analysis shows that information about the distribution of welfare exacerbates suspicion, whereas information about purely aggregate welfare mitigates it. Moreover, this force of suspicion captures intuitive comparative statics where it is amplified by greater polarization between winners and losers, and stronger crowding-out effects.

While we have framed the issue of suspicion in terms of how an individual reasons about the support of others, we view it to apply more broadly to the political and economic competition among groups of voters (where each voter now stands in for a group). In recent years, there has been significant interest in understanding "identity politics" in both academic and popular discourse. One approach to understanding the role of identity in distributive politics and trade policy (e.g. Shayo, 2009; Grossman and Helpman, 2018) has been to model how pride, self-esteem, and envy contributes towards the conflict across groups. We view these to be important and potentially inescapable features of identity politics, but our paper develops a plausible complementary force that relies purely on self-interest: namely, if groups of voters have different interests and obtain different information, then each group of voters may fear that policies supported by (sufficiently many) other groups hurt them. This force is amplified if, as we highlight in Section 5, there is a minority elite group that is sufficiently advantaged that elite voters need not fear adverse selection, and many non-elite groups, each of which has to be concerned by adverse selection.

Our paper suggests a new theoretical mechanism on how asymmetric information

can lead to electoral failures. We believe that various features of this mechanism merit empirical investigation. An immediate question is: are payoffs negatively correlated? We view that question to be important, but a potentially more relevant question is whether voters perceive payoffs to be negatively correlated. Fiorina (2016) argues convincingly that even though the American electorate has not polarized over the years, there is a strong perception that the electorate has polarized. This (misspecified) perception may be sufficient to induce suspicion and concerns of adverse selection when voters are asymmetrically informed.

It would also be useful to test components of the strategic thinking identified here both in the lab and field: do voters update negatively based on the support of others for a policy? Recent survey and poll evidence suggest this to be the case,[27] and we hope to investigate this issue in future work.

Our work also suggests new theoretical directions. We abstract from the source and diffusion of information as well as the design of policies. Since interested parties— politicians, lobbyists, activists, and elites—are often involved both in designing and promoting policies, the scope for adverse selection appears rife in democracies with highly unequal balances of political and economic power.

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[27]For instance, in the recent Charter school debate, see West, Henderson, Peterson, and Barrows (2018) and Williams (2018) for evidence of this form of suspicious reasoning.

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A   Appendix (For Online Publication Only)

Our appendix is divided into three parts. Appendix A.1 develops some preliminary notation and results. Appendix A.2 proves our two main results. Appendix A.3 proves our additional results on comparative statics and uniqueness.

A.1   Preliminaries

In this section, we develop some preliminary notation and results. Appendix A.1.1 develops some necessary notation. Appendix A.1.2 introduces notation for population uncertainty and proves a result that we use in Theorems 1 and 2. Appendix A.1.3 describes details of the decomposition result discussed at the end of Section 2.1. Appendices A.1.4–A.1.6 describe notation for strategies and equilibria, and prove our preliminary results on existence and the public information benchmark.

A.1.1   Some Notation

Let $\bar{v} \equiv \max\{|v_i| : v \in \mathcal{V}\}$) be the absolute value of the largest loss/gain from R. We use g and m to denote typical realizations of the random variables G and M, respectively, and Z (with typical realization z) to denote the random part of the population size. Similar to (2) on p. 21, for any non-negative z, denote

$$\tau_z \equiv \lceil \tau(n_0 + z) \rceil. \tag{9}$$

If the electorate's size is $n_0 + z$, R wins if and only if it receives at least τ_z votes.

A.1.2   Population Uncertainty

The population size is $n_0 + Z$ where Z is distributed Poisson with mean $\mu \geq 0$. Since we establish Theorems 1 and 2 directly for the case where $\mu = 0$, suppose that $\mu > 0$.

We first derive an uninformed voter's subjective perception about the size of the population based on the event that she is recruited. Our approach follows Myerson (1998) where we suppose that there is a finite population of $\bar{N} \geq n_0$ potential voters, each voter is equally likely to be recruited, and we take $\bar{N} \to \infty$.

Denote by R_i^k the event that voter i is recruited and she has signal s_i^k. Our analysis focuses on the event R_i^0, namely where voter i obtains signal s_i^0 (i.e., is uninformed), and conditioning on this event, a voter's belief that there are m informed voters in a

population of size $n_0 + z$. It follows from standard calculations[28] that taking the limit $\bar{N} \to \infty$ yields

$$
\begin{aligned}
P(M = m, Z = z | R_i^0) &= \left(\frac{n_0 + z}{n_0 + \mu} \right) P(m | N = n_0 + z - 1) P(z) \\
&= \left(\frac{n_0 + z}{n_0 + \mu} \right) \binom{n_0 + z - 1}{m} \lambda^m (1 - \lambda)^{n_0 + z - 1 - m} P(z),
\end{aligned} \tag{10}
$$

where the second equality substitutes the definition of $P(m | N = n_0 + z - 1)$. Abusing notation, we write the LHS as $P(m, z | R_i^0)$, and we prove a result that bounds a series of sums that we use in the proofs of Theorems 1 and 2.

Lemma 1. *Let n_0 be a strictly positive integer and Z be a random variable that has full support on the non-negative integers, mean $\mu \geq 0$, and satisfies $\lim_{z \to \infty} \frac{P(z+1)}{P(z)} = k$ for some $k \in [0, \frac{1}{4})$. Then there is $\bar{L}$ such that, for all $\lambda \in (0, 1)$ and positive integer $\bar{m}$, $\sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z} P(m, z | R_i^0) \leq \sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil} P(m, z | R_i^0) \leq \lambda^{\bar{m}} \bar{L}.$*

Proof. Since $\binom{n_0+z}{\lceil 0.5(n_0+z) \rceil} \geq 1$ for all z, it follows by (10) that

$$
\begin{aligned}
\sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z} P(m, z | R_i^0) &\leq \sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil} P(m, z | R_i^0) \\
&= \sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z-1} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil} \frac{n_0+z}{n_0+\mu} \binom{n_0+z-1}{m} \lambda^m (1-\lambda)^{n_0+z-1-m} P(z) \\
&\leq \lambda^{\bar{m}} \sum_{z=0}^{\infty} \sum_{m=\bar{m}}^{n_0+z} \frac{n_0+z}{n_0+\mu} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil}^2 P(z) \\
&\leq \lambda^{\bar{m}} \sum_{z=0}^{\infty} \frac{(n_0+z)^2}{n_0+\mu} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil}^2 P(z),
\end{aligned}
$$

where the second inequality follows because all terms are non-negative, $\lambda^m \leq \lambda^{\bar{m}}$ when $m \geq \bar{m}$, $(1 - \lambda) \leq 1$, and $\binom{n_0+z-1}{m} \leq \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil}$ for all $m \in \{\bar{m}, ..., n_0 + z - 1\}$.

Let $a(z) \equiv \frac{(n_0+z)^2}{n_0+\mu} \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil}^2$. By the ratio test for series, and the tail property of Z, we establish the result if we show that $\lim_{z \to \infty} \frac{a(z+1)}{a(z)} < 4$. For this, we consider two cases. First, suppose $n_0 + z$ is odd. Then, $\frac{a(z+1)}{a(z)} = \left(\frac{n_0+z+1}{n_0+z} \right)^2 \left(\frac{n_0+z+1}{0.5(n_0+z+1)} \right)^2$, which converges to 4. Now, suppose $n_0 + z$ is even. Then, $\frac{a(z+1)}{a(z)} = \left(\frac{n_0+z+1}{n_0+z} \right)^2 \left(\frac{n_0+z+1}{0.5(n_0+z+2)} \right)^2$, which also converges to 4. Hence, by the tail property of Z, $\frac{a(z+1)P(z+1)}{a(z)P(z)}$ converges to a limit strictly less than 1, and so the the series $\sum_{z=0}^{\infty} a(z) P(z)$ converges to some $\bar{L}$. $\square$

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[28]We suppress the calculations for expositional brevity. Details are available upon request.

Remark 1. Because $\lim_{z\to\infty} \frac{P(z+1)}{P(z)} = 0$ when Z follows a Poisson distribution, Lemma 1 ensures our results hold under Assumption 4. Our proofs in Theorems 1 and 2 use only the result established in Lemma 1, and so the theorems apply to distributions with thinner tails as well as fatter tails so long as the series $\sum_{z=0}^{\infty} a(z)P(z)$ in Lemma 1 converges. Since this series converges whenever a distribution has a finite support, our theorems also apply in those cases.

A.1.3 Decomposition

We prove the decomposition result discussed at the end of Section 2.1. Consider a distribution P satisfying Assumptions 1 and 2(a). Let $\lambda = 1 - P(s_i^0)$ and, for all $\{n, s\} \subset \Omega$, let $\tilde{P}(s) = P(s)\lambda^{-n}$ if $s \in \mathcal{M}^n$ for some n and $\tilde{P}(s) = 0$ otherwise. The following claims show that $\tilde{P}$ is a probability distribution on $\tilde{\Omega}$, and that for every $\lambda' \in (0,1)$ there exists a unique P' in the family $(\tilde{P}, \lambda)$ satisfying Assumptions 1 and 2.

Claim 1. $\tilde{P}$ *is a probability distribution.*

Proof. By definition, $\tilde{P}$ assigns non-negative weight to each element in $\tilde{\Omega}$. We show that $\sum_{\omega \in \tilde{\Omega}} \tilde{P}(\omega) = 1$. It suffices to show that $\sum_{\{\omega \in \tilde{\Omega}: N(\omega) = n\}} \tilde{P}(\omega|n) = 1$ for every n. Fix some n. It follows by integration on $\mathcal{S}^n$ that $\sum_{s \in \mathcal{M}^n} \tilde{P}(s|n) = \lambda^{-n} \sum_{s \in \mathcal{M}^n} P(s|n)$, and so it suffices to establish that $\sum_{s \in \mathcal{M}^n} P(s|n) = \lambda^n$.

Fix a positive integer q that is strictly less than n, and consider an event $\{n, s_1, \ldots, s_q\} \equiv \{n, s^q\}$ where $s_i \in \mathcal{M}$ for every $i = 1, \ldots, q$. Then, by Assumption 3(a),

$$P(s^q|n) = P(s^q|n)P(s_{q+1}^0|n) + \sum_{s_{q+1}\in\mathcal{M}} P(s^q, s_{q+1}|n)$$

$$= P(s^q|n)(1 - \lambda) + \sum_{s_{q+1}\in\mathcal{M}} P(s^q, s_{q+1}|n) = \frac{1}{\lambda} \sum_{s_{q+1}\in\mathcal{M}} P(s^q, s_{q+1}|n). \tag{11}$$

Proceeding by induction, $P(s^q|n) = \left(\frac{1}{\lambda}\right)^{n-q} \sum_{j=q+1}^{n} \sum_{s_j \in \mathcal{M}} P(s_1, \ldots, s_n|n)$. Substituting $q = 1$, and adding across all $s_1 \in \mathcal{M}$ yields

$$\sum_{s_1\in\mathcal{M}} P(s_1|n) = \sum_{s_1\in\mathcal{M}} \left(\frac{1}{\lambda}\right)^{n-1} \sum_{j=2}^{n} \sum_{s_j\in\mathcal{M}} P(s_1, \ldots, s_n|n) = \left(\frac{1}{\lambda}\right)^{n-1} \sum_{s\in\mathcal{M}^n} P(s|n). \tag{12}$$

By the same reasoning leading to (11), $P(s_2, \ldots, s_n|n) = \frac{1}{\lambda} \sum_{s_1\in\mathcal{M}} P(s_1, s_2, \ldots, s_n|n)$ for each $(s_2, \ldots, s_n) \in \mathcal{S}^{n-1}$. As $\sum_{(s_2,\ldots,s_n)\in\mathcal{S}^{n-1}} P(s_2, \ldots, s_n|n) = 1$, it follows that

$$1 = \sum_{(s_2,\ldots,s_n)\in\mathcal{S}^{n-1}} \frac{1}{\lambda} \sum_{s_1\in\mathcal{M}} P(s_1, s_2, \ldots, s_n|n) = \frac{1}{\lambda} \sum_{s_1\in\mathcal{M}} P(s_1|n),$$

implying that $\sum_{s_1 \in \mathcal{M}} P(s_1|n) = \lambda$. Using (12), we conclude that $\sum_{s \in \mathcal{M}^n} P(s|n) = \lambda^n$. $\qquad\square$

The following claim shows that, for each $\lambda' \in (0,1)$, there exists a unique distribution P' in the family $(\tilde{P}, \lambda)_{\lambda \in (0,1)}$ that satisfies Assumptions 1–4. For each n and $s \in \mathcal{S}^n$, let $\tilde{E}(n,s) = \{\tilde{s} \in \mathcal{M}^n : \tilde{s}_j = s_j \text{ whenever } s_j \neq s^0\}$.

Claim 2. *For each $\lambda' \in (0,1)$, there exists a unique distribution P' in the family $(\tilde{P}, \lambda)_{\lambda \in (0,1)}$ that satisfies Assumptions 1 and 2. In particular, for any $\omega = (n, v, s) \in \Omega$,*

$$P'(\omega) = \lambda^{M(\omega)} (1-\lambda)^{n-M(\omega)} \sum_{s' \in \tilde{E}(n,s)} \tilde{P}(n, v, s'). \tag{13}$$

Proof. We fix n and consider $\omega \in \Omega$ such that $N(\omega) = n$, proceeding by induction. First, suppose $M(\omega) = n$. Then (13) follows from our construction in the text. Now suppose (13) is true for any ω where $M(\omega) = m+1$ for some $m < n$. We establish below that this is true for any ω' where $M(\omega') = m$.

Consider any $\omega' = (n, v, s)$ where $M(\omega') = m$, and suppose $s_i = s^0$. Observe that,

$$
\begin{aligned}
P(v, s_{-i}|n) &= \sum_{s_i' \in \mathcal{S}} P(v, s_{-i}, s_i'|n) = P(v, s_{-i}|n) P(s_i' = s^0|n) + \sum_{s_i' \in \mathcal{M}} P(v, s_{-i}, s_i'|n) \\
&= P(v, s_{-i}|n)(1-\lambda) + \sum_{s_i' \in \mathcal{M}} P(v, s_{-i}, s_i'|n) = \frac{1}{\lambda} \sum_{s_i' \in \mathcal{M}} P(v, s_{-i}, s_i'|n).
\end{aligned}
\tag{14}
$$

where the first equality is by definition, the second equality follows from Assumption 3(a), the third equality follows from $P(s_i' = s^0|n) = (1-\lambda)$, and the fourth equality follows from simplification. Using Assumption 3(a), $s_i = s^0$, and $P(s_i|n) = (1-\lambda)$, it follows that $P(\omega'|n) = (1-\lambda)P(v, s_{-i}|n)$. Substituting (14) for $P(v, s_{-i}|n)$ yields

$$P(v, s|n) = \left(\frac{1-\lambda}{\lambda}\right) \sum_{s_i' \in \mathcal{M}} P(v, s_{-i}, s_i'|n) = \lambda^{M(\omega')} (1-\lambda)^{n-M(\omega')} \sum_{s' \in \tilde{E}(n,s)} \tilde{P}(v, s'|n),$$

where the second equality follows from the induction hypothesis and simplification. $\qquad\square$

A.1.4 Strategies and equilibrium

Let $\Sigma \equiv \{\sigma : \mathcal{S} \to [0,1]\}$ be the set of mappings from signals to $[0,1]$. In the private information environment, a strategy for voter i can be described by $\sigma_i \in \Sigma$, where $\sigma_i(s_i)$ is the probability that i votes for R when receiving signal s_i. With some abuse of notation, a symmetric strategy profile can also be described in terms of an element

$\sigma \in \Sigma$; in particular, we denote by (σ_i, σ_{-i}) a strategy profile where voter i follows strategy $\sigma_i \in \Sigma$, and other voters follow the symmetric strategy $\sigma_{-i} \in \Sigma$.

Let $P_\sigma(\tau_{N(\omega)}|\omega)$ denote the probability that at least $\lceil \tau N(\omega) \rceil$ voters vote for R when voters follow the symmetric strategy profile σ and state ω is realized. Then voter i's expected payoff function for the symmetric strategy profile σ and signal s_i^k is defined by $\pi_i(\sigma|s_i^k) \equiv \sum_{\omega \in \Omega} P_\sigma(\tau_{N(\omega)}|\omega) V_i(\omega) P(\omega|R_i^k)$.

Definition 3 (Equilibrium). *A symmetric strategy profile σ is an equilibrium if the following conditions are satisfied for all n and $i \in \{1, ..., n\}$:*

(i) $\pi_i(\sigma|.) \geq \pi_i(\sigma_i', \sigma_{-i}|.)$ *for all* $\sigma_i' \in \Sigma$,

(ii) *for each* $s_i \in \mathcal{S}$*: if there exists* σ_i' *such that* $\pi_i(\sigma_i', \tilde{\sigma}_{-i}|s_i) \geq \pi_i(\tilde{\sigma}|s_i)$ *for all* $\tilde{\sigma}$*, then*

$$\pi_i(\sigma_i, \tilde{\sigma}_{-i}|s_i) \geq \pi_i(\sigma_i', \tilde{\sigma}_{-i}|s_i) \text{ for all } \tilde{\sigma}.$$

The equilibrium is strict *if the inequality in part (i) is strict for all* $s_i \in \mathcal{S}$.

Condition (i) is the standard requirement of a Bayes Nash equilibrium (BNE): for all signals, voters play a best response to the strategies of other voters. Condition (ii) states that voters play a weakly undominated strategy. In the public information environment, strategies, payoffs, and equilibrium are defined analogously, except that voters condition on the population size n and signal profile $s \in \mathcal{S}^n$.

A.1.5 Equilibrium characterization

We first provide a simple characterization of equilibrium in the private information environment. For $\alpha \in [0,1]$, define the symmetric strategy profile σ^α as follows:

$$\sigma_i^\alpha(s_i) \equiv \begin{cases} \alpha & \text{if } s_i = s^0 \\ 1 & \text{if } s_i \in \mathcal{G} \\ 0 & \text{if } s_i \in \mathcal{B} \end{cases}.$$

Define the function $\Pi : [0,1] \to \mathbb{R}$ as follows:

$$\Pi(\alpha) \equiv \pi_i(\sigma_i^1, \sigma_{-i}^\alpha|s_i^0) - \pi_i(\sigma_i^0, \sigma_{-i}^\alpha|s_i^0)$$

$$= \sum_{z=0}^{\infty} \sum_{m=0}^{n_0+z-1} \sum_{g=0}^{m} V(g,m,z) P_\alpha(piv|g,m,z) P(g|s_i^0, m, z) P(m,z|R_i^0),$$

where $V(g,m,z) \equiv V_i(s_i^0, g, m, n_0 + z)$ is a voter's expected payoff conditional on receiving the uninformative signal, g voters receiving good news, m voters being informed in a population of size $n_0 + z$ (by Assumption 1, this does not need a voter subscript);

$P_\alpha(piv|g, m, z)$ is the probability that the voter is pivotal given $(G, M, Z) = (g, m, z)$ and that other voters are following the strategy profile σ^α_{-i}, which is

$$P_\alpha(piv|g, m, z) \equiv \begin{cases} f(\alpha, g, m, z) & \text{if } \alpha \in (0, 1) , \ 0 \leq \tau_z - g \leq n_0 + z - m \\ 1 & \text{if } (\alpha, \tau_z - g) \in \{(0, 1), (1, n_0 + z - m)\} , \\ 0 & \text{otherwise.} \end{cases}$$

where, for $\alpha \in (0, 1)$ and $0 \leq \tau_z - g \leq n_0 + z - m$,

$$f(\alpha, g, m, z) = \binom{n_0 + z - 1 - m}{\tau_z - g - 1} \alpha^{\tau_z - g - 1} (1 - \alpha)^{n_0 + z - (m - g) - \tau_z};$$

$P(g|s^0_i, m, z)$ is the probability for an uninformed voter that g voters receive good news conditional on m voters being informed in a population of size $n_0 + z$; $P(m, z|R^0_i)$ is the probability that there are $n_0 + z - 1$ other voters, $m \leq n_0 + z - 1$ of whom are informed, conditional on voter i being recruited as an uninformed type (see Equation 10), and $P(z) \equiv P(Z = z)$ is the probability that the population is of size $n_0 + z$. Hence, $\Pi(\alpha)$ is the difference in the expected payoff for an uninformed voter when they vote for R versus voting for Q, conditional on other voters following the strategy profile σ^α_{-i}, because the payoff-difference is non-zero only when the voter is pivotal.

Lemma 2. *The function Π is well-defined and continuous on $[0, 1]$.*

Proof. Define the sequence of functions $\{w_z : [0, 1] \to \mathbb{R}\}$ by

$$w_z(\alpha) = \sum_{m=0}^{n_0 + z - 1} \sum_{g=0}^{m} V(g, m, z) P_\alpha(piv|g, m, z) P(g|s^0_i, m, z) P(m, z|R^0_i),$$

for all $\alpha \in [0, 1]$, so that $\Pi(\alpha) = \sum_{z=0}^{\infty} w_z(\alpha)$. Fix some $z \in \mathbb{N} \cup \{0\}$. The argument α enters w_z only in the term $P_\alpha(piv|g, m, z)$. The function $f(\alpha|m, g)$, used to define $P_\alpha(piv|g, m, z)$, is continuous on $(0, 1)$ for all (g, m, z) such that $0 \leq \tau_z - g \leq n_0 + z - m$. In addition,

$$\lim_{\alpha \to 0} f(\alpha|g, m, z) = \begin{cases} 1 & \text{if } \tau_z - g - 1 = 0, \\ 0 & \text{otherwise.} \end{cases}$$

$$\lim_{\alpha \to 1} f(\alpha|g, m, z) = \begin{cases} 1 & \text{if } \tau_z - g = n_0 + z - m, \\ 0 & \text{otherwise.} \end{cases}$$

Hence, $P_\alpha(piv|g, m, z)$ is continuous in α on $[0, 1]$, and so $w_z : [0, 1] \to \mathbb{R}$ is continuous.

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Moreover, for all (g, m, z) and α, $|w_z(\alpha)| \leq \bar{v} P(z)$. Since $\sum_{z=0}^{\infty} \bar{v} P(z) = \bar{v} \sum_{z=0}^{\infty} P(z) = \bar{v}$, it follows by the Weierstrass M-test that the series $\sum_{z=0}^{\infty} w_z(\alpha)$ converges absolutely and uniformly, and so $\Pi(\alpha)$ is well-defined. Since each of the functions w_z are continuous on $[0, 1]$, it then follows by the uniform limit theorem that $\Pi(\alpha)$ is continuous on $[0, 1]$. $\square$

Lemma 3. *Strategy profile σ^* is an equilibrium if and only if $\sigma^* = \sigma^\alpha$ for some $\alpha \in [0, 1]$ and one of the following three conditions is satisfied: (i) $\alpha = 1$ and $\Pi(\alpha) \geq 0$, (ii) $\alpha = 0$ and $\Pi(\alpha) \leq 0$, or (iii) $\alpha \in (0, 1)$ and $\Pi(\alpha) = 0$. Moreover, σ^α is a strict equilibrium if and only if either (i') $\alpha = 1$ and $\Pi(\alpha) > 0$, or (ii') $\alpha = 0$ and $\Pi(\alpha) < 0$.*

Proof. By standard arguments, the strategy profile σ^α is a BNE if and only if one of the conditions (i)–(iii) is satisfied, and is a strict BNE if and only if either condition (i') or (ii') is satisfied. Moreover, by Assumption 2(b), when σ^α is a BNE, then it is an equilibrium. It therefore remains to show that if σ^* is an equilibrium, then there must be some $\alpha \in [0, 1]$ such that $\sigma^* = \sigma^\alpha$.

Suppose σ^* is an equilibrium but $\sigma_i^*(s_i^k) = \beta \neq 1$ for some $s^k \in \mathcal{G}$. Let σ' be the strategy where $\sigma'(s) = \frac{1}{2}$ for all $s \in \mathcal{S}$. When voters other than i follow strategy profile σ'_{-i}, voter i is pivotal in a population of size $n_0 + z$ with probability $P(piv | n_0 + z, \sigma'_{-i}) = \binom{n_0+z-1}{\tau_z} \left(\frac{1}{2}\right)^{n_0+z-1} > 0$. Moreover, conditioning on being pivotal conveys no information about the information received by other voters. By Lemma 1 and the Weierstrass M-test, $\sum_{z=0}^{\infty} P(piv | n_0 + z, \sigma'_{-i}) V_i(s_i^k, n_0 + z) P(z)$ converges absolutely to some $\tilde{c} > 0$ because, for all z, $\binom{n_0+z-1}{\tau_z} \left(\frac{1}{2}\right)^{n_0+z-1} \leq (n_0 + z) \binom{n_0+z}{\lceil 0.5(n_0+z) \rceil}^2$, and $|V_i(s_i^k, n_0 + z)| \leq \bar{v}$.

As a result, $\pi_i(\sigma_i^*, \sigma'_{-i} | s_i^k) = \beta \tilde{c} < \tilde{c} = \pi_i(\sigma_i^1, \sigma_{-i} | s_i^k)$. On the other hand, by Assumption 2(b), $\pi_1(\sigma_i^1, \tilde{\sigma}_{-1} | s_i^k) \geq \pi_1(\tilde{\sigma} | s_i^k)$ for all $\tilde{\sigma}$. Hence, σ^* is not an equilibrium. An analogous argument shows that, in an equilibrium, it must be the case that $\sigma_i^*(s_i^k) = 0$ whenever $s^k \in \mathcal{B}$. Since σ^* is a symmetric strategy profile, it follows that $\sigma^* = \sigma^\alpha$ for some $\alpha \in [0, 1]$. $\square$

A.1.6 Proofs of Preliminary Results (Propositions 1 and 2)

Proof of Proposition 1 on p. 15. First, consider the private information environment. By Lemma 3, if $\Pi(0) \leq 0$ then σ^0 is an equilibrium, and if $\Pi(1) \geq 0$ then σ^1 is an equilibrium. It remains to show that there is an equilibrium when $\Pi(0) > 0$ and $\Pi(1) < 0$. In that case, since Π is continuous on $[0, 1]$ by Lemma 1, it follows by the intermediate value theorem that there exists some α^* such that $\Pi(\alpha^*) = 0$ and so σ^{α^*} is an equilibrium.

For public information, define the symmetric strategy profile σ^{pub} as follows:

$$\sigma^{pub}(n, s) = \begin{cases} 1 & \text{if } V_i(n, s) > 0 \\ 0 & \text{otherwise} \end{cases}.$$

By standard arguments, σ^{pub} is an equilibrium. To show that this is the unique equilibrium, suppose for contradiction that $\sigma^* \neq \sigma^{pub}$ is also an equilibrium. For some (z, s), $\sigma(z, s) \neq \sigma^{pub}(z, s)$ and, by Assumption 3(a), $V_i(s) \neq 0$. Define the strategy σ' as in the proof of Lemma 3. Now consider the case $V_i(s) > 0$, and $\sigma_i(s) < 1$. Then

$$\begin{aligned}
\pi_i(\sigma_i^{pub}, \sigma'_{-i}|s, n_0 + z) &= V_i(s) \binom{n_0 + z - 1}{\tau_z - 1} \left(\frac{1}{2}\right)^{n_0 + z - 1} \\
&> \sigma_i^*(s) V_i(s) \binom{n_0 + z - 1}{\tau_z - 1} \left(\frac{1}{2}\right)^{n_0 + z - 1} = \pi_i(\sigma_i^*, \sigma_{-i}|s, n_0 + z).
\end{aligned}$$

The case where $V_i(s) < 0$ is symmetric. Therefore, σ^* violates condition (ii) in the definition of an equilibrium. $\square$

Proof of Proposition 2 on p. 17. In the public information environment, the unique equilibrium is σ^{pub} from the proof of Proposition 1. Given this strategy profile, if every voter receives the uninformative signal, then $V(G = M = 0, Z = z) > 0$ for all z implies that R wins the election in the unique equilibrium. The probability that all voters receive the uninformative signal is $(1 - \lambda)^{n_0 + z}$ in a population of size $n_0 + z$. Hence, the probability that R wins the election is at least $\sum_{z=0}^{\infty}(1 - \lambda)^{n_0 + z} P(z)$. For any fixed $\bar{z}$, this is greater than $(1 - \lambda)^{n_0 + \bar{z}} P(Z \leq \bar{z})$. Since $P(Z \leq \bar{z})$ converges to 1, we can choose $\bar{z}$ so that $P(Z \leq \bar{z}) \geq \sqrt{(1 - \varepsilon)}$. Now fix $\bar{\lambda}' \in (0, 1)$ such that $(1 - \bar{\lambda}')^{n_0 + \bar{z}} \geq \sqrt{1 - \varepsilon}$. Then, for all $\lambda \in (0, \bar{\lambda}')$, $\sum_{z=0}^{\infty}(1 - \lambda)^{n_0 + z} P(z) \geq (\sqrt{1 - \varepsilon})^2 = 1 - \varepsilon$, and so R wins with probability exceeding $1 - \varepsilon$. $\square$

A.2 Proofs of Main Results (Theorems 1 and 2)

A.2.1 Proof of Theorem 1 on p. 18

Suppose payoffs are τ-negatively correlated (i.e., $V^G(\tau) < 0$). Recall that σ^0 is the strategy profile where uninformed voters choose Q, and informed voters choose R when they receive good news and Q when they receive bad news. We first show that there exists $\bar{\lambda} > 0$ such that for all $\lambda \in (0, \bar{\lambda})$, σ^0 is a strict equilibrium. By Lemma 3, the

strategy profile σ^0 is a strict equilibrium if and only if the following is strictly negative

$$\Pi(0) = \pi_i\left(\sigma_i^1, \sigma_{-i}^0 | s_i^0\right) - \pi_i\left(\sigma_i^0, \sigma_{-i}^0 | s_i^0\right)$$

$$= \sum_{z=0}^{\infty} V(\tau_z - 1, m, z) P(G = \tau_z - 1 | m, z) P(m, z | R_i^0), \qquad (15)$$

where $V(\tau_z - 1, m, z) = V(G = \tau_z - 1, M = m, Z = z)$.

We first consider the summand in (15) where $z = 0$:

$$\sum_{m=\tau_0-1}^{n_0-1} \binom{n_0 - 1}{m} \lambda^{m-\tau_0-1}(1 - \lambda)^{n_0-1-m} P(G = \tau_z - 1 | M = m, Z = 0) V(\tau_z - 1, m, 0) P(Z = 0).$$

It follows from $\lambda < 1$, $V(\tau_z - 1, m, 0) \leq \bar{v}$, and $P(G = \tau_z - 1 | m, z) \leq 1$, that the term is bounded above by

$$\binom{n_0 - 1}{\tau_0 - 1} P(G = \tau_0 - 1 | M = \tau_0 - 1, Z = 0) P(Z = 0) V^G(\tau) + \lambda \bar{v} P(Z = 0) \sum_{m=\tau_0}^{n_0-1} \binom{n_0 - 1}{m}.$$

We now consider the remaining terms in the series (15). Since $V(\tau_z, m, z) \leq \bar{v}$, it follows by Lemma 1 that the remaining series is bounded above by $\lambda \bar{L} \bar{v}$, where $\bar{L}$ does not depend on λ. As a result, $\Pi_i(0)$ is bounded above by

$$\binom{n_0 - 1}{\tau_0 - 1} P(G = \tau_0 - 1 | M = \tau_0 - 1, Z = 0) P(Z = 0) V^G(\tau) + \lambda \bar{v} \left(\bar{L} + \sum_{m=\tau_0}^{n_0-1} \binom{n_0 - 1}{m} P(Z = 0) \right).$$

The first term does not depend on λ and is strictly negative because payoffs are τ-negatively correlated (i.e., $P(G = \tau_0 - 1 | M = \tau_0 - 1, Z = 0) V^G(\tau) < 0$) and $P(Z = 0) > 0$. In the second term, the bracket is a finite positive number that does not depend on λ. Hence, there is $\bar{\lambda} \in (0, 1)$ such that, for all $\lambda < \bar{\lambda}$, $\Pi_i(\lambda) < 0$ and so σ^0 is an equilibrium.

Now suppose that the voters follow the strategy profile σ^0. If all voters are uninformed, Q wins the election. Hence, following the argument in the proof of Proposition 2, there exists $\bar{\lambda}'$ such that for all $\lambda \in (0, \bar{\lambda}')$, Q wins with probability exceeding $(1 - \varepsilon)$ in the equilibrium strategy σ^0.

A.2.2   Proof of Theorem 2 on p. 20

Suppose payoffs are not τ-negatively correlated and, without loss of generality, let $\lambda \leq \frac{1}{2}$. Let $v^* = \min_{\kappa \in [0,\tau]} V^G(\kappa) P(G = \lceil \kappa n_0 \rceil - 1 | M = \lceil \kappa n_0 \rceil - 1, Z = 0)$. Payoffs not being τ-negatively correlated implies that $V^G(\tau) > 0$; in combination with $V^G(0) > 0$,

Assumption 6 implies that $v^* > 0$. Recall that, for $\alpha \in [0,1]$, σ^α is the (private) strategy profile where uninformed voters chose R with probability α and choose Q with probability $(1-\alpha)$, and informed voters choose R when they receive good news and Q when they receive bad news. The following Lemma establishes that there is a sufficiently small λ so that σ^α is not an equilibrium.

Lemma 4. *For every $\bar{\alpha} \in (0,1)$, there exists $\lambda_{\bar{\alpha}} \in (0,1)$ such that, if $\alpha \in (0,\bar{\alpha})$ and $\lambda \in (0,\lambda_{\bar{\alpha}})$, then $\Pi(\alpha) > 0$.*

Proof. Fix some $\bar{\alpha} \in (0,1)$ and let $\alpha \in (0,\bar{\alpha})$. For $\omega = (n,v,s) \in \Omega$, an uninformed voter i is pivotal if and only if $\tau_z - 1$ vote for R. If $G(n,v,s) = g$ this requires $q \equiv \tau_z - g - 1$ uninformed voters to choose R. Define $\Theta \equiv \{(q,m,z) \in \mathbb{N}^3 : 0 \leq \tau_z - q - 1 \leq m \leq n_0 + z - 1\}$. We want to show that, for λ sufficiently small,

$$\Pi(\alpha) = \sum_{z=0}^{\infty} \sum_{m=0}^{n_0+z-1} \sum_{g=0}^{m} V(g,m,z) P(piv|g,m,z) P(g|m,z) P(m,z|R_i^0) \equiv \sum_{\theta \in \Theta} c(\theta) > 0,$$

where for $\theta = (q,m,z) \in \Theta$, $c(\theta) \equiv \alpha^q \lambda^m \tilde{V}(q,m,z) \tilde{P}(q|m,z) B(\theta) A(\theta) P(z)$, $\tilde{V}(q,m,z) \equiv V(g = \tau_z - q - 1, m, z)$, $\tilde{P}(q|m,z) \equiv P(g = \tau_z - q - 1|m,z)$, $B(\theta) \equiv \binom{n_0+z-1-m}{q}\binom{n_0+z-1}{m}$, and $A(\theta) \equiv (1-\alpha)^{n_0+z-1-m-q}(1-\lambda)^{n_0+z-1-m}$.

We first provide a lower bound for $\Pi(\alpha)$ by giving a lower bound $\underline{c}(\theta)$ of $c(\theta)$ for each $\theta \in \Theta$. We partition Θ into four sets.

(1) $\Theta_1 = \{(q,m,z) \in \Theta : z = 0, m = \tau_0 - q - 1\}$. Then, $\tilde{V}(q,m,z) \tilde{P}(q|m,z) \geq v^* > 0$ and $P(z) > 0$. Hence, for $(q,m,z) \in \Theta_1$, $c(q,m,z) \geq \underline{c}(q,m,z) \equiv \alpha^q \lambda^{\tau_0-q-1} v^* \left(\frac{1-\bar{\alpha}}{2}\right)^{n_0} P(Z = 0)$, because $B(q,m,z) \geq 1$, $A(q,m,z) \geq \left(\frac{1-\bar{\alpha}}{2}\right)^{n_0}$. As a result, $\sum_{\theta \in \Theta_1} \underline{c}(\theta) = \sum_{q=0}^{\tau_0-1} \alpha^q \lambda^{\tau_0-q-1} v^* \left(\frac{1-\bar{\alpha}}{2}\right)^{n_0} P(Z=0)$.

(2) $\Theta_2 = \{(q,m,z) \in \Theta : z > 0, m = 0\}$. Then, $\tilde{V}(q,m,z) = \tilde{V}(q,0,z) \equiv \tilde{V}(0|z) > 0$. Hence, for $(q,m,z) \in \Theta_2$, $c(q,m,z) \geq \underline{c}(q,m,z) \equiv 0$. As a result, $\sum_{\theta \in \Theta_2} \underline{c}(\theta) = 0$.

(3) $\Theta_3 = \{(q,m,z) \in \Theta : z = 0, m > \tau_0 - q - 1\}$. In that case, $\tilde{V}(q,m,z) \geq -\bar{v}$ which is negative. Hence, for $(q,m,z) \in \Theta_3$, $c(q,m,z) \geq \underline{c}(q,m,z) \equiv -\alpha^q \lambda^{\tau_0-q} \bar{v} \left(\frac{n_0}{\lceil 0.5n_0 \rceil}\right)^2$, because $m \geq \tau_0 - q$, and so $\lambda^m \leq \lambda^{\tau_0-q}$, $\tilde{P}(q|m,z) \leq 1$, $B(q,m,z) \leq \left(\frac{n_0}{\lceil 0.5n_0 \rceil}\right)^2$, $A(q,m,z) \leq 1$, and $P(Z=0) \leq 1$. As a result,

$$\sum_{\theta \in \Theta_3} \underline{c}(\theta) = -\sum_{q=0}^{\tau_0-1} \sum_{m=\tau_0-q}^{n_0-q-1} \alpha^q \lambda^{\tau_0-q} \bar{v} \left(\frac{n_0}{\lceil 0.5n_0 \rceil}\right)^2 \geq -\sum_{q=0}^{\tau_0-1} n_0 \alpha^q \lambda^{\tau_0-q} \bar{v} \left(\frac{n_0}{\lceil 0.5n_0 \rceil}\right)^2.$$

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(4) $\Theta_4 = \{(q, m, z) \in \Theta : z > 0, m > 0\}$. In that case, $\tilde{V}(q, m, z) \geq -\bar{v}$ which is negative. Hence, for all $(q, m, z) \in \Theta_4$,

$$c(q, m, z) \geq \underline{c}(q, m, z) \equiv \begin{cases} -\alpha^q \lambda^{\tau_0 - q} \bar{v} \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z) & \text{if } q \leq \tau_0 - 1, \\ -\alpha^q \lambda \bar{v} \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z) & \text{if } q > \tau_0 - 1, \end{cases}$$

because $m \geq \tau_z - q - 1$, and so $\lambda^m \leq \lambda^{\tau_0 - q}$ when $q \leq \tau_0 - 1$, and $\lambda^m \leq \lambda$ when $q > \tau_0 - 1$, $\tilde{P}(q|m, z) \leq 1$, $B(q, m, z) \leq \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2$, and $A(q, m, z) \leq 1$. Since $\underline{c}(\theta) < 0$ for every $\theta \in \Theta_4$,

$$\sum_{\theta \in \Theta_4} \underline{c}(\theta) \geq - \sum_{q=0}^{\tau_0 - 1} \sum_{z=0}^{\infty} \sum_{m=\tau_z - q - 1}^{n_0 + z - 1 - q} \alpha^q \lambda^{\tau_0 - q} \bar{v} \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z)$$

$$- \sum_{q=\tau_0}^{\infty} \sum_{z=0}^{\infty} \sum_{m=\max\{0, \tau_z - q - 1\}}^{\max\{0, n_0 + z - 1 - q\}} \alpha^q \lambda \bar{v} \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z)$$

$$\geq - \sum_{q=0}^{\tau_0 - 1} \alpha^q \lambda^{\tau_0 - q} \bar{v} \sum_{z=0}^{\infty} (n_0 + z) \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z)$$

$$- \sum_{q=\tau_0}^{\infty} \alpha^q \lambda \bar{v} \sum_{z=0}^{\infty} (n_0 + z) \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z)$$

By Lemma 1, the series $\sum_{z=0}^{\infty} (n_0 + z) \left(\frac{n_0 + z}{\lceil 0.5(n_0 + z) \rceil} \right)^2 P(z)$ converges absolutely to some $\bar{c}$. As a result, $\sum_{\theta \in \Theta_4} \underline{c}(\theta) \geq -\lambda \bar{v} \bar{c} \sum_{q=0}^{\tau_0} \alpha^q \lambda^{\tau_0 - q} - \lambda \bar{v} \bar{c} \sum_{q=\tau_0 + 1}^{\infty} \alpha^q$.

Since $(\Theta_1, \Theta_2, \Theta_3, \Theta_4)$ is a partition of Θ, and $n_0 \left(\frac{n_0}{\lceil 0.5 n_0 \rceil} \right)^2 P(Z = 0) \leq \bar{c}$,

$$\Pi(\alpha) \geq \sum_{\theta \in \Theta_1} \underline{c}(\theta) + \sum_{\theta \in \Theta_2} \underline{c}(\theta) + \sum_{\theta \in \Theta_3} \underline{c}(\theta) + \sum_{\theta \in \Theta_4} \underline{c}(\theta)$$

$$\geq \left(v^* \left(\frac{1 - \bar{\alpha}}{2} \right)^{n_0} P(Z = 0) - 2\lambda \bar{v} \bar{c} \right) \sum_{q=0}^{\tau_0 - 1} \alpha^q \lambda^{\tau_0 - q - 1} - \lambda \bar{v} \bar{c} \sum_{q=\tau_0}^{\infty} \alpha^q$$

$$= \left(v^* \left(\frac{1 - \bar{\alpha}}{2} \right)^{n_0} P(Z = 0) - 2\lambda \bar{v} \bar{c} \right) \sum_{q=0}^{\tau_0 - 1} \alpha^q \lambda^{\tau_0 - q - 1} - \lambda \bar{v} \bar{c} \alpha^{\tau_0 - 1} \frac{1}{1 - \alpha}$$

$$\geq \left(v^* \left(\frac{1 - \bar{\alpha}}{2} \right)^{n_0} P(Z = 0) - 2\lambda \bar{v} \bar{c} \right) \sum_{q=0}^{\tau_0 - 1} \alpha^q \lambda^{\tau_0 - q - 1} - \lambda \bar{v} \bar{c} \alpha^{\tau_0 - 1} \frac{1}{1 - \bar{\alpha}}$$

$$= \alpha^{\tau_0 - 1} \left(v^* \left(\frac{1 - \bar{\alpha}}{2} \right)^{n_0} P(Z = 0) - \lambda \bar{v} \bar{c} \left(2 + \frac{1}{1 - \bar{\alpha}} \right) \right)$$

$$+ \left(v^* \left(\frac{1 - \bar{\alpha}}{2} \right)^{n_0} P(Z = 0) - 2\lambda \bar{v} \bar{c} \right) \sum_{q=0}^{\tau_0 - 2} \alpha^q \lambda^{\tau_0 - q - 1}.$$

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There exists some $\bar{\lambda} \in (0,1)$ such that, for all $\lambda < \bar{\lambda}$, $v^* \left(\frac{1-\bar{\alpha}}{2} \right)^{n_0} P(Z = 0) > \lambda \bar{v} \bar{c} \left(2 + \frac{1}{1-\bar{\alpha}} \right)$. Hence, for $\lambda < \bar{\lambda}$, $\Pi_i(\alpha) > 0$. $\qquad\square$

We now use Lemma 4 to complete the proof. Fix $\varepsilon \in (0,1)$. The statement for the public information environment follows from Proposition 2. Therefore, we only need to show that there exists λ_ε such that in every equilibrium of the private information environment, R wins with probability exceeding $1 - \varepsilon$.

First, fix $\bar{z}_\varepsilon$ such that $P(Z \leq \bar{z}_\varepsilon) \geq (1-\varepsilon)^{\frac{1}{3}}$. Such $\bar{z}_\varepsilon$ exists because $P(z)$ is countably additive, and so $\lim_{z' \to \infty} P(Z \leq z') = 1$.

For a given λ, if voters follow a strategy profile σ^α, and a population size $n_0 + z$ is realized, the probability that R wins exceeds $(1 - \lambda)^{n_0+z} \alpha^{n_0+z}$, which describes the probability that all voters are uninformed and vote for R in a population $n_0 + z$ given the strategy profile σ^α. Hence, the ex ante probability that R wins exceeds $(1 - \lambda)^{n_0+\bar{z}_\varepsilon} \alpha^{n_0+\bar{z}_\varepsilon} P(Z \leq \bar{z}) \geq (1 - \lambda)^{n_0+\bar{z}_\varepsilon} \alpha^{n_0+\bar{z}_\varepsilon} (1 - \varepsilon)^{\frac{1}{3}}$.

Now let $\bar{\lambda}_\varepsilon = 1 - (1 - \varepsilon)^{\frac{1}{3(n_0+\bar{z}_\varepsilon)}}$, and let $\bar{\alpha}_\varepsilon = (1 - \varepsilon)^{\frac{1}{3(n_0+\bar{z}_\varepsilon)}}$. Then, $\bar{\lambda}_\varepsilon \in (0,1)$ and $\bar{\alpha}_\varepsilon \in (0,1)$. Moreover, if $\lambda < \bar{\lambda}_\varepsilon$ and $\alpha > \bar{\alpha}_\varepsilon$, then the probability that R wins when voters follow the strategy profile σ^α exceeds $(1 - \varepsilon)^{\frac{n_0+z}{3(n_0+\bar{z})}} (1 - \varepsilon)^{\frac{n_0+z}{3(n_0+\bar{z})}} (1 - \varepsilon)^{\frac{1}{3}} = (1 - \varepsilon)$.

Finally, by Lemma 4, there exists $\bar{\lambda}'_\varepsilon \in (0, \frac{1}{2})$ such that, if $\lambda < \bar{\lambda}'_\varepsilon$ and $\alpha \leq \bar{\alpha}_\varepsilon$, then σ^α is not an equilibrium in the private information environment. Let $\lambda_\varepsilon = \min\{\bar{\lambda}'_\varepsilon, \bar{\lambda}_\varepsilon\}$. Then for all $\lambda < \lambda_\varepsilon$, σ^α is an equilibrium only if R wins with probability exceeding $(1-\varepsilon)$.

To complete the proof, it only remains to show that, when $\lambda < \lambda_\varepsilon$, then σ^0 is not an equilibrium, but this argument follows closely from Theorem 1 (using the assumption that payoffs are not τ-negatively correlated to show that a lower bound on $\Pi(0)$ is strictly positive for sufficiently small λ).

A.3 Proofs of Additional Results (Propositions 4–10)

Proof of Proposition 4 on p. 24. Note that $P \succeq_{\tau\text{-}nc} P'$ if and only if $\frac{P(W_i|\tau_0-1)}{1-P(W_i|\tau_0-1)} \geq \frac{P'(W_i|\tau_0-1)}{1-P'(W_i|\tau_0-1)}$, where τ_0 is defined as in (2) on p. 21. Hence, $\succeq_{\tau\text{-}nc}$ is complete and transitive. The representation follows directly from the subsequent calculations.

$$
\begin{aligned}
P(W_i|\tau_0 - 1) &= \sum_{\hat{\eta}=0}^{n_0} P(W_i|S_i = s^0, M = G = \tau_0 - 1, \eta = \hat{\eta}) P(\hat{\eta}|S_i = s^0, M = G = \tau_0 - 1) \\
&= \sum_{\hat{\eta}=\tau_0-1}^{n_0} \left(\frac{\hat{\eta} - \tau_0 + 1}{n_0 - \tau_0 + 1} \right) P(\hat{\eta}|M = G = \tau_0 - 1) \\
&= \left(\frac{1}{n_0 - \tau_0 + 1} \right) \left(-\tau_0 + 1 + \sum_{\hat{\eta}=\tau_0-1}^{n_0} \hat{\eta} P(\hat{\eta}|M = G = \tau_0 - 1) \right)
\end{aligned}
$$

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$$= \left(\frac{1}{n_0 - \tau_0 + 1} \right) \left(-\tau_0 + 1 + E_P(\eta | M = G = \tau_0 - 1) \right),$$

where the second equality uses Assumptions 1 and 2(a).

$\square$

Proof of Proposition 5 on p. 24. We use the following lemma:

Lemma 5. *For every $m \geq 1$, and vectors $a, q, r \in \mathbb{R}_+^m$ such that $a \cdot q \neq 0$, $q_1 \leq ... \leq q_m$, and $r_1 \leq ... \leq r_m$,*

$$\frac{\sum_{i=1}^m r_i a_i q_i}{\sum_{i=1}^m a_i q_i} \geq \frac{\sum_{i=1}^m r_i a_i}{\sum_{i=1}^m a_i}. \tag{16}$$

Proof. Because all the denominators are non-negative, (16) is equivalent to $\sum_{i,j=1}^m r_i q_i a_i a_j$ $\geq \sum_{i,j=1}^m r_i q_j a_i a_j$, which is obtained by cross-multiplying and re-grouping terms. Each $a_i a_j$, which is non-negative, is multiplied by $r_i q_i + r_j q_j$ on the LHS and $r_i q_j + r_j q_i$ on the RHS. Therefore, this inequality is satisfied if for each i and j

$$r_i q_i + r_j q_j \geq r_i q_j + r_j q_i. \tag{17}$$

For $i \geq j$, (17) is equivalent to $(r_i - r_j)q_i \geq (r_i - r_j)q_j$, which is true since $r_i - r_j \geq 0$ and $q_i \geq q_j$. Therefore (16) is satisfied. $\square$

We use Lemma 5 to prove our result. To distinguish random variables from their realizations, we use η to denote the random variable representing the number of winners in each state, and $\hat{\eta}$ as a particular realization of η. Observe that

$$P(\hat{\eta}|M = G = \tau_0 - 1) = \frac{P(G = \tau_0 - 1|\hat{\eta}, M = \tau_0 - 1)P(\hat{\eta})}{\sum_{\tilde{\eta}=\tau_0-1}^{n_0} P(G = \tau_0 - 1|\tilde{\eta}, M = \tau_0 - 1)P(\tilde{\eta})} = \frac{\frac{\hat{\eta}!}{(\hat{\eta}-\tau_0+1)!}P(\hat{\eta})}{\sum_{\tilde{\eta}=\tau_0-1}^{n_0} \frac{\tilde{\eta}!}{(\tilde{\eta}-\tau_0+1)!}P(\tilde{\eta})},$$

where we use Assumption 2(a) to derive that $P(\tilde{\eta}|M = \tau_0 - 1) = P(\tilde{\eta})$, and

$$P(G = \tau_0 - 1|\tilde{\eta}, M = \tau_0 - 1) = \frac{\binom{\tilde{\eta}}{\tau_0-1}\binom{n_0-\tilde{\eta}}{0}}{\binom{n_0}{\tau_0-1}} = \frac{\tilde{\eta}!}{(\tilde{\eta}-\tau_0+1)!}\frac{(n_0-\tau_0+1)!}{n_0!}.$$

So, by the proof of Proposition 4, $P \succeq_{\tau\text{-}nc} P'$ if and only if

$$\frac{\sum_{\hat{\eta}=\tau_0-1}^{n_0}(\hat{\eta} - \tau_0 + 1)\frac{\hat{\eta}!}{(\hat{\eta}-\tau_0+1)!}P(\hat{\eta})}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{\hat{\eta}!}{(\hat{\eta}-\tau_0+1)!}P(\hat{\eta})} \geq \frac{\sum_{\hat{\eta}=\tau_0-1}^{n_0}(\hat{\eta} - \tau_0 + 1)\frac{\hat{\eta}!}{(\hat{\eta}-\tau_0+1)!}P'(\hat{\eta})}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{\hat{\eta}!}{(\hat{\eta}-\tau_0+1)!}P'(\hat{\eta})}. \tag{18}$$

Consider a transformation of variables from $\hat{\eta}$ to i such that $i = \hat{\eta} - \tau_0 + 1$. With this

new index, define the vectors r, a, q such that $r_i = i - 1$, $a_i = \frac{(i+\tau_0-2)!}{(i-1)!} P'(i + \tau_0 - 2)$ and $q_i = \frac{P(i+\tau_0-2)}{P'(i+\tau_0-2)}$. Inequality (18) is then re-written as

$$\frac{\sum_{i=1}^{n_0-(\tau_0-1)} r_i a_i q_i}{\sum_{i=1}^{n_0-(\tau_0-1)} a_i q_i} \geq \frac{\sum_{i=1}^{n_0-(\tau_0-1)} r_i a_i}{\sum_{i=1}^{n_0-(\tau_0-1)} a_i}.$$

Because r_i is non-decreasing in i and $a_i \geq 0$, it follows from Lemma 5 that the above inequality is satisfied if q_i is non-decreasing in i. Therefore, a sufficient condition for (18) is that for every $\hat{\eta} \geq \tau_0 - 1$, $\frac{P(\hat{\eta})}{P'(\hat{\eta})}$ is non-decreasing in $\hat{\eta}$, implied by condition (6). $\qquad\square$

Proof of Proposition 6 on p. 25. Signals convey no distributional information when for every signal profile $s \in \mathcal{S}^{n_0}$ and for every pair of voters i and j, $V_i(s) = V_j(s)$. We show that $V^G(\tau) > 0$ in two steps.

Step 1: We show that $P(s_i \in \mathcal{G}, s_j \in \mathcal{B}) = 0$. Towards a contradiction, consider a non-null signal profile $s \in \mathcal{S}^{n_0}$ where $s_i \in \mathcal{G}$ and $s_j \in \mathcal{B}$. Then, $V_i(s_i) > 0$ and $V_j(s_j) < 0$, and by Assumption 2(b), the sign of $V_i(s)$ is that of $V_i(s_i)$ and the sign of $V_j(s)$ is that of $V_j(s_j)$. But since signals convey no distributional information, $V_i(s) = V_j(s)$.

Step 2: Consider the event $E \equiv \{s \in \mathcal{S}^{n_0} : S_i = s^0, M = G = \tau_0\}$. Observe that $V^G(\tau) = V_i(E) = \sum_{s \in E} V_i(s) P(s|E)$. Consider a particular $s \in E$. Because $s_i = s^0$, by Assumption 2(a), $V_i(s) = V_i(s_{-i})$. By Bayes Rule,

$$V_i(s_{-i}) = (1 - \lambda) V_i(s_{-i}) + \sum_{s' \in \mathcal{G}} V_i(s', s_{-i}) P(s'|s_{-i}) + \sum_{s' \in \mathcal{B}} V_i(s', s_{-i}) P(s'|s_{-i})$$

$$= (1 - \lambda) V_i(s_{-i}) + \sum_{s' \in \mathcal{G}} V_i(s', s_{-i}) P(s'|s_{-i}) = \frac{1}{\lambda} \sum_{s' \in \mathcal{G}} V_i(s', s_{-i}) P(s'|s_{-i}),$$

where the second equality follows from Step 1, and the third equality follows from re-arranging terms. By definition of $\mathcal{G}$, $V_i(S_i = s') > 0$ for every $s' \in \mathcal{G}$, and therefore, it follows from Assumption 2(b) that $V_i(s', s_{-i}) > 0$. Therefore, the above expression confirms that for every $s \in E$, $V_i(s) > 0$, and therefore, $V^G(\tau) = V_i(E) > 0$. $\qquad\square$

Proof of Proposition 7 on p. 25. We assume that signals convey no aggregate information (i.e., $P(\eta|s) = P(\eta)$ for all η and s) and a voter with an informative signal learns her priority. This implies that priorities (ρ) and the number of winners (η) must be independent and, by Assumption 1, that the prior distribution over priorities is uniform. As a result,

$$P(W_i) = P(\rho_i \leq \eta) = \sum_{\hat{\rho}=1}^{n_0} P(\rho_i = \hat{\rho}, \eta \geq \rho) = \sum_{\hat{\rho}=1}^{n_0} P(\rho_i = \hat{\rho}) P(\eta \geq \hat{\rho}) = \sum_{\hat{\rho}=1}^{n_0} \frac{1}{n_0} P(\eta \geq \hat{\rho}).$$

We want to show that $P(W_i|\tau_0 - 1) < P(W_i)$, where $P(W_i|\tau_0 - 1)$ is the probability that an uninformed voter i is a winner conditional on $M = G = \tau_0 - 1$. First note that there is a priority $\rho^* \in \{0, ..., n\}$ such that $V_j(\rho_j) > 0$ if and only if $\rho_j \leq \rho^*$ (i.e., all priorities less than or equal to ρ^* are good news, and higher priorities are bad news). Now consider an uninformed voter i in the event where $M = G = \tau_0 - 1$ (for simplicity, as before, we denote this event by "$\tau_0 - 1$"). Observe that

$$P(W_i|\tau_0 - 1) = P(\rho_i \leq \eta|\tau_0 - 1) = \sum_{\hat{\rho}=1}^{n_0} P(\rho_i = \hat{\rho}, \eta \geq \hat{\rho}|\tau_0 - 1) = \sum_{\hat{\rho}=1}^{n_0} P(\rho_i = \hat{\rho}|\tau_0 - 1)P(\eta \geq \hat{\rho})$$

$$= \sum_{\hat{\rho}=1}^{\rho^*} P(\rho_i = \hat{\rho}|\tau_0 - 1)P(\eta \geq \hat{\rho}) + \sum_{\hat{\rho}=\rho^*+1}^{n_0} P(\rho_i = \hat{\rho}|\tau_0 - 1)P(\eta \geq \hat{\rho})$$

$$= \sum_{\hat{\rho}=1}^{\rho^*} P(\rho_i \leq \rho^*|\tau_0 - 1)P(\rho_i = \hat{\rho}|\rho_i \leq \rho^*, \tau_0 - 1)P(\eta \geq \hat{\rho})$$

$$+ \sum_{\hat{\rho}=\rho^*+1}^{n_0} P(\rho_i > \rho^*|\tau_0 - 1)P(\rho_i = \hat{\rho}|\rho_i > \rho^*, \tau_0 - 1)P(\eta \geq \hat{\rho}),$$

where the first and second equalities follow by definition; the third equality follows because η is independent of ρ; the fourth equality follows by definition; and the fifth equality follows by Bayes rule. Then, because the marginal distribution over ρ is uniform,

$$P(W_i|\tau_0 - 1) = \sum_{\hat{\rho}=1}^{\rho^*} \left(\frac{\rho^* - \tau_0 + 1}{n_0 - \tau_0 + 1}\right)\left(\frac{1}{\rho^*}\right)P(\eta \geq \hat{\rho}) + \sum_{\hat{\rho}=\rho^*+1}^{n_0} \left(\frac{n_0 - \rho^*}{n_0 - \tau_0 + 1}\right)\left(\frac{1}{n_0 - \rho^*}\right)P(\eta \geq \hat{\rho}),$$

As a result, $P(W_i|\tau_0-1)-P(W_i) = \frac{(\tau_0-1)(\rho^*-n_0)}{n_0\rho^*(n_0-\tau_0+1)} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta \geq \hat{\rho}) + \frac{\tau_0-1}{n_0(n_0-\tau_0+1)} \sum_{\hat{\rho}=\rho^*+1}^{n} P(\eta \geq \hat{\rho})$. The sign of the right hand side in the above equation is negative if and only if $\frac{\rho^*-n_0}{\rho^*} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta \geq \hat{\rho}) + \sum_{\hat{\rho}=\rho^*+1}^{n_0} P(\eta \geq \hat{\rho}) < 0$. The preceding inequality is equivalent to $\frac{1}{\rho^*} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta \geq \hat{\rho}) > \frac{1}{n_0} \sum_{\hat{\rho}=1}^{n_0} P(\eta \geq \hat{\rho})$, which, by further manipulation, is equivalent to $\frac{1}{\rho^*} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta < \hat{\rho}) < \frac{1}{n_0} \sum_{\hat{\rho}=1}^{n_0} P(\eta < \hat{\rho})$. As $P(\eta < \hat{\rho}) \geq P(\eta < \rho^*)$ for all $\hat{\rho} > \rho^*$ (with a strict inequality for some $\hat{\rho}$), it follows that the right hand side of the above inequality is strictly greater than $\frac{1}{n_0} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta < \hat{\rho}) + \left(\frac{n_0-\rho^*}{n_0}\right)P(\eta < \rho^*)$. It is therefore sufficient to show that $\frac{1}{\rho^*} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta < \hat{\rho}) \leq \frac{1}{n_0} \sum_{\hat{\rho}=1}^{\rho^*} P(\eta < \hat{\rho}) + \left(\frac{n_0-\rho^*}{n_0}\right)P(\eta < \rho^*)$, which is equivalent to showing that $\left(\frac{n_0-\rho^*}{n_0\rho^*}\right) \sum_{\hat{\rho}=1}^{\rho^*} P(\eta < \hat{\rho}) \leq \left(\frac{n_0-\rho^*}{n_0}\right)P(\eta < \rho^*)$. Hence, the result follows because $P(\eta < \hat{\rho}) \leq P(\eta < \rho^*)$ for all $\hat{\rho} = 1, ..., \rho^*$. $\square$

Proof of Proposition 8 on p. 27. The formal argument follow closely the proof of Theorem 1 and we therefore provide a sketch of the proof.

Suppose payoffs are majority-τ-negatively correlated with respect to the binary partition $\{\mathcal{E}, \mathcal{N}\mathcal{E}\}$. Let σ^A be the pure strategy-profile where elites vote for R unless they receive bad news, and non-elites vote for Q unless they receive good news. To establish the result, it suffices to show that σ^A is a strict equilibrium for λ sufficiently small. Clearly, informed voters are playing a strict best-response. Similar to the proof of Theorem 1, for uninformed voters we can focus on the event $\tilde{E} \equiv \{s_i = s^0, M = G = M(\mathcal{N}\mathcal{E}) = \tau_0 - |\mathcal{E}|\}$ when λ is sufficiently small. The reason is that, according to strategy-profile σ^A, in all other events where voter i is pivotal, the number of voters with informed signals is strictly greater than $\tau_0 - |\mathcal{E}|$; as a result, the likelihood of these other pivotal events are dominated by the likelihood of event $\tilde{E}$ as $\lambda \to 0$. For a sufficiently small λ, the sign of the ex interim payoff of an uninformed voter coincides with the sign of the expected payoff conditional on event $\tilde{E}$. Payoffs being majority-τ-negatively correlated is then exactly the condition required to ensure that for both elite and non-elite voters, σ^A is specifying a strict best-response when the voter is uninformed. In particular, condition (a) in Definition 2 ensures that uninformed elite voters are playing a strict best response, and condition (c) ensures that uninformed non-elite voters are playing a strict best response. $\qquad\square$

Proof of Proposition 9 on p. 28. For the purpose of Proposition 9, an environment can be described by a tuple $(n_0, \tau_0, p, |\mathcal{E}|)$, where n_0 is the size of the population, τ_0 is the number of votes required for the reform to pass, $p = (p_0, ..., p_{n_0})$ is an ex-ante distribution over the number of winners (i.e., p_η is the ex-ante probability that there are η winners), and $|\mathcal{E}|$ is the number of elite voters in the population.

For such an environment, we want notation to describe (i) the interim distributional uncertainty of a non-elite voter, and (ii) the interim aggregate uncertainty. For the interim distributional uncertainty, $u_\eta \equiv P(W_i | \tilde{E}, \eta)$ denotes the interim probability of a non-elite voter i being a winner conditional on the event $\tilde{E} \equiv \{S_i = s^0, M = M(\mathcal{N}\mathcal{E}) = G = \tau_0 - 1 - |\mathcal{E}|\}$ and there being η winners. We let $u \equiv (u_{\tau_0-1}, ..., u_{n_0})$ be the corresponding vector (note that u_η is not defined for $\eta < \tau_0 - 1$). For $\eta = \tau_0 - 1, ..., n_0$,

$$u_\eta = P(W_i | \tilde{E}, \eta) = \frac{\eta - |\mathcal{E}| - (\tau_0 - 1 - |\mathcal{E}|)}{n_0 - |\mathcal{E}| - (\tau_0 - 1 - |\mathcal{E}|)} = \frac{\eta - (\tau_0 - 1)}{n_0 - (\tau_0 - 1)}$$

For the interim aggregate uncertainty, $q_\eta \equiv P(\eta | \tilde{E})$ denotes the interim probability of η winners conditional on the event $\tilde{E}$. Let $q \equiv (q_{\tau_0-1}, ..., q_{n_0})$ be the corresponding vector

(note that $q_\eta = 0$ if $\eta < \tau_0 - 1$). For $\eta = \tau_0 - 1, ..., n_0$, Bayes rule yields

$$P(\eta|\tilde{E}) = \frac{P\big(G = \tau_0 - 1 - |\mathcal{E}|\big|\eta, M = M(\mathcal{NE}) = \tau_0 - 1 - |\mathcal{E}|\big)p_\eta}{\sum_{\eta'=\tau_0-1}^{n_0} P\big(G = \tau_0 - 1 - |\mathcal{E}|\big|\eta', M = M(\mathcal{NE}) = \tau_0 - 1 - |\mathcal{E}|\big)p_{\eta'}}, \quad (19)$$

where p_η is the ex ante probability of there being η winners. Using the hypergeometric distribution, we obtain

$$P(G = \tau_0-1-|\mathcal{E}||\eta, M=M(\mathcal{NE})=\tau_0-1-|\mathcal{E}|) = \frac{\binom{\eta-|\mathcal{E}|}{\tau_0-1-|\mathcal{E}|}\binom{n_0-\eta}{0}}{\binom{n_0-|\mathcal{E}|}{\tau_0-1-|\mathcal{E}|}} = \frac{\frac{(\eta-|\mathcal{E}|)!}{(\eta-\tau_0+1)!}}{\frac{(n_0-|\mathcal{E}|)!}{(n_0-\tau_0+1)!}}. \quad (20)$$

Plugging (20) into (19), and canceling the common terms $\frac{(n_0-|\mathcal{E}|)}{(n_0-\tau_0+1)}$, yields

$$q_\eta = P(\eta|\tilde{E}) = \frac{\frac{(\eta-|\mathcal{E}|)!}{(\eta-\tau_0+1)!}p_\eta}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{(\hat{\eta}-|\mathcal{E}|)!}{(\hat{\eta}-\tau_0+1)!}p_{\hat{\eta}}}.$$

Finally, we denote by $r \equiv P(W_i|\tilde{E})$ the probability that a non-elite voter i is a winner conditional on the event $\tilde{E}$. By the Law of Total Probability, $r = u \cdot q$.

We prove Proposition 9 by comparing two environments, which differ only in the number of elites in the population. The first environment is described by the tuple $(n_0, \tau_0, p, |\mathcal{E}|)$, with u denoting the distribution for the interim distributional uncertainty, q denoting the distribution for the interim aggregate uncertainty, and r denoting the interim probability of winning. The second environment is described by the tuple $(n_0, \tau_0, p, |\mathcal{E}'|)$, with u' denoting the distribution for the interim distributional uncertainty, q' denoting the distribution for the interim aggregate uncertainty, and r' denoting the interim probability of winning. Let $0 \le |\mathcal{E}'| < |\mathcal{E}| \le \tau_0 - 1$.

Our goal is to show that $r \le r'$. Observe that for $\eta = \tau_0-1, ..., n_0$, $u_\eta = \frac{\eta-(\tau_0-1)}{n_0-(\tau_0-1)} = u'_\eta$, and so $u = u'$ (i.e., interim distributional uncertainty does not depend on the number of elites in the population). Moreover, $q_\eta = 0$ for every $\eta < \tau_0-1$. Therefore, $r = u\cdot q = u'\cdot q$ and $r' = u' \cdot q'$. Because u' is non-decreasing in η, it suffices to show that q' first-order stochastically dominates q. Below, we prove that implication by showing that q' likelihood-ratio dominates q. Observe that for every $\eta < n_0$,

$$
\begin{aligned}
q_\eta q'_{\eta+1} &= \left(\frac{\frac{(\eta-|\mathcal{E}|)!}{(\eta-\tau_0+1)!}p_\eta}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{(\hat{\eta}-|\mathcal{E}|)!}{(\hat{\eta}-\tau_0+1)!}p_{\hat{\eta}}}\right)\left(\frac{\frac{(\eta+1-|\mathcal{E}'|)!}{(\eta-\tau_0+2)!}p_{\eta+1}}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{(\hat{\eta}-|\mathcal{E}'|)!}{(\hat{\eta}-\tau_0+1)!}p_{\hat{\eta}}}\right)\\
&\ge \left(\frac{\frac{(\eta+1-|\mathcal{E}|)!}{(\eta-\tau_0+2)!}p_{\eta+1}}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{(\hat{\eta}-|\mathcal{E}|)!}{(\hat{\eta}-\tau_0+1)!}p_{\hat{\eta}}}\right)\left(\frac{\frac{(\eta-|\mathcal{E}'|)!}{(\eta-\tau_0+1)!}p_\eta}{\sum_{\hat{\eta}=\tau_0-1}^{n_0} \frac{(\hat{\eta}-|\mathcal{E}'|)!}{(\hat{\eta}-\tau_0+1)!}p_{\hat{\eta}}}\right) = q_{\eta+1}q'_\eta,
\end{aligned}
$$

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where the equalities follow by definition and the weak inequality follows from

$$\frac{(\eta - |\mathcal{E}|)!(\eta + 1 - |\mathcal{E}'|)!}{(\eta + 1 - |\mathcal{E}|)!(\eta - |\mathcal{E}'|)!} = \frac{(\eta + 1 - |\mathcal{E}'|)}{(\eta + 1 - |\mathcal{E}|)} > 1,$$

because $|\mathcal{E}'| < |\mathcal{E}|$. Thus, q' likelihood-ratio dominates q, which completes the proof. $\square$

Proof of Proposition 10 on p. 29. If σ is a strict equilibrium, it must be that case that $\sigma \in \{\sigma^0, \sigma^1\}$ by Lemma 3. When λ is sufficiently small, Q wins with probability exceeding $1 - \varepsilon$ in the strategy profile σ^0. Thus, we need to show that, for λ sufficiently small, the strategy profile σ^1 is not an equilibrium when $V^B(\tau) < 0$. For the strategy profile σ^1, an uninformed voter i is pivotal if and only if $B = n_0 - \tau_0$. Hence, σ^1 is an equilibrium if and only if

$$\sum_{m=n_0-\tau_0+1}^{n_0-1} V_i \left(S_i = s^0, M = m, B = n_0 - \tau_0 + 1\right) P\left(B = n_0 - \tau_0 + 1 | M = m\right) P\left(M = m\right) \geq 0.$$

As in the proof of Theorem 1, it is sufficient to show that a lower bound on the sum on the LHS is strictly greater than zero. The algebra manipulations parallel the corresponding manipulations in the proof of Theorem 1, and so we omit the formal details. σ^1 is not an equilibrium if

$$\left(\frac{\lambda}{1-\lambda}\right) \bar{v} \sum_{m=n_0-\tau_0+2}^{n_0-1} \binom{n_0-1}{m} < -V^B(\tau)P(B = n_0-\tau_0+1 | M = n_0-\tau_0+1)\binom{n_0-1}{n_0-\tau_0+1}.$$

Since the RHS is strictly positive and does not depend on λ, there is a $\tilde{\lambda}$ such that, for all $\lambda < \tilde{\lambda}$, the strict inequality holds and σ^1 is not an equilibrium. $\square$

A.4   Analysis of Correlation of Information and Interests

This extension captures settings where winners have an informational advantage over losers. This informational superiority may come from winners, or elite voters, having a greater ability to design the policy choice, and therefore being better able to observe how they fare from it. We capture this asymmetry by relaxing the assumption that payoffs are independent of one's chances of obtaining information (Assumption 2(a)). Instead, being a winner is positively correlated with obtaining information. We prove that this form of informational advantage amplifies the possibility for electoral failures.

Each voter's signal is an element of $\{s^0, s^1\}$ where (i) conditioning on the event that voter i is a loser (L_i), $P(s_i = s^0 | L_i) = 1$, and (ii) conditioning on being a winner (W_i),

voter i obtains s^1 with probability $\lambda \in (0,1)$ and s^0 otherwise. Thus, realization s^1 guarantees that one is a winner whereas s^0 increases the chance of being a loser. We assume that the population size is n_0.

As before, the prior probability of being a winner is sufficiently high that R is ex ante optimal (as described by inequality (3) on p. 21). But, unlike our baseline analysis, the interim belief conditioning on there being $\tau_0 - 1$ informed winners depends on the value of λ, because assumption 2(a) is violated. To account for this dependence, we say that payoffs are (τ, λ)-negatively correlated if inequality (4) is satisfied at the value λ.

Proposition 11. *When winners are the only ones who obtain the realization s^1, the following is true:*

a) *There exists a strict symmetric equilibrium in which all voters who obtain signal s^0 vote for Q if and only if payoffs are (τ, λ)-negatively correlated.*

b) *If payoffs are (τ, λ)-negatively correlated, then payoffs are (τ, λ')-negatively correlated for every λ' in $(\lambda, 1)$.*

c) *Payoffs are (τ, λ)-negatively correlated for every λ in $(0,1)$ if*

$$\frac{\sum_{\eta = \tau_0 - 1, \ldots, n_0} (\eta - (\tau_0 - 1)) \binom{\eta}{\tau_0 - 1} P(\eta)}{\sum_{\eta = \tau_0 - 1, \ldots, n_0} (n_0 - \eta) \binom{\eta}{\tau_0 - 1} P(\eta)} < \frac{v_l}{v_w}. \tag{21}$$

When winners are the only players who obtain s^1, there are two effects for those who obtain signal s^0. The first is a direct effect that s^0 is bad news about how one fares from the reform. The second is a strategic effect where these voters feel crowded out when they condition on being pivotal. Increasing λ amplifies the direct effect so that a voter with signal s^0 has a stronger incentive to vote against the reform at higher values of λ. That information exacerbates this electoral failure implies that a sufficient condition for payoffs to be (τ, λ)-negatively correlated for every λ is for it to be true when $\lambda \approx 0$, a property used in Proposition 11(c).

Proof of Proposition 11 on p. 54. We proceed in the order of results.
(a) Consider a strategy profile in which any voter with a signal s^1 votes for R and any voter with a signal s^0 votes for Q. Voting for R with signal s^1 is a strict best-response. With a signal s^0, the difference in payoffs between voting for R and Q is $P(G = \tau_0 - 1) V^G(\tau_0 - 1)$, which by definition is strictly negative when payoffs are (τ, λ)-negatively correlated.

(b) We begin by re-writing the probability of being a winner, conditional on being pivotal and uninformed. To make it clear as to which environment we are referring to, we write $P^{\tilde{\lambda}}(W_i | \tau - 1)$ to represent $P(W_i | \tau_0 - 1)$ when the probability of receiving signal s^1

conditional on being a winner is $\tilde{\lambda}$. Observe that:

$$P^\lambda(W_i|\tau_0 - 1) = \sum_{\eta=0}^{n_0} P(W_i|S_i = s^0, G = \tau_0 - 1, \eta)P(\eta|S_i = s^0, G = \tau_0 - 1)$$

$$= \sum_{\eta=\tau_0-1}^{n_0} \frac{\eta - (\tau_0 - 1)}{n_0 - (\tau_0 - 1)} P(\eta|S_i = s^0, G = \tau_0 - 1)$$

$$= \sum_{\eta=\tau_0-1}^{n_0} \frac{\eta - (\tau_0 - 1)}{n_0 - (\tau_0 - 1)} P(\eta|G = \tau_0 - 1)$$

$$= \left(\frac{1}{n_0 - (\tau_0 - 1)} \right) \frac{\sum_{\eta=\tau_0-1}^{n_0}(\eta - (\tau_0 - 1))P(\eta)\binom{\eta}{\tau_0-1}\lambda^{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}}{\sum_{\eta=\tau_0-1}^{n_0} P(\eta)\binom{\eta}{\tau_0-1}\lambda^{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}}$$

$$= \left(\frac{1}{n_0 - (\tau_0 - 1)} \right) \frac{\sum_{\eta=\tau_0-1}^{n_0}(\eta - (\tau_0 - 1))P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}}{\sum_{\eta=\tau_0-1}^{n_0} P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}}$$

where the first equality is by definition and Bayes Rule, the second equality uses the exchangeability of voters, the third equality uses the exchangeability of voters to highlight that $S_i = s^0$ is redundant information given $G = \tau_0 - 1$, the fourth equality uses Bayes Rule, and the fifth equality cancels λ^{τ_0-1} from the numerator and denominator.

Now consider a fixed $\lambda \in (0, 1)$ and $\lambda' > \lambda$. Observe that $P^\lambda(W_i|\tau_0-1) \geq P^{\lambda'}(W_i|\tau_0 - 1)$ is equivalent to

$$\frac{\sum_{\eta=\tau_0-1}^{n_0}(\eta - \tau_0 + 1)P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-\tau_0+1}}{\sum_{\eta=\tau_0-1}^{n_0} P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-\tau_0+1}} \geq \frac{\sum_{\eta=\tau_0-1}^{n_0}(\eta - \tau_0 + 1)P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda')^{\eta-\tau_0+1}}{\sum_{\eta=\tau_0-1}^{n_0} P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda')^{\eta-\tau_0+1}}.$$

We prove the claim using Lemma 5. Let $\zeta = \frac{1-\lambda}{1-\lambda'} > 1$, and re-index by $i = \eta - (\tau_0 - 2)$. Define the vectors $r_i = i - 1$, $a_i = P(i + \tau_0 - 2)\binom{i+\tau_0-2}{\tau_0-1}(1 - \lambda')^{i-1}$, and $q_i = \zeta^{i-1}$. Then observe that the above inequality is equivalent to

$$\frac{\sum_{i=1}^{n_0-(\tau_0-2)} r_i a_i q_i}{\sum_{i=1}^{n-(\tau_0-2)} a_i q_i} \geq \frac{\sum_{i=1}^{n_0-(\tau_0-2)} r_i a_i}{\sum_{i=1}^{n_0-(\tau_0-2)} a_i},$$

which, by Lemma 5, is satisfied since both q and r are increasing in their index.

Finally, we note that payoffs are τ-negatively correlated for λ implies that $\frac{P^\lambda(W_i|\tau_0-1)}{1-P^\lambda(W_i|\tau_0-1)} < \frac{v_l}{v_w}$, which implies that $\frac{P^{\lambda'}(W_i|\tau_0-1)}{1-P^{\lambda'}(W_i|\tau_0-1)} < \frac{v_l}{v_w}$ because $P^\lambda(W_i|\tau_0 - 1) \geq P^{\lambda'}(W_i|\tau_0 - 1)$.

(c) We consider $\lim_{\lambda \to 0} \frac{P^\lambda(W_i|\tau_0-1)}{P^\lambda(L_i|\tau_0-1)}$. Observe that

$$\frac{P^\lambda(W_i|\tau_0 - 1)}{P^\lambda(L_i|\tau_0 - 1)} = \frac{\sum_{\eta=\tau_0-1}^{n_0}(\eta - (\tau_0 - 1))P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}}{\sum_{\eta=\tau_0-1}^{n_0}(n_0 - \eta)P(\eta)\binom{\eta}{\tau_0-1}(1 - \lambda)^{\eta-(\tau_0-1)}},$$

where we use similar steps to calculate the denominator as we did for the numerator. Taking the limit as $\lambda \to 0$ generates the term in (21), and using (b), it follows that payoffs are τ-negatively correlated for every $\lambda \in (0, 1)$. $\qquad\square$