Bandwagons in Costly Elections: The Role of Loss Aversion*

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Abstract

The formal study of voluntary elections with costly participation predicts that the supporters of the *underdog* –i.e., of the candidate that is expected to lose– are less likely to abstain than the supporters of the expected winner (Palfrey and Rosenthal, 1985; Herrera et al., 2014). While some empirical/experimental studies identify this underdog effect (Levine and Palfrey, 2007), in others *bandwagons* emerge: the supporters of the expected winner are found to abstain less often than the supporters of the underdog (Agranov et al., 2018). We focus on large elections and follow Kőszegi and Rabin (2006) by considering that voters experience gains and losses with respect to their expected equilibrium payoffs. When the election is sufficiently close (i.e., when the shares of the supporters of the two alternatives are not too asymmetric), we find that *bandwagons emerge in every equilibrium*. To our knowledge, this is the first formal study that explains bandwagons in large elections, by incorporating a commonly accepted behavioural model in an otherwise standard context of costly voting.

Keywords: costly voting; loss-aversion; underdog effect; bandwagon; majority rule.
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1 Introduction

During electoral campaigns, candidates struggle to demonstrate their superiority over their rivals in terms of popularity and chances of winning the election. To this end, they advertise pre-election poll results when these results appear favourable to them, and try to undermine/dismiss them when these results suggest that they are unlikely to win.[1] The formal study of costly elections under majority rule, though, has long established that such behaviour is not optimal for the candidates. Indeed, when participation to the election is costly for the voters, an underdog effect emerges: the supporters of the candidate that is expected to lose are less likely to abstain than the supporters of the expected winner.

Does this render the will of real-world candidates to appear popular/likely-winners irrational? Are they acting against their own interests when trying to convince the electorate that they are ahead in pre-election polling? Not necessarily. While the formal results seem unambiguous, the empirical evidence is mixed (see, for instance, Irwin and Van Holsteyn, 2000; Levine and Palfrey, 2007; Agranov et al., 2018). Indeed, several empirical and experimental studies that have been conducted on the subject not only have failed to detect an underdog effect, but they have identified bandwagon effects instead: supporters of the expected winner abstained less often than the supporters of the expected loser (Klor and Winter, 2007; Großer and Schram, 2010; Morton et al., 2015; Agranov et al., 2018). That is, real-world candidates who try to convince voters that they are front-runners might be serving efficiently their own interests after all.

What could be the source of discrepancy behind the theoretical predictions and the occasionally opposite empirical observations? In a recent contribution, Agranov et al. (2018) investigate several possible explanations and suggest that the voters' win motivation –the satisfaction derived from voting for the winning candidate– might be responsible for bandwagons (see also Callander, 2007). Indeed, they convincingly argue that a number of other potential explana-

[1] A non-exhaustive list of papers studying the role of political campaigns in shaping electoral outcomes includes Banducci and Karp (2003), Hersh and Schaffner (2013), Frenkel (2014).

tions, including loss-aversion, cannot explain the bandwagons observed in their experiments and, hence, a plausible justification for bandwagons might simply be the fact that voters are happier when siding with the winner.

In this paper, we revisit the potential of voters' loss-aversion in explaining bandwagons. The theory of loss aversion postulates that voters experience gains and losses with respect to reference payoffs but, importantly, it does not specify how these reference points are determined. Agranov et al. (2018), who first considered the issue of loss-aversion in the pivotal voting model with costly participation, assumed that voters evaluate gains and losses with respect to a common exogenous payoff (normalized to zero). Despite it being a natural starting point, this is not the only reasonable approach to modelling reference dependent preferences. Kőszegi and Rabin (2006) proposed an alternative way of selecting reference payoffs in strategic settings with loss-averse players: the voters might experience gains and losses, not with respect to some exogenously given payoff but taking as reference the endogenously determined expected equilibrium payoffs.

We introduce loss-aversion with respect to the expected equilibrium payoffs –thereafter, simply loss-aversion– in an otherwise standard model of costly voting in binary majority elections, and show that, indeed, it can lead to bandwagon effects. According to the Kőszegi and Rabin (2006) formulation of reference dependence, each player considers not only the payoff consequence of her actions but also the potential of each action to shift the payoff away from its expected level. Loss averse voters with such reference dependent preferences face very different participation incentives depending on whether they support the expected winner or the underdog. The supporters of the expected winner anticipate a high payoff, and hence abstention endangers a large loss in payoff with respect to the expected outcome; while underdog supporters expect a low payoff anyway, and, therefore, abstention mainly decreases the chances of a large gain. Since loss-averse voters over-weigh losses compared to gains, it follows that loss-aversion is a force pushing for bandwagons.

Of course, loss-aversion is not the only relevant force in a costly voting setup. The standard pivotality asymmetries pushing for underdog over-representation are also present. Hence, the emergence of bandwagons depends on the relative strength of loss-aversion compared to the degree of heterogeneity in the probability of being pivotal. We focus on large elections and prove that as long as the voters are loss-averse (i.e., experience losses more intensely than gains) and the election is sufficiently close (i.e., when the shares of the supporters of the two alternatives are not too asymmetric), then bandwagons appear in every equilibrium. To derive this result we also consider that voters care primarily about the electoral result, and less so about their gain-loss experience. This assumption seems quite plausible when considering real-world elections: the consequences of the electoral outcome are usually significant, and the empirical weight assigned to losses is, according to the literature, larger than the one assigned to gains (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991).

To our knowledge, this is the first formal argument explaining bandwagons in large elections without also predicting cross-voting. Indeed, while the theory that voters simply enjoy a boost of fixed size to their utility when voting for the winner of the elections is also plausible (see Callander, 2007; Agranov et al., 2018), it predicts that supporters of the expected loser can end up voting for their least preferred alternative if their desire to side with the winner is very strong. In our model such cross-voting behaviour is never optimal: for every possible parametrization and voters' beliefs, the best response of each voter is either to abstain or to vote for the alternative she prefers. This is neither an advantage nor disadvantage of the current approach vis-a-vis alternative theories, but, rather, a salient distinctive feature that provides the basis for a future identification exercise (or meta-analysis of existing empirical studies). That is, we do not only propose an alternative rationale behind bandwagons, but also notice that it can be empirically disentangled from other plausible explanations.

In what follows, we first briefly review the relevant literature (section 2), then we describe our model (section 3) and provide the formal analysis (section 4), and, finally, we conclude (section 5).

2 Literature review

The current paper builds on the literature on costly voting and turnout rates in electoral competition. Based on the game-theoretic framework of Ledyard (1984) and Palfrey and Rosenthal (1983, 1985), theory predicts the existence of the underdog effect. Supporters of the candidate who is expected to lose, have higher turnout rates than supporters of the expected winner (Borgers, 2004; Levine and Palfrey, 2007; Goeree and Grosser, 2007; Taylor and Yildirim, 2010; Herrera et al., 2014; Kartal, 2015).

Despite the robust prediction of the theory, several empirical studies find evidence of bandwagon effects. Irwin and Van Holsteyn (2000) conducting a meta-analysis study, show despite the mixed evidence, the existence of the bandwagon effect is more frequent than the underdog effect. Kiss and Simonovits (2014) report bandwagons in elections of 2002 and 2006 in Hungary, Hodgson and Maloney (2013) in British elections over the period 1885-1910, while Morton et al. (2015) in France elections of 2005.

While there is solid evidence that an underdog effect can emerge in costly voting setups (Levine and Palfrey, 2007), most laboratory experiments report bandwagons (Klor and Winter, 2007; Duffy and Tavits, 2008; Großer and Schram, 2010; Morton and Ou, 2015; Agranov et al., 2018) and suggest several mechanisms to rationalise their findings. Agranov et al. (2018) support that bandwagon effects emerge by the feeling to vote for the winner. They argue their results fit the predictions of Callander (2007) model, which shows that the bandwagon effect may emerge by voter's tendency to conform. In a slightly different experimental setup, Morton and Ou (2015) suggest that both the desire to vote for the winner and other-regarding preferences could induce bandwagon behaviour. Other-regarding preferences may lead voters to vote for a more socially appealing candidate that is often against their material self-interest.

While voters being risk-averse in their outcome-related preferences does not lead to bandwagons in a standard setup with additively separable preferences over electoral outcomes and participation decisions (see Agranov et al., 2018), risk-aversion along with non-separable preferences over the two payoff-relevant dimensions could potentially undermine the underdog effect. Indeed, Grillo (2017) considering a model with two players shows that a bandwagon effect may emerge when the preferences over the electoral outcome and participation are non-separable. In our work, we formally show that when the final utility depends additionally and asymmetrically on gains/losses with respect to expected payoffs, then bandwagons may emerge in large elections.

Our analysis contributes to this literature by suggesting loss aversion as a potential mechanism to explain the existence of bandwagon effects. Although Agranov et al. (2018) and Hermann et al. (2019) argue that bandwagons cannot be attributed to loss aversion, they base their argument on deviations from exogenous reference points. We revisit the role of loss aversion and reference-dependent preferences, assuming that the reference point is determined endogenously. Following Kőszegi and Rabin (2006, 2007), each voter's reference point is formed by her rational expectations about the electoral outcome. We prove that the reference-dependence leads to higher participation rates among the supporters of the expected winner generating bandwagon effects.[2]

Recently, scholars started to investigate the effect of loss aversion on alternative political economy models. Alesina and Passarelli (2019) and Lockwood and Rockey (2020) show that status quo bias and moderating effect over policies can be explained by voter's loss aversion while Attanasi et al. (2017) explain preferences for more protective rules. Grillo (2016) study strategic communication between voters and candidates and supports that the reference-dependence introduced by Kőszegi and Rabin (2006, 2007) yields truth-telling equilibria in electoral campaigns. Schumacher et al. (2015) argue that because of loss aversion, parties with low office aspiration are more likely to make radical reforms than when they are in opposition. Since their expectation of losing in the next election is high they are eager to take the risk of making radical reforms. Acharya and Grillo (2019) study the tendency to re-elect a leader consider-

[2]Daido and Tajika (2020) have incorporated loss aversion in a model of voluntary voting without costs. In such a setting loss-averse voters might resort to abstention as it alleviates potential losses stemming from aggregate uncertainty regarding candidates' popularity. Focusing on a standard model of costly voting, we show that loss aversion has different effects on the participation rates of the majority and the minority group. Abstention generates higher expected losses for the supporters of the expected winner, inducing a higher tendency to vote.

ing the canonical crisis bargaining model where loss averse voters evaluate material outcomes relative to an endogenous reference point.

3 Model

We study a costly voting model under population uncertainty, where the size of the electorate is finite but uncertain.[3] The number of citizens eligible to vote in a given election, is a random variable n that is drawn from a Poisson distribution with parameter $N > 0$.

Two political parties, namely A and B, compete for winning the elections. The citizens' preferences over parties are chosen exogenously by nature. Each citizen is assigned to be a type A with probability $\phi \in (0, 1)$ and a type B with probability $(1 - \phi)$. Without loss of generality, we set $\phi < \frac{1}{2}$ so that prior to elections, the party A is expected to have fewer supporters than the party B.[4] We assume a winner-take-all electoral system, under which party $J \in \{A, B\}$ wins the elections. Supporters of the winner gain a payoff equal to 1 whereas the remaining citizens get 0. In case of a tie, both types of citizens receive a payoff equal to $\frac{1}{2}$.

During elections, citizens have to choose to vote for party A, party B or abstain. In line with Palfrey and Rosenthal (1985), we consider that, in case of voting, citizen i incurs a participation cost, c_i. Voting costs are drawn independently for each citizen from a uniform distribution F on $[0, 1]$.

While the preferences of an individual over parties and her participation cost are her private information, the preference and cost assignment process is common knowledge. That is, all individuals know that the preferences and the costs are i.i.d. draws from the described distributions.

Following Kőszegi and Rabin (2006), the overall utility for a citizen consists of two components: the actual outcome utility that is equal to the payoff from the election outcome minus the

[3] Population uncertainty is an assumption often used in the literature. See, for example, Myerson (1998, 2000), Bouton and Castanheira (2012) and Herrera et al. (2014).

[4] The symmetric case $\left(\phi = \frac{1}{2}\right)$ while theoretically interesting in a number of ways (see, e.g., Borgers, 2004), it cannot give rise to underdog effects by definition (see Definition 2 in Section 4.2) and it is hence skipped.

cost of voting; and the gain-loss utility which is derived by the comparison between the actual outcome with a reference point. The gain-loss utility reads

$$\mu(x) = \begin{cases} \eta x, & \text{if } x \geq 0 \\ \eta \lambda x, & \text{if } x < 0 \end{cases},$$

where the parameter $\eta > 0$ denotes the weight attached to the gain-loss utility whereas the parameter $\lambda > 1$ is the coefficient of loss aversion (i.e., it measures how much agents overweigh losses compared to gains).[5]

In line with Kőszegi and Rabin (2006), we consider that the reference points are endogenous. In specific, we assume that they are determined by citizen's expectations (beliefs) about the electoral outcome. Conditional on voting for her favourite party and on some expectations regarding others' behavior, citizen i expects her favourite party to win with probability $p_i \in [0,1]$ and lose with probability $(1 - p_i)$. In like manner, when she abstains, she expects a $q_i \in [0,1]$ chance of winning, where $p_i > q_i$, and a $(1 - q_i)$ chance of losing. Voting for the party she likes less is strictly dominated by abstention, and hence we do not formally consider this possibility.

A reference point in our setup coincides with the expected payoff conditional on a citizen's action (i.e., her expectations are not fixed but are affected by her choice). Intuitively, she anticipates the consequences that prevail given her actions and she proceeds with a strategy that maximizes her expected utility.[6]

[5]We use the particular notation to capture the loss aversion described by prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1991). However, we ignore its diminishing returns, for the sake of simplicity (Kőszegi and Rabin, 2006). This is a common assumption used in literature (see Heidhues and Kőszegi 2008, 2014; Rosato 2016; Grillo 2016; Dato et al. 2017, 2018; Daido and Tajika 2020).

[6]This solution concept is known as the choice-acclimating personal equilibrium (CPE); see Kőszegi and Rabin (2007).

For any electoral outcome, the expected utility of citizen i, is given by

$$EU_i = \begin{cases} p_i - c_i + \eta\, p_i\,[1 - c_i - (p_i - c_i)] + \eta\,\lambda\,(1 - p_i)\,[-c_i - (p_i - c_i)]\,, & \text{if } i \text{ votes} \\ \\ q_i + \eta\, q_i\,(1 - q_i) + \eta\,\lambda\,(1 - q_i)\,(-q_i)\,, & \text{if } i \text{ abstains.} \end{cases} \tag{1}$$

Like Kőszegi and Rabin (2006), we assume that, in equilibrium, a citizen's expectations are correct, i.e. they are compatible with the decision rules adopted by the other citizens. Moreover, in such Poisson models the focus is on symmetric equilibria, i.e. every voter of the same preference type employs the same decision rule (see Myerson, 1998, 2000; Martinelli, 2002; Bouton and Castanheira, 2012 and Herrera et al. 2014). Hence, in equilibrium $p_i = p_A$ and $q_i = q_A$ (resp. $p_i = p_B$ and $q_i = q_B$) for every citizen i of type A (resp. B).

4 Analysis

Let α (resp. β) be the probability that, in equilibrium, a random citizen of type A (resp. B) votes for her favourite party. Then the expected turnout rate is $T = \alpha\phi + \beta(1 - \phi)$. As in all similar setups, the equilibria of the game will take the form of cut-off threshold pairs (c_A, c_B). That is, citizens of type A with a cost below a threshold c_A vote for party A, citizens of type B with a cost below a threshold c_B votes for party B and the remain citizens abstain. Therefore, the turnout probability of type A citizens is $a = F(c_A)$ and the turnout probability of type B citizens is $\beta = F(c_B)$.

In a threshold equilibrium, a voter i with participation cost equal to the threshold cost is indifferent between voting and abstaining. The expected marginal benefit of voting equates the voting cost,

$$c_i^* = MB_i \equiv (p_i - q_i)\Big[1 - \eta(\lambda - 1)\Big(1 - (p_i + q_i)\Big)\Big]. \tag{2}$$

To focus on equilibria with non-negative cut-off cost thresholds, we use the following assumption for the remainder of the analysis.

Assumption 1. The weight attached to gain-loss utility is not large, i.e., $\eta < \frac{1}{\lambda - 1}$.

Under this assumption, the term that captures the effect of loss aversion on the equilibrium condition is always bounded above zero $\left(\text{i.e. } \left[1 - \eta(\lambda - 1)\Big(1 - (p_i + q_i)\Big)\right] > 0\right)$. This implies that the extra gain or loss that emerges from the comparison of the actual outcome with the reference point is not prevalent in the voters' overall utility.

4.1 Equilibrium existence and asymptotics

Notice that the equilibrium thresholds c_J^* for citizens of type $J \in \{A, B\}$ is written,

$$c_J^* = MB_J \equiv (p_J - q_J)\left[1 - \eta(\lambda - 1)\left(1 - (p_J + q_J)\right)\right] \ , \tag{3}$$

where the probability of creating or breaking a tie $(p_J - q_J)$ takes the following form,

$$(p_A - q_A) = \sum_{k=0}^{\infty} \left(\frac{e^{-\phi N\alpha}(\phi N\alpha)^k}{k!}\right)\left(\frac{e^{-(1-q)N\beta}[(1-\phi)N\beta]^k}{k!}\right)\frac{1}{2}\left(1 + \frac{(1-\phi)N\beta}{k+1}\right) \ , \tag{4}$$

$$(p_B - q_B) = \sum_{k=0}^{\infty} \left(\frac{e^{-\phi N\alpha}(\phi N\alpha)^k}{k!}\right)\left(\frac{e^{-(1-\phi)N\beta}[(1-\phi)N\beta]^k}{k!}\right)\frac{1}{2}\left(1 + \frac{\phi N\alpha}{k+1}\right) \tag{5}$$

and the sum of the relevant winning probabilities $(p_J + q_J)$,

$$(p_A + q_A) = \sum_{k=0}^{\infty} \left(\frac{e^{-\phi N\alpha}(\phi N\alpha)^k}{k!}\right)\left(\frac{e^{-(1-\phi)N\beta}[(1-\phi)N\beta]^k}{k!}\right)\left(\frac{3}{2} + \frac{1}{2}\frac{(1-\phi)N\beta}{k+1} + \sum_{j=1}^{\kappa}\frac{[\phi N\alpha]^j}{k+j}\right) \ , \tag{6}$$

$$(p_B + q_B) = \sum_{k=0}^{\infty} \left(\frac{e^{-\phi N\alpha}(\phi N\alpha)^k}{k!}\right)\left(\frac{e^{-(1-\phi)N\beta}[(1-\phi)N\beta]^k}{k!}\right)\left(\frac{3}{2} + \frac{1}{2}\frac{\phi N\alpha}{k+1} + \sum_{j=1}^{\kappa}\frac{[(1-\phi)N\beta]^j}{k+j}\right) \ . \tag{7}$$

In the following proposition we prove the existence of the equilibrium.

Proposition 1. An equilibrium exists for every admissible parametrization.

Proof. Fix any admissible parametrization (N, ϕ, η and λ). We can write $(p_J - q_J)$ and $(p_J + q_J)$ for every $J \in \{A, B\}$ in terms of the cut-off costs where $\alpha = F(c_A)$ and $\beta = F(c_B)$. In this way, the pair of equilibirum conditions from expression (3) becomes a function of c_A and c_B,

$$\begin{aligned} c_A &= (p_A - q_A)\Big[1 - \eta(\lambda - 1)\Big(1 - (p_A + q_A)\Big)\Big] \equiv D^A(c_A, c_B) \\ c_B &= (p_B - q_B)\Big[1 - \eta(\lambda - 1)\Big(1 - (p_B + q_B)\Big)\Big] \equiv D^B(c_A, c_B) \end{aligned}. \tag{8}$$

Given that $\eta < \frac{1}{\lambda - 1}$, the marginal benefit of participation for a type J voter is strictly increasing in p_J and strictly decreasing in q_J. Indeed,

$$\frac{\partial MB_J}{\partial p_J} = 1 - \eta(\lambda - 1)(1 - 2\,p_J) > 0\,, \qquad \forall\, p_J \in [0, 1]\,,$$

$$\frac{\partial MB_J}{\partial q_J} = -\Big(1 - \eta(\lambda - 1)(1 - 2\,q_J)\Big) < 0\,. \qquad \forall\, q_J \in [0, 1]\,.$$

Therefore, for $p_J = 1$ and $q_J = 0$ the maximum marginal benefit $MB_J = 1$ is attained. Moreover, D_A and D_B are continuous functions of c_A, c_B, from $[0, 1]^2$ into itself; and $[0, 1]^2$ is a compact convex subset of $\mathbb{R}^2$. Hence, by Brouwer's theorem there exists at least one fixed point (c_A^*, c_B^*) which satisfies both equations and defines an equilibrium. ■

Next, we study some important properties of equilibria in large elections. We assume that all parameters of the model remain fixed, except for the expected size of the electorate, N, and we examine how aspects of the equilibria change as N increases.

Lemma 1. Fix any η, λ and ϕ. For any increasing and diverging sequence of positive numbers, $\{N_t\}_{t=0}^{\infty}$, and any sequence of equilibria defined by (α_{N_t}, β_{N_t}), there exists $\epsilon > 1$ such that $\frac{\alpha_{N_t}}{\beta_{N_t}} \in (\frac{1}{\epsilon}, \epsilon)$ for every t.

Proof. In this proof we combine results from Herrera et al. (2014), where the authors employ the modified Bessel functions to describe marginal benefits from voting in large elections, with novel arguments that are required to address the additional complexities of our more general objective functions. The modified Bessel functions of the first kind (Abramowitz and Stegun, 1965) are defined as

$$I_0(z) := \sum_{k=0}^{\infty} \frac{\left(\frac{z}{2}\right)^k}{k!} \frac{\left(\frac{z}{2}\right)^k}{k!} \qquad \text{and} \qquad I_1(z) := \sum_{k=0}^{\infty} \frac{\left(\frac{z}{2}\right)^k}{k!} \frac{\left(\frac{z}{2}\right)^{k+1}}{(k+1)!}, \tag{9}$$

where $x = \phi N \alpha_N$, $y = (1-\phi) N \beta_N$, $z = 2\sqrt{xy}$. Notice that x, y and z are functions of the size of the electorate, however, we remove subscript N for expositional reasons.

We can now rewrite $(p_A - q_A)$ and $(p_B - q_B)$, in expressions (4) and (5), in terms of the modified Bessel functions,

$$(p_A - q_A) = \frac{1}{2} \sum_{k=0}^{\infty} \left(\frac{e^{-x} x^k}{k!}\right) \left(\frac{e^{-y} y^k}{k!}\right) \left(1 + \frac{y}{k+1}\right) = \frac{e^{-x} e^{-y}}{2} \left(I_0(2\sqrt{xy}) + \sqrt{\frac{y}{x}} I_1(2\sqrt{xy}) \right) \tag{10}$$

and

$$(p_B - q_B) = \frac{1}{2} \sum_{k=0}^{\infty} \left(\frac{e^{-x} x^k}{k!}\right) \left(\frac{e^{-y} y^k}{k!}\right) \left(1 + \frac{x}{k+1}\right) = \frac{e^{-x} e^{-y}}{2} \left(I_0(2\sqrt{xy}) + \sqrt{\frac{x}{y}} I_1(2\sqrt{xy}) \right). \tag{11}$$

Let us fix η, λ and ϕ; and also an increasing and diverging sequence $\{N_t\}_{t=0}^{\infty}$ and a sequence of equilibria defined by $(\alpha_{N_t}, \beta_{N_t})$.

First, we show that the z corresponding to our equilibrium sequence diverges.

Suppose not, i.e. along some subsequence, z is bounded below a positive number. This implies that (i) either both x and y are bounded along some sub-subsequence; or (ii) x (y) diverges and y (x) converges to zero along some sub-subsequence. Consider the case where both x and y are bounded along some sub-subsequence. Then the marginal benefits will be positive and bounded away from zero, and therefore α_{N_t} and β_{N_t} will be bounded above zero for every t along some sub-subsequence. That is, x, y will diverge leading to a contradiction.

Consider now the case where x (y) diverges and y (x) converges to zero along some sub-subsequence. Then the marginal benefit of type B (A) is arbitrarily larger than the marginal benefit of type A (B) which implies that along some sub-subsequence $y > x$ ($x > y$).

As z diverges, the modified Bessel functions from expression (9) are asymptotically equivalent, and for large N,

$$I_0(z) \approx I_1(z) \approx \frac{e^{-z}}{2\pi z}\,. \tag{12}$$

Next, using the expressions for $(p_J - q_J)$ from equations (10) and (11), we can rewrite the marginal benefit for $J \in \{A, B\}$ as a function of the modified Bessel functions. In particular, the ratio of equilibrium marginal benefits takes the form

$$\frac{MB_A}{MB_B} = \frac{\left(I_0(2\sqrt{xy}) + \sqrt{\frac{y}{x}}I_1(2\sqrt{xy})\right)}{\left(I_0(2\sqrt{xy}) + \sqrt{\frac{x}{y}}I_1(2\sqrt{xy})\right)}\Pi\,, \tag{13}$$

where Π denotes the ratio of the terms capturing the effect of loss aversion,

$$\Pi = \frac{[1-\eta(\lambda-1)\,(1-p_A-q_A)]}{[1-\eta(\lambda-1)\,(1-p_B-q_B)]} \in \left[\frac{1-\eta(\lambda-1)}{1+\eta(\lambda-1)}, \frac{1+\eta(\lambda-1)}{1-\eta(\lambda-1)}\right].$$

Finally, we argue that $\frac{y}{x}$ is bounded above zero. Define $w = \sqrt{\frac{y}{x}}$. Suppose that along some subsequence w diverges to infinity. Then, for every fixed $h > \frac{1}{\Pi}$, there exists a sub-subsequence such that $w > h$ and hence,

$$\frac{MB_A}{MB_B} > \frac{\left(I_0(2\sqrt{xy}) + hI_1(2\sqrt{xy})\right)}{\left(I_0(2\sqrt{xy}) + \frac{1}{h}I_1(2\sqrt{xy})\right)}\Pi \simeq \frac{1+h}{1+\frac{1}{h}}\Pi > 1\,.$$

However, when w diverges, then $\beta_{Nt}/\alpha_{Nt} \to \infty$ along some sub-sub-subsequence. Since F is increasing and $\phi < \frac{1}{2}$, we have that

$$\frac{\phi}{1-\phi}\frac{F^{-1}(\alpha_{N_t})}{F^{-1}(\beta_{N_t})} \to 0\,,$$

along this sub-subsequence. Further, by using our equilibrium conditions, we get

$$\frac{\phi}{1-\phi}\frac{MB_A}{MB_B} \to 0\,,$$

which contradicts the assumption that w diverges (and, hence, the assumption that a subsequence exists with $\frac{MB_A}{MB_B} > \frac{1+h}{1+\frac{1}{h}}\Pi > 1$ for every $h > \frac{1}{\Pi}$).

So w is bounded below a positive number. We can follow a similar reasoning to show that it is also bounded from below by a positive number. Therefore, $\frac{\alpha_{N_t}}{\beta_{N_t}}$ is bounded by a positive number both from above and from below. ■

These results establish that for every diverging sequence of positive numbers (capturing the expected electorate size), and any corresponding sequence of equilibria, the expected number of voters for each alternative diverges, but no alternative enjoys an arbitrarily larger support than the other. This allows us to confidently use the "$\simeq$" symbol when dealing with equilibrium conditions in large societies, and makes the following characterization exercise less intense in terms of notation.

4.2 Conditions for Bandwagons

We now move to the main part of our analysis, where we identify conditions under which bandwagons emerge in large societies. First we give a formal definition of the bandwagon and the underdog effect.

Definition 1. If in some equilibrium we have $\phi\alpha_N > (1-\phi)\beta_N$ and $\alpha_N > \beta_N$, or $\phi\alpha_N < (1-\phi)\beta_N$ and $\alpha_N < \beta_N$, then we have a bandwagon effect.

Definition 2. If in some equilibrium we have $\phi\alpha_N > (1-\phi)\beta_N$ and $\alpha_N < \beta_N$, or $\phi\alpha_N < (1-\phi)\beta_N$ and $\alpha_N > \beta_N$, then we have an underdog effect.

That is, if the supporters of the expected winner are less likely to abstain than the supporters of the expected loser, we have a bandwagon; and when the supporters of the expected loser are less likely to abstain than the supporters of the expected winner, then an underdog effect is present.

Recall that $w = \sqrt{\frac{y}{x}}$, $x = \phi N \alpha_N$, $y = (1-\phi) N \beta_N$, and that w is bounded by a positive number from above and from below along any sequence of equilibria. Consistent with expressions (10), (11) and condition (12), when N is arbitrarily large, we have

$$\frac{(p_A - q_A)}{(p_B - q_B)} \simeq \frac{1+w}{1+\frac{1}{w}} \, ,$$

which means that

$$\frac{(p_A - q_A)}{(p_B - q_B)} \simeq \frac{\sqrt{(1-\phi)\beta_N}}{\sqrt{\phi \alpha_N}} \, .$$

It is easy to show that $\hat{\Pi}(p) > 1$ for $p > \frac{1}{2}$ whereas $\hat{\Pi}(p) < 1$ for $p < \frac{1}{2}$.

Since x, y diverge to infinity along every sequence of equilibria, it follows that, in large societies, $p_A \simeq q_A = p$ and $p_B \simeq q_B \simeq 1 - p$. Subsequently, in large societies, the Π ratio becomes

$$\Pi \simeq \hat{\Pi}(p) = \frac{1 - \eta(\lambda - 1)(1 - 2p)}{1 - \eta(\lambda - 1)(2p - 1)} \, . \tag{14}$$

Hence, as N increases the ratio of equilibrium conditions becomes

$$\frac{c_A^*}{c_B^*} = \frac{F^{-1}(\alpha_N)}{F^{-1}(\beta_N)} \simeq \frac{\sqrt{(1-\phi)\beta_N}}{\sqrt{\phi \alpha_N}} \, \hat{\Pi}(p) \, . \tag{15}$$

If we denote the expected share of voters of type A in equilibrium by $S_A = \phi \, \alpha_N$ ($S_B = (1-\phi) \, \beta_N$, respectively, for voters of type B), we can rewrite (15) as follows,

$$\frac{S_A}{S_B} \simeq \Big(\frac{F^{-1}(\beta_N)}{F^{-1}(\alpha_N)}\Big)^2 \, \hat{\Pi}(p)^2 \, . \tag{16}$$

Proposition 2. For every fixed admissible pair of parameters (η, λ), there exists a $\hat{\phi} < \frac{1}{2}$, such that a bandwagon effect emerges in large societies in all sequences of equilibria when $\phi \in (\hat{\phi}, \frac{1}{2})$.

Proof. First, we derive necessary conditions for the non-emergence of bandwagons in large societies. Fix $\epsilon \in (0, \frac{1}{2})$. When Candidate A is the expected winner, then we must have a bandwagon. Hence, a necessary condition for the non-emergence of bandwagons is that $p \leq \frac{1}{2} + \epsilon$.

Equation (15) for $\alpha_N > \beta_N$, gives,

$$\frac{F^{-1}(\alpha_N)\sqrt{\alpha_N}}{F^{-1}(\beta_N)\sqrt{\beta_N}} = \frac{\sqrt{1-\phi}}{\sqrt{\phi}}\hat{\Pi}(p) > 1 \Rightarrow \hat{\Pi}(p) > \sqrt{\frac{\phi}{(1-\phi)}}\,,$$

substituting for $\hat{\Pi}(p)$ by equation (14),

$$\frac{1-\eta(\lambda-1)(1-2p)}{1+\eta(\lambda-1)(1-2p)} > \sqrt{\frac{\phi}{(1-\phi)}} \;\Rightarrow\; p > \frac{1}{2}\left(1 - \frac{1-\sqrt{\frac{\phi}{(1-\phi)}}}{\eta(\lambda-1)\left(1+\sqrt{\frac{\phi}{(1-\phi)}}\right)}\right)\,.$$

Therefore, a second necessary condition for the non-emergence of bandwagons is

$$p \geq \frac{1}{2}\left(1 - \frac{1}{\eta(\lambda-1)}\frac{1-\sqrt{\frac{\phi}{1-\phi}}}{1+\sqrt{\frac{\phi}{1-\phi}}}\right) - \epsilon\,.$$

Notice that the right hand side of the above condition is strictly increasing in ϕ,

$$\frac{\partial}{\partial\phi}\left[\frac{1}{2}\left(1 - \frac{1}{\eta(\lambda-1)}\frac{1-\sqrt{\frac{\phi}{1-\phi}}}{1+\sqrt{\frac{\phi}{1-\phi}}}\right)\right] = \frac{1}{2}\frac{1}{\eta(\lambda-1)}\frac{1}{(1-\phi)\left(2\,\phi+\sqrt{\frac{\phi}{1-\phi}}\right)} > 0\,,$$

and

$$\lim_{\phi\to\frac{1}{2}}\frac{1}{2}\left(1 - \frac{1}{\eta(\lambda-1)}\frac{1-\sqrt{\frac{\phi}{1-\phi}}}{1+\sqrt{\frac{\phi}{1-\phi}}}\right) = \frac{1}{2}\left(1 - \frac{1}{\eta(\lambda-1)}\frac{1-\sqrt{1}}{1+\sqrt{1}}\right) = \frac{1}{2}\,.$$

Notice that for any admissible pair of parameters (η, λ), there exists a $\hat{\phi} < \frac{1}{2}$ such that both $\frac{1}{2} + \epsilon$ and the right hand side of the second condition are in $(0, 1)$ when $\phi > \hat{\phi}$ and $\epsilon > 0$ is sufficiently small.

For such values of ϕ and ϵ, it follows that the non-emergence of bandwagons requires that both parties enjoy a substantially large election probability. That is, that there exists an $\hat{\epsilon} > 0$, such that $p \in [\hat{\epsilon}, 1 - \hat{\epsilon}]$.

But if in a large society $p \in [\hat{\epsilon}, 1 - \hat{\epsilon}]$ for some $\hat{\epsilon} > 0$, it follows that $S_A \to S_B$: otherwise –that is, if $|S_A - S_B| > \epsilon'$ for some $\epsilon' > 0$ along some sequence of equilibria– either $p \to 0$ or $p \to 1$.

Now, if $S_A \to S_B$, then by expression (16), it follows that $p \to p^*$, with

$$p^* = \frac{1}{2}\Big[1 + \frac{1}{\eta(\lambda - 1)} \frac{F^{-1}(\alpha_N) - F^{-1}(\beta_N)}{F^{-1}(\alpha_N) + F^{-1}(\beta_N)}\Big] \, .$$

Since $\phi < \frac{1}{2}$, we must have $\frac{\alpha_N}{\beta_N} \to \frac{1-\phi}{\phi} > 1$, in order for $S_A \to S_B$ to be feasible. By the fact that F is uniform, it follows that

$$p^* = \frac{1}{2}\Big[1 + \frac{1}{\eta(\lambda - 1)}(1 - 2\phi)\Big] \, .$$

Therefore, $p^* > \frac{1}{2} + \epsilon$, when $\epsilon > 0$ is sufficiently small. This leads to a contradiction with the first condition for the non-emergence of bandwagons. Therefore a bandwagon effect is present in all sequences of equilibria when ϕ is sufficiently close to $\frac{1}{2}$. ■

Simply put, if for a given ϕ, p needs to be well above zero for an underdog effect to emerge, then underdogs cannot emerge in equilibrium. Notice that these sufficiently large values of $\phi < \frac{1}{2}$ that guarantee the existence of bandwagons in all equilibria, do not need to be very close to $\frac{1}{2}$. As we see in Figure 1, the combinations of p and ϕ that would lead to an underdog effect are not plausible in equilibrium for any $\phi > 0.003$ in the left panel, and any $\phi > 0.265$ in the right panel.

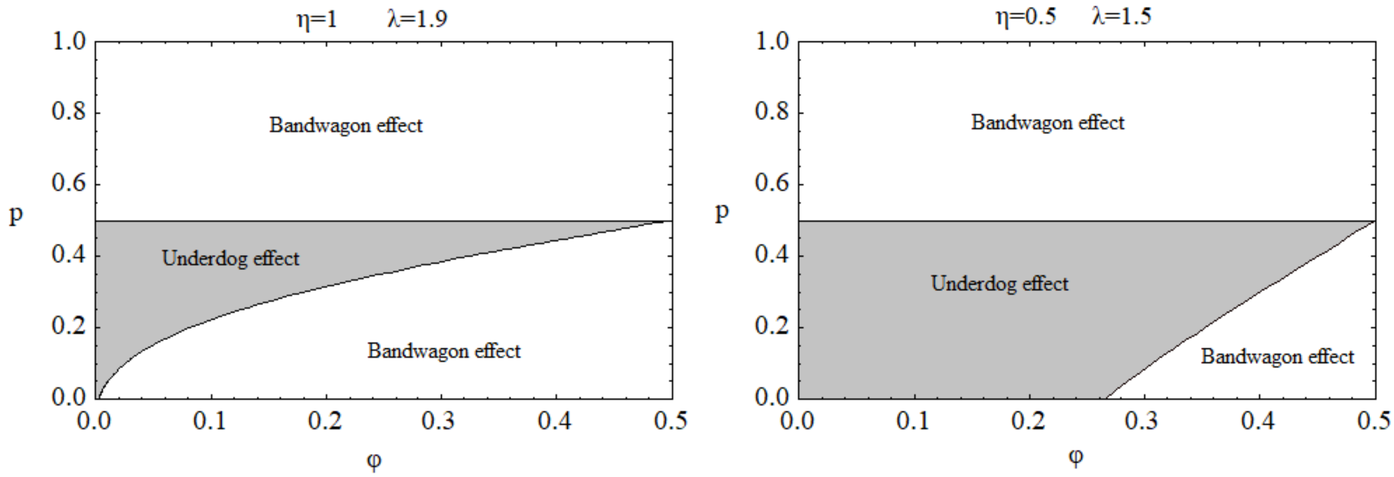

Figure 1: Combinations of p and ϕ yielding an underdog and a bandwagon effect, for alternative pairs of (η, λ).

We conclude our analysis by further exploring three salient cases of possible equilibrium sequences.

(i) Sequences of equilibria such that $p \to 1$. That is, when party A wins almost surely.

(ii) Sequences of equilibria such that $p \to 0$. That is, when party B wins almost surely.

(iii) Sequences of equilibria such that $p \in [\epsilon, 1-\epsilon]$ for some $\epsilon \in \left(0, \frac{1}{2}\right)$. That is, when both parties have substantial chances to win the election.

Let us investigate under which conditions bandwagons emerge in each of the three cases.

Case (i): We first consider the case in which party A is expected to win the election almost surely. That is, we assume that a sequence of equilibria such that $p \to 1$ exists. In such sequences, the existence of a bandwagon effect follows trivially: when $p \to 1$ then party A is expected to win in large elections, and since $\phi < 1/2$, it must be the case that $\alpha_N > \beta_N$.

Case (ii): We now move to the more interesting case in which party B is expected to win almost surely. Hence, $\hat{\Pi}(0) \simeq \frac{1-\eta(\lambda-1)}{1+\eta(\lambda-1)} < 1$. As party B is the expected winner, $S_B > S_A$ which according to equation (16) implies that

$$\frac{F^{-1}(\beta_N)}{F^{-1}(\alpha_N)} < \frac{1}{\hat{\Pi}(0)} \, .$$

Since $\hat{\Pi}(0) < 1$, the case of party B being the expected winner can accommodate both a bandwagon and an underdog effect depending on whether the left-hand side of the above inequality is above or below one (see Figure 2).

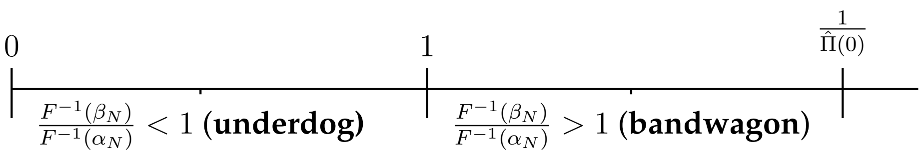

Figure 2: Party B as the expected winner

According to Definition 1 and as shown in Figure 2, in order to observe a bandwagon effect under this case, it also requires $\beta_N > \alpha_N$. Hence,

$$\frac{F^{-1}(\beta_N)}{F^{-1}(\alpha_N)} > 1 \xrightarrow{\text{eq. (15)}} \frac{\sqrt{\phi \alpha_N}}{\sqrt{(1-\phi)\beta_N}} \frac{1}{\hat{\Pi}(0)} > 1 \xrightarrow{\beta_N > \alpha_N} \frac{\phi}{(1-\phi)\hat{\Pi}(0)^2} > 1 \Rightarrow \phi > \frac{1}{2} \frac{\big(1-\eta(\lambda-1)\big)^2}{1+\eta^2(\lambda-1)^2} \, .$$

As a result, such subsequence entails a bandwagon if and only if $\phi > \frac{\hat{\Pi}(0)^2}{1+\hat{\Pi}(0)^2} \simeq \frac{1}{2} \frac{(1-\eta(\lambda-1))^2}{1+\eta^2(\lambda-1)^2}$.

Accordingly, when ϕ fails this condition, expression (15) leads to $\alpha_N > \beta_N$, corresponding to an underdog effect (see Figure 3). Therefore, given the degree of loss aversion, a relative close competition in terms of candidate's popularity generates higher participation rates of the supporters of the expected winner.

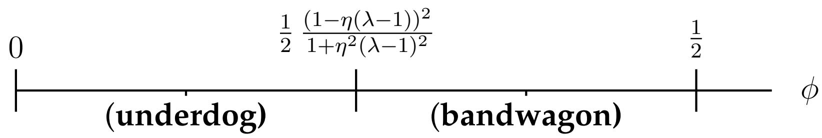

Figure 3: Values of ϕ and the bandwagon/underdog effect

We can now explain the relationship between ϕ and the coefficient of loss aversion. As shown above, the plausibility of a bandwagon depends on the condition that $\phi > \frac{1}{2} \frac{(1-\eta(\lambda-1))^2}{1+\eta^2(\lambda-1)^2}$.

Notice that the degree of loss aversion favors this condition. The more loss averse the voters are, the more likely a bandwagon effect is. To understand this, consider the following extreme examples where $\lambda \to 1$ and $\lambda \to 1 + \frac{1}{\eta}$.[7] When $\lambda \to 1$ (loss neutral voters), a bandwagon effect requires that $\phi \to \frac{1}{2}$. In contrast, when $\lambda \to 1 + \frac{1}{\eta}$, the existence of a bandwagon effect if guaranteed for every admissible ϕ. Figure (4) describes combinations of the parameter values that permit for underdog and bandwagon effects in this kind of equilibria.

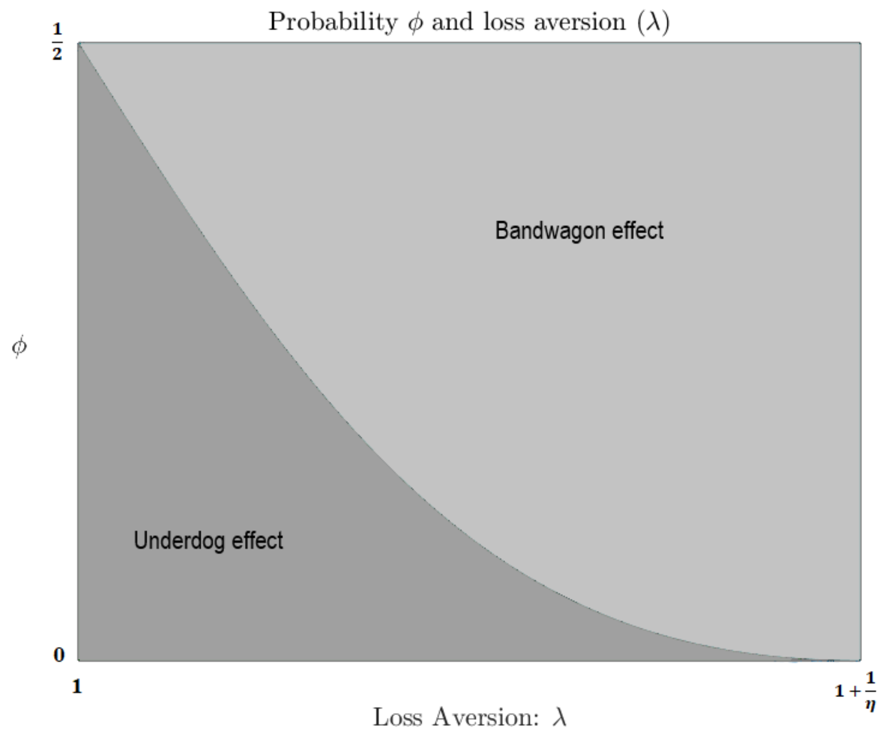

Figure 4: Combinations of ϕ, η and λ that support an underdog and a bandwagon effect in sequences of equilibria with $p \to 0$.

Hence, the addition of loss aversion proves to be critical for the theoretical justification of bandwagon effects in large electorates. Indeed, as shown in Figure 4, two opposing forces are at play. On the one hand, loss aversion pushes for bandwagons, and on the other hand, pivotality asymmetries push for underdog over-representation. Essentially, it is the relative strength between loss aversion (captured by λ) and pivotality asymmetries that determines which effect dominates.

[7] Assumption 1 restricts λ to be below this value.

Case (iii): Finally, as we know from the proof of Proposition 2, all sequences of equilibria such that $p \in [\epsilon, 1-\epsilon]$, for some $\epsilon \in \left(0, \frac{1}{2}\right)$, always entail a bandwagon.

5 Conclusion

The current paper attempts to provide the missing link between theoretical studies that argue in favour of the underdog effect in costly voting environments under majority rule, and empirical studies that often provide opposing evidence of bandwagons in similar setups. We do so, by introducing loss averse voters in the spirit of Kőszegi and Rabin (2006) into a voluntary and costly election à la Palfrey and Rosenthal (1985). Within this framework, we allow for endogenously determined reference points, namely the expected equilibrium payoffs, with respect to which loss averse voters experience gains and losses.

Due to expectation based references and voters weighting losses more than gains, abstention induces larger losses for the supporters of the expected winner relative to the potential gains that participation induces to the supporters of the minority. At the same time, consistent with the theory of strategic voting, the probability of being pivotal is larger for underdog supporters, pushing for the emergence of an underdog effect. We study the interplay between those two opposing forces, and try to assess how they balance out in equilibrium. Notice that a full equilibrium characterisation is more demanding in our setup compared to the standard setting without loss-aversion, due to the potential existence of multiple equilibria for some parameter values. Despite that, we were able to provide meaningful sufficient conditions for a bandwagon effect, in every equilibrium of the game.

As far as empirical/experimental studies are concerned, we stress that loss aversion provides a testable alternative to theories of bandwagon emerging due to voters' satisfaction when siding with the winner. Indeed, cross-voting is never optimal in our framework, and, hence, a properly designed laboratory experiment should be able to evaluate the empirical relevance of these competing approaches.

Lastly, our work paves the way to future study on the topic. In light of our results, more research can be conducted concerning the role of pre-election information. As prior information constitutes a key determinant of the reference point formation, disclosure strongly motivates behaviour under expectation based loss aversion. A natural extension to our analysis may concern whether and how prior information is manipulated by political parties, exploiting voters' loss aversion to their own ends. Additionally, experimental work can be directed towards exploring the dynamics between the two opposing forces for bandwagon and underdog effects in equilibrium which in turn determines the electoral outcome.

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