Taking Pride in Voting

The Effect of Strength of Opinion and the Bandwagon Effect on Voting Behavior

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Date final version: 21-7-2019

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By extending a model by Karamychev and Swank (2019) I explain how pride can be the driving force behind peoples' motivation to be politically active and to explain how pre-election polls can disrupt this political activity and bias elections. Pride and strength of opinion increase voter turnout while pre-election polls only do so at the expense of the unbiasedness of the election outcome. The models also show how the chance that someone is correct in his political opinions increases the incentives to truthfully communicate about politics and makes them less susceptible to the biases of a bandwagon effect.

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Table of Contents

1. Introduction

Whereas clearly, many people have their reasons to vote and be politically active in general, economists have had a hard time to identify and explain what exactly these reasons are. A basic model, like the calculus of voting models (Downs, 1957 and Riker and Ordeshook, 1968) do not explain why many people decide to incur cost of voting when the expected benefits of doing so is basically zero. The probability that a single vote makes the difference is negligible and so any cost incurred regarding politics, whether those are direct costs, effort or opportunity costs should motivate citizens to abstain from political activity. Economic models therefore usually rely on an extra factor creating a positive utility of voting to outweigh its costs, like the value to see democracy continue (Downs, 1957) or doing one's civic duty (Riker and Ordeshook, 1968). The important distinction between these two added terms is that in Downs' model it is an instrumental mechanism; the utility is gained from the direct effect of your vote. In Riker and Ordeshook's model the mechanism is expressive; the utility arises from expressing yourself (Fiorina, 1976).

Many countries have tried to stimulate political activity, but as long as we do not exactly know what drives people to be politically active it is very hard to stimulate it. To increase voter turnout, Switzerland set out to decrease the cost of voting by allowing citizens to cast their vote by mail. But despite what the calculus of voting theories would predict, voter turnout actually decreased (Funk, 2005). The fact that the decrease was bigger in smaller communities led her to conclude that voting is at least partly caused by social image concerns. This suggests that voters don't necessarily care whether they do their civic duty, but rather whether others saw them doing so. This is supported by a set of survey experiments done by Gerber et al. (2016) that show that voting directly effects how others think of you. The positive effect on your social image of voting can be compared to the positive effects of doing things like recycling, doing voluntary work or staying in shape. This also explains why many papers have found that non-voters lie when asked whether they voted (among others Silver et al., 1986, Harbaugh, 1996 and Belli et al., 1999).

This focus on expressive, rather than instrumental mechanisms has been the starting point for a more recent strand of literature to explain voting. A model by Karamychev and Swank (2019) uses pride and shame to explain information gathering, communication and voting in politics. People vote to receive utility from pride and avoid receiving disutility from shame. In their model shame depends on one's strength of opinion. This creates an incentive to manipulate communication to reduce the strength of opinion and therefore the feelings of shame. In this paper I extend this model and focus on the effect of pride on communication and voter turnout. In the first model pride, rather than shame, depends on the strength of opinion. I show that in this case there are stronger incentives to communicate truthfully.

The second model in this paper explores another expressive mechanism of voting. Several empirical studies have found a so called bandwagon effect in voting (among others McAllister & Studlar, 1991, Mehrabian, 1998, Morton et al., 2015, Morwitz and Pluzinski, 1996, Schmitt-Beck, 1996, Skalaban, 1988). However, the theoretical literature on a bandwagon effect in voting is limited. In the second model of this paper utility increases if someone is perceived to have voted for the winning party. This allows me to explore how a bandwagon effect could affect voting and communication about politics. The model explains how a bandwagon effect makes it less likely that citizens share information, but when they do the bandwagon effect increases voter turnout. This comes at the expense of a bias towards the party that, before the elections take place, is proclaimed to be the likely winner.

In the next section I will discuss the relevant literature in more detail. Then I will present the basic form of the model, which will be followed by two sections in which I introduce and analyze the two new models. In the first one pride will depend on the strength of opinion and in the second one I add the effect of voting for the winning party to the utility function of citizens to explore the effects of a bandwagon effect of a voting poll. In the following two sections I discuss and conclude the results.

2. Theoretical Framework

The early work on turnout decision in elections using instrumental mechanisms could not explain voting behavior in large scale elections. Since then much of the literature has focused on the expressive mechanisms. Many papers have focused on the effect of social image concerns in voting.

Many empirical studies point to an effect of social image concerns on voting, but the most interesting and relevant one to this paper is probably the field experiment done by Gerber et al. (2008). They find that voter turnout increases when people in your surroundings will find out whether you voted or not. Compared to the control group, voter turnout increased dramatically when participants were told that their turnout would be revealed to the members of their household. The increase was even bigger when they were told that turnout would be exposed to the neighborhood (Gerber et al., 2008). This experiment also included a group of participants receiving mail stressing that voting is your civic duty, which also increased voter turnout. These type of mailing campaigns to increase turnout are common in the United States, but none of these policies have increased turnout as much as telling people that their turnout decision will be exposed to those around them (Gerber et al., 2008).

Whereas empirical studies on social image concerns and voting are abundant, papers studying the exact mechanisms behind it with theoretical models are more limited. Dellavigna et al. (2016) combine a field experiment with a theoretical model to predict and explain their results. Their focus is on perceived voting and the incentive to lie about this. They find that voters are more likely to participate in a door-to-door survey than non-voters. By incentivizing lying by offering a higher reward or a shorter survey they test who value making a statement with their turnout decision more and who will lie to get the reward. Voters are significantly more likely to tell the truth, ignoring the extra rewards for lying, than nonvoters (Dellavigna et al., 2016). Their theoretical model is closely related to their field experiment. Their model includes positive utility from telling others that you voted, which depends on the amount of times you expect to be asked about your turnout decision and a cost of lying. The cost of lying assumes that people do not like to lie and so it is not affected by the perception of others (Dellavigna et al., 2016). This is the largest contrast to this paper's model, in which all (relevant) aspects of the utility function are driven by the perception of others.

The model in this paper builds on work by Karamychev and Swank (2019) who provide a theory in which information acquisition, communication and turnout decision are all driven by the perception of a citizen by his neighbors. It explains how communication about politics influences the perception of someone's turnout decision and his strength of opinion. Having stronger opinions increases turnout, but it also influences the expectations of his neighbors. Stronger opinions increase the disutility of shame and therefore it creates an incentive to manipulate communications to keep the perceived strength of opinion low (Karamychev and Swank, 2019).

Regarding a bandwagon effect in voting, the literature is largely limited to empirical studies. Many papers have found such a bandwagon effect in different settings. McAllister and Studlar (1991) show how pre-election polls influenced the results of elections in Great Britain during the general elections in 1979, 1983, and 1987. Skalaban (1988) has also found such an effect of pre-election polls on the results of the presidential elections of 1980 in the United States. In both studies the pre-election polls bias the outcome of the election towards the expected winner as announced by the poll. By exploiting differences in voting deadlines between France and some of its overseas territories Morton et al. (2015) were actually able to identify a bandwagon effect of exit polls. The overseas territories were more likely to vote for the party likely to win according to the exit poll. This bias disappeared after a reform changing the date of the elections of the overseas territories. The media can have the same effect as a pre-election poll as shown by Schmitt-Beck (1996). He finds that mass media influences voters' beliefs about the likely winner and that this creates a bandwagon effect favoring the party supported by the media.

The bandwagon effect in voting has also been a big topic in experimental designs in the context of (real) elections. In an experiment by Morwitz & Pluzinski (1996), a poll changes the beliefs of participants whenever they supported the likely looser and it reinforces beliefs when the poll matches a candidates prior beliefs. In an experiment by Mehrabian (1998), the setting of the real general elections of 1996 in the United States were used. The participants were randomly exposed to polls announcing different candidates as likely winner. The polls, that were completely made up, influenced the participants in the direction of the expected winner.

Apart from the bias that voting polls create through the bandwagon effect, the empirical studies also shed light on who are most likely to be affected. Many of the above mentioned papers have found the bandwagon effect to be stronger for people with weaker opinions (Mehrabian, 1998, Morwitz & Pluzinski, 1996, Schmitt-Beck, 1996, Skalaban, 1988). When voters preferences are not as strong, or they are not as confident that the party they support is the right party for them, they are more likely to be influenced by a voting poll or mass media and abandon their own opinion and follow that of the crowd. The effect of mass media on voter preferences is also found to be stronger for less educated people (Schmitt-Beck, 1996).

The theoretical models of the bandwagon effect on voting are very limited and therefore there aren't many models to explain the results discussed above. Callander (2007) finds a bandwagon effect in a model of sequential voting, but not in a simultaneous voting game. These results stem from the fact that in his model information about a likely winner is attained by looking at other voters, whereas in the model of this paper information about the likely winner is publicly available. In the model by Callander citizens are motivated to vote by the positive utility of influencing the elections and the positive utility of voting for the winner. The model does not include social image concerns and the bandwagon effect is not affected by the perception of the other citizen of the likelihood that he votes for the winner. In his model, like some others (for example Hong and Konrad 1998) the utility from influencing the election outcome is the only incentive not to vote for the expected winner every time, whereas the model I use focusses on large scale elections in which the election outcome cannot be influenced.

By extending the existing model by Karamychev and Swank (2019) I offer more insight into the effects of social image concerns in voting, especially on the side of pride in voting. By adding a bandwagon effect I attempt to offer a model which is able to explain some of the empirical results described above. The next section introduces the basic form of this model.

3. The Basic Model

In a recent paper Karamychev and Swank (2019) have constructed a model explaining voting behavior including information acquisition, communication and the effects of social image concerns. I extend this model and focus on the effect of pride on the utility of voters.

An election that is decided by a simple majority rule is modeled as follows. People vote for a policy $x \epsilon \{0,1\}$, where voting against the policy is denoted by $x = 0$ and voting in favor of the policy by $(x = 1)$. The payoff from the policy for a citizen depends on whether the project is good or bad for him. This is given by the state of the world $w \epsilon \{-1,1\}$. The payoff directly gained from the policy and the decision regarding its implementation for citizens equals wx. When the policy is not implemented, $x = 0$ and there is no utility to be gained or lost. When it is implemented citizens receive utility when the policy is good for them and receive a disutility when the policy is bad for them. Voting in favor or against the policy can also be interpreted as voting for one party or the other. The probability that the state of the world is positive is equal to z. For simplicity I assume that $z = \frac{1}{2}$ and so the probability of a good and a bad state are equal. In this way I model a setting in which a policy affects everyone, but not necessarily in the same way. Citizens can have different states of the world and so have different preferences regarding policy implementation.

To model neighborhoods of citizens in which they communicate about politics, the population consists of an infinite number of citizen pairs. Within these pairs citizens communicate. Citizens within these pairs are homogeneous and so essentially they want the same projects to be implemented, however the pairs are heterogeneous, meaning that not all pairs want the same projects to be implemented. These neighborhoods can reflect a physical neighborhood, or any other setting in which citizens communicate and share the same interests, like a group of friends. A pair consists of citizen i and citizen $-i$, the analysis will revolve around citizen i. The citizen receives a signal about the state of the world $s_i \epsilon \{-1,1\}$. These signals can be regarded as information that citizens acquire about the policy of the election. Acquiring information, for example by reading the newspaper, will give you an idea which policy will be in your best interest. The quality of this signal is equal to the probability that the signal is correct, which is denoted by e_i. In this model the information acquisition stage that is included in the model by Karamychev and Swank (2019) is ignored. The probability of correct signals is given and is equal within neighborhoods, but not necessarily across neighborhoods and is given by e_i. This implies that some neighborhoods are better informed regarding politics than others. No assumptions are made regarding the origin of this difference and so it could be interpreted in many different ways, for example different education levels or levels of political interests across neighborhoods.

After receiving a signal, a citizen has the opportunity to communicate with their neighbor. They can send a cheap talk message $m_i \epsilon \{-1,1\}$ which could be used to try and communicate about the signals received. After they both send a message, citizens update their beliefs about the probability of the state of the world being good using Bayes' rule. This posterior belief is denoted by $\hat{z}_i(s_i, m_{-i}) = Pr(w = 1|s_i, m_{-i})$, this will be referred to as the opinion of the citizen. This resembles citizens talking about politics and using the information of the other citizen, who has the same interests, to form your opinion. The strength of this opinion is equal to the difference between the prior and posterior beliefs. By the assumption that the prior probability of the state of the world being 1 is equal to $z = \frac{1}{2}$, the strength of i's opinion is equal to $|\hat{z}_i(s_i, m_{-i}) - \frac{1}{2}|$. If a citizens posterior opinion is close to the prior opinion, he is considered to have a weak opinion, if the posterior opinion is close to 0 or 1 he is considered to have a strong opinion. Basically if a citizen's opinion is confirmed by another citizen's opinion, it increases confidence in his opinion, whereas contradicting opinions, weakens the strength of opinion. Additionally, people who are more likely to be right for some reason, for example by spending more time acquiring information, or by a better general knowledge of political subjects, expect their acquired information to be correct more often, leading to stronger opinions.

A citizen's social image concerns are not determined by his actual opinion, but by how citizen $-i$ perceives his opinion. The opinion of citizen i as perceived by citizen $-i$ is given by $\hat{z}_i^p(s_i, m_{-i})$, and the expectations of i about this value is given by the perceived opinion of citizen $-i$ for a given signal times the probability of citizen $-i$ receiving this signal:

$$E_i\left[\hat{z}_i^p(s_i, m_{-i})\right] = \Pr(s_{-i} = 1|s_i)\,\hat{z}_i^p(1, m_{-i}) + \Pr(s_{-i} = -1|s_i)\hat{z}_i^p(-1, m_{-i})$$

Based on the information citizens have acquired through their own signal and the message of the other citizen they decide whether to vote or not. This turnout decision is given by $t_i \,\epsilon\, \{0,1\}$, with $t_i = 1$ meaning that citizen i votes and $t_i = 0$ meaning that he does not vote. When i decides to vote, he votes in favor of the project as long as he beliefs that the state of the world for him is more likely to be positive than negative. Formally, when $t_i = 1$, citizen i votes $x = 1$ if $\hat{z}_i(s_i, m_{-i}) > \frac{1}{2}$. This is how opinions determine how citizens vote.

Being perceived as having voted arouses feelings of pride, whereas being perceived as not having voted arouses the disutility of shame. Because this utility originates from social image concerns they aren't necessarily dependent on the actual turnout decision, but rather on the turnout decision as perceived by others. If neighbors are very likely to find out whether you voted your actual turnout decision is very important, whereas if this probability is very low, your perceived turnout, which is determined by signals and messages is important. Let $k_i^p = 1$ denote that citizen $-i$ observes whether citizen i has voted or not and $k_i^p = 0$ that this is not observed. The probability that the turnout decision is observed is equal to $Pr(k_i^p = 1) = \kappa$. The utility that is gained or lost as a result of pride or shame depends on the turnout decision as perceived by citizen $-i$, which depends on the probability of him observing citizen i's vote or not and the information that is exchanged. This means that the probability that $-i$ believes that $t_i = 1$, given the signals and messages is equal to $\hat{t}_i^p(k_i^p, s_{-i}, m_i)$. If the turnout decision is perfectly observable, the signal and message do not influence the perceived turnout decision, as it is either equal to 0 or 1. In practice this means that whenever you do not directly see evidence of someone voting, you base whether you think he voted on the conversations you had about politics. Voting comes at a cost c_i^v, which is unknown at the time of opinion forming until the day of the elections. It is uniformly distributed on the interval $[0, \bar{c}]$. The cost of voting of citizen i and $-i$ are independent.

The decision of a citizen to vote or not depends on his utility function. In a simple model without extra factors influencing pride or shame, this is given by:

$$U_i = wx + \theta_1 E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right] - \theta_2\left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right] - t_i c_i^v$$

The first term is the utility citizen i obtains from the project, which is independent of his turnout decision or opinion as his influence on the outcome of the election is negligible. The second term is the utility received from pride, which depends on the expectation of i about the perceived turnout decision. The second term is the shame of being perceived as not having voted. Both pride and shame are weighted according to a citizen's preferences by θ_1 and θ_2. The last term is the cost of voting, which is only incurred if the citizen decides to vote, if he does not vote $t_i = 0$ and the last term becomes zero. In this model the difference between pride and shame are the preferences for both and obviously the sign; the effect of pride is positive, the effect of shame is negative.

The timing of the model is as follows. Nature determines the state of the world. In the communication stage citizens send messages to each other. Then citizens form their opinions based on this information. Next the citizens decide whether to vote or not. Lastly the payoffs are realized.

To analyze the game I start off by finding the sequential equilibria in which strategies for both the turnout and the communication for each citizen are best responses to each other. I then go on to analyze the stability of these equilibria by finding the conditions under which citizens do not have an incentive to deviate. The focus of the analysis is on non-babbling, separating equilibria, because there will always be a babbling, pooling equilibrium. In such an equilibrium citizens send random messages which are therefore uninformative. There are no incentives to deviate by sending a message equal to your signal, because neighbors will ignore the message anyway.

4. Model 1: Strength of Opinion and Pride

In this model I examine what the effect of social image concerns on political activity is when the pride of a citizen from voting depends on his strength of opinion. Similar to the term for shame in the model by Karamychev and Swank (2019), pride is multiplied by the strength of opinion. Citizens experience a larger feeling of pride when they have a stronger opinion. The social pressure to vote is created by the fact that people expect someone to vote, because it's one's civic duty. These expectations are higher for citizens with a stronger opinion. In this way strength of opinion could influence both pride and shame. This model offers the alternative analysis of the model by Karamychev and Swank (2019) by making pride dependent on strength of opinion. This results in the following utility function for citizen i:

$$U_i = wx + \theta_1 E_i \left|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}\right| E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right] - \theta_2 \left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right] - t_i c_i^v$$

Utility of citizen i now increases in his strength of opinion. If someone has a stronger opinion he is more proud that people perceived him as having voted.

4.1 Turnout decision

At the last stage of this game citizens have received their signal and sent a message. They use this information to decide whether to vote or not. A citizen votes if his utility of voting ($t_i = 1$) is larger than his utility of not voting ($t_i = 0$). The expected utility of voting is equal to:

$$U_i = E_i(wx) + \kappa\theta_1 E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}| + (1-\kappa)\theta_1 E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|E_i\left[\hat{t}_i^p(0, s_{-i}, m_i)\right]$$
$$- (1-\kappa)\theta_2 \left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right] - t_i c_i^v$$

When not voting, his expected utility is equal to:

$$U_i = E_i(wx) + (1-\kappa)\theta_1 E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|E_i\left[\hat{t}_i^p(0, s_{-i}, m_i)\right] - \kappa\theta_2$$
$$- (1-\kappa)\theta_2 \left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right]$$

The first term in both equations shows that citizens do care about policy outcome, but it cannot be influenced by their decision to vote. When the turnout decision is observed with probability κ, voting creates feelings of pride and avoids feelings of shame. Not voting means no utility from pride and a disutility from shame whenever voting is observed. With probability $(1-\kappa)$ voting is not observed, in this case citizens gain or lose utility according to their turnout decision as perceived by the other. This part of the utility function is not influenced by the actual turnout decision, but only by the signal received by citizen $-i$ and the message i sends to him. These two equations show how the probability that people observe your turnout decision matters for your utility. If turnout is not observed, your decision regarding this is irrelevant, because the perceived turnout depends on the communication with your neighbor about politics. If the chance of your neighbors seeing whether you voted increases, your decision to actually vote becomes more important.

Citizen i votes if $U_i(t=1) > U_i(t=0)$. This is the case whenever the benefit of voting is larger than the cost of doing so: $b^*(s_i, m_{-i}) > c_i^v$. Where the benefit of voting equals:

$$b^*(s_i, m_{-i}) = \kappa\left(\theta_1 E_i \left|\hat{z}_i^p(s_i, m_{-i}) - \frac{1}{2}\right| + \theta_2\right)$$

An increase in the benefits of voting, or a decrease in the cost of voting, increases the likelihood that citizen i votes. Citizen i is more likely to vote when he is more sensitive to pride or shame. When you care more for what others think of you, the (dis)utility of your social image will be larger. The expected benefits of voting also increases in the chance that your turnout decision is observed. If voting is not observed your perceived turnout determines your utility, which can only be affected during the communication stage. The higher the chance that your actual turnout decision is observed, the higher your benefits of voting. Lastly, given the signals and messages determined in the previous stage, a stronger opinion also increases ones likelihood to vote, because it increases the expected utility of pride. This shows how the effect of social image concerns on voting might be different depending on the expectations your surroundings have of you.

4.2 Communication stage

Before the turnout decision is made, citizens communicate. The signals and messages received determine a citizen's strength of opinion, which in turn affects the turnout decision. Citizens can decide to send a truthful message where $m_i = s_i$ or they can decide to lie to influence their perceived strength of opinion. This analysis identifies the conditions for an equilibrium in which citizens truthfully reveal their signals. In such an equilibrium, because the messages sent are the same as the signals received, both citizens have the same information. In this case the perception of one's strength of opinion is the same as the actual strength of opinion, the same goes for the expectations regarding your strength of opinion as perceived by the other; $\hat{z}_i(s_i, m_{-i}) = \hat{z}_i^p(s_{-i}, m_i) = E[\hat{z}_i(s_{-i}, m_i)]$. The influence of the signals received are given by lemma 1.

Lemma 1 In an equilibrium where citizens share information and the turnout decision is given by $b^*(s_i, m_{-i}) > c_i^v$, the influence of signals on opinions and voting is given by:

$$\hat{z}_i(1,1) = \frac{e_i^2}{e_i^2 + (1-e)^2} > \hat{z}_i(s_i, -s_i) = \tfrac{1}{2}$$

$$\hat{z}_i(1,1) - \tfrac{1}{2} = \tfrac{1}{2} - \hat{z}_i(-1,-1) \quad and \quad \left|\hat{z}_i(1,1) - \tfrac{1}{2}\right| = \left|\hat{z}_i(-1,-1) - \tfrac{1}{2}\right|$$

$$\hat{t}_i^p(0, s_{-i}, s_{-i}) = \frac{\kappa\left(\theta_1 \left|\frac{e_i^2}{e_i^2 + (1-e)^2} - \frac{1}{2}\right| + \theta_2\right)}{\bar{c}}$$

$$\hat{t}_i^p(0, s_{-i}, -s_{-i}) = \frac{\kappa\theta_2}{\bar{c}}$$

The effect of signals on opinions is the same as in the model by Karamychev and Swank (2019). The effect on turnout is similar, but different in the sense that strength of opinion now influences turnout through pride instead of shame. The first equation shows how congruent signals lead to stronger opinions than dissonant signals. Opposite signals cancel out, because the information of both signals is equally strong. Opinions are the chance that the state of the world is $w = 1$. They're updated according to Bayes' rule. Therefore the chance of having received the correct signal in the case of receiving matching signals is given by the left-hand side of the first equation. Matching signals, both positive and negative, influence opinions in the same way with the same magnitude, only in opposite directions, this is displayed by second equation. If you talk to your neighbor and have the same opinion, you become more confident that you are right and so your opinion become stronger. If your view on the topic is opposite of that of your neighbor you start to doubt yourself and your opinion weakens. If you value your neighbor's take on the matter as strongly as that of your own, your opinions will cancel out. The last two equations of lemma 1 show how signals and strength of opinion affect voting. The perceived voting is equal to the chance that a player's benefits exceed the costs of voting. It's equal to the benefits divided by the range of the distribution of the cost of voting. For conflicting signals the strength of opinion is zero and so the turnout decision only depends on its influence on utility through shame.

The existence of an equilibrium in which citizens truthfully reveal their signals depends on their incentives to deviate. If these incentives are too high, an equilibrium in which citizens share information will not exist. The only equilibrium we then have is a babbling equilibrium in which messages are uninformative and citizens make decision according to their own signal, ignoring the message sent by the other citizen. By deviating from an equilibrium with sharing information, situations with congruent signals become situations with dissonant signals and vice versa. Because signals are informative, the chance of congruent signals is higher than the chance of dissonant signals and so, by deviating a citizen decreases the probability of congruent signals and increases the probability of dissonant signals. This means that the probability of strong opinions decreases. Intuitively, if you and your neighbor care about the same things and you gather information on the subject the chance of both of you agreeing that one policy is right is higher than the chance that you disagree. If you then start to say the opposite of whatever you find out about the policy, the chance is bigger that when you talk to your neighbor you have opposite views on the subject. By doing so your neighbor starts to doubt about his opinion and most importantly he thinks that you also start to doubt your opinion.

Weaker opinions affect a citizen's utility through the utility of pride and the disutility of shame. First of all weaker opinions lead to a lower chance that a citizen votes, this means a lower utility from pride and a higher disutility from shame. Second of all, a decrease in the strength of opinion directly decreases the utility gained from pride. Through both these channels lying decreases utility. Because the reasoning here is straightforward, the complete formal analysis can be found in the appendix. When shame rather than pride depends on strength of opinion, like in the original model, the second channel decreases the disutility of shame which therefore creates an incentive to deviate from the equilibrium. But in this paper's model for an equilibrium with sharing information to be stable, the following condition needs to hold and, by definition, always will hold:

$$\kappa\left(\theta_1\left|\hat{z}_i(1,1)-\tfrac{1}{2}\right|+\theta_2\right)+\kappa\theta_1\theta_2-\tfrac{1}{2}\kappa\theta_1\left(2\kappa\theta_2+\kappa\theta_1\left|\hat{z}_i(1,1)-\tfrac{1}{2}\right|\right)>0$$

The only negative effect here is the higher expected cost of voting, which is caused by a higher probability to vote. However, this negative affect of stronger opinions is always dominated by the positive effect of stronger opinions. The positive effect of strength of opinion also implies a positive effect of the probability of receiving the right signal e_i. Stronger sensitivity of shame also positively affects the equation. The first derivatives of this condition with respect to sensitivity to pride and shame and strength of opinion are all always positive, as is shown in the appendix, showing that the effect of these variables on the stability of the equilibrium is always positive.

If these conditions are not met, we do not have an equilibrium with sharing information, but only a babbling equilibrium. This is a situation where citizens send random, uninformative messages and so the only information available is the signal a citizen receives. Citizens therefore always follow their signal and there is no situation where citizens are indifferent between the two voting options. A citizen's signal is correct with probability e_i and so a citizen's opinion in the absence of an informative message is equal to e_i and the strength of opinion is given by $e_i - \frac{1}{2}$. The perceived opinion is exactly the same as it is common knowledge that a citizen's signal is correct with probability e_i and that he follows his signal. Citizen $-i$ does not have to know citizen i's signal or who he voted for to know that his opinion is equal to e_i.

The condition for a stable separating equilibrium shows how the utility of a citizen is always higher when sharing information than when they keep information for themselves. This difference increases in sensitivity to pride and shame, strength of opinion and the chance of being correct about the state of the world. This implies that for people who care more about what others think of them, people who have stronger opinion and people who are correct more often it is more important to share information with neighbors.

4.3 Expected voter turnout

The previous section has focused on the communication about politics, but what we're ultimately interested in is the voter turnout. In section 4.1 I've already shown what drives people to vote by deriving the threshold for turning out. This equation can be used to calculate the expected voter turnout in the two equilibria. In the appendix I provide the formal proof showing that the expected voter turnout is the same for both equilibria. The intuition behind this is that, compared to a babbling equilibrium, opinions are stronger in case of congruent signals, but they are weaker with dissonant signals. These effects on opinion drive the effect on voter turnout and the positive and negative effect cancel each other out leaving the expected voter turnout unaffected whether citizens share information or not. The expected voter turnout is given by the last two equations of lemma 1 times the probabilities of congruent signals for the third one and times the probability of dissonant signals for the last one. Just as for the individual turnout decision, the total expected turnout increases in sensitivity to pride and shame, the probability of neighbors finding out whether you voted and a decrease in the cost of voting. The probability of being correct, positively affects expected turnout in two ways, first of all it creates stronger opinions and second of all it increases the probability of congruent signals, for which the expected turnout is higher.

All in all the analysis of this model provides an explanation of how pride can motivate people to vote and to share information about politics. It also shows how the expected voter turnout is higher for people with stronger opinions and people who are correct in their opinions about the policy even when they know that they do not influence policy outcome. This model can explain the mechanisms behind the empirical results of (natural) field experiments in which the probability that people find out about your turnout decision was increased or decreased (for example Dellavigna et al., 2016, Funk, 2005, Gerber et al., 2008).

5. Model 2: The Bandwagon Effect

According to the bandwagon effect, people prefer to belong to the winning party, and so in this model a citizen's utility is positively affected by voting for the winning policy. To add the bandwagon effect to the previously discussed model, after the opinion forming stage and before the turnout decision the outcome of a voting poll is revealed. The poll announces π, which is the chance that $x = 1$. Because at the voting stage, the winner is unknown, the utility is affected by the probability that i votes for the winning party. Turnout and communication of a neighborhood does not influence the policy outcome and so the chance that citizen i is correct is determined by the probability that the voting poll is correct and whether i votes according to the poll or not. The chance that i votes for the winning party is given by a_i, which is equal to π when following the poll and $(1 - \pi)$ when not following the poll. Pride also depends on strength of opinion, and so citizen i's opinion is given by:

$$U_i = wx + \left(E_i(a_i^p(s_i, m_{-i})) + E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|\right)\theta_1 E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]$$
$$- \theta_2\left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right] - t_i c_i^v$$

Utility does not only increase in strength of opinion, but also in the chance that i votes for the winning party. The voting strategy depends on a citizen's opinion, just like in the model without a bandwagon effect. Perceived voting matters, and so utility does not increase if i just votes according to the poll, others need to notice it as well. Therefore in the utility function, the perceived value of a_i is included. Perceived voting can only be influenced through the message you send. Citizens are still expected to follow congruent signals, but in the case of dissonant signals they follow the voting poll instead of flipping a coin. Even when $-i$ knows that you have received dissonant signals and so you do not have a seemingly rational reason to vote for either party, you follow the poll. The logic behind this is that when you have no reason to pick one party over the other, you might as well vote for the winning party. The assumption here is that the bandwagon effect is an increase in utility simply from voting for the winning party and not necessarily showing that you were correct, which would be more in line with some sort of reputation effect. This assumption is also supported by previously discussed literature which find that the bandwagon effect is stronger for people with weaker opinions; people with weak opinions tend to just vote for the likely winner (Mehrabian, 1998, Morwitz & Pluzinski, 1996, Schmitt-Beck, 1996, Skalaban, 1988).

If $\pi > \frac{1}{2}$ then we say that the poll announces that $x = 1$ will win. The analysis focusses on this situation, as the one for $\pi < \frac{1}{2}$ is the symmetric equivalent of this. In case that $\pi = \frac{1}{2}$, the voting poll is uninformative and the model is similar to the previous model with pride just depending on the strength of opinion.

5.1 Turnout decision

The added bandwagon effect influences citizens' utility and so it changes the turnout decision. Just as in the first model, citizens decide to vote whenever this yields a higher utility. Citizen i's utility when voting is equal to:

$$\begin{aligned} U_i = E_i(wx) &+ \kappa\theta_1\left(E_i(a_i^p(s_i, m_{-i})) + E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|\right) \\ &+ (1-\kappa)\theta_1\left(E_i(a_i^p(s_i, m_{-i})) + E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|\right)E_i\left[\hat{t}_i^p(0, s_{-i}, m_i)\right] \\ &- (1-\kappa)\theta_2\left[1 - E_i\left[\hat{t}_i^p\left(k_i^p, s_{-i}, m_i\right)\right]\right] - t_i c_i^v \end{aligned}$$

The utility of not voting equals:

$$\begin{aligned} U_i = E_i(wx) &+ (1-\kappa)\theta_1\left(E_i(a_i^p(s_i, m_{-i})) + E_i|\hat{z}_i^p(s_i, m_{-i}) - \tfrac{1}{2}|\right)E_i\left[\hat{t}_i^p(0, s_{-i}, m_i)\right] - \kappa\theta_2 \\ &- (1-\kappa)\theta_2\left[1 - E_i\left[\hat{t}_i^p(0, s_{-i}, m_i)\right]\right] \end{aligned}$$

The chance of voting for the winning party depends on turnout decision. If a citizen does not vote, he does not get any credit from his neighbors for having an opinion that would have made him vote for the winning party. Therefore, just like strength of opinion, it is multiplied by the chance that his turnout decision is observed (κ) and multiplied by the chance that it is not observed $(1-\kappa)$ times the likelihood of i voting as perceived by his neighbor. Citizen i votes when $U_i(t=1) > U_i(t=0)$, or in other words, i votes whenever his benefits of doing so exceed the costs: $b^*(s_i, m_{-i}) > c_i^v$. The benefits are equal to:

$$b^*(s_i, m_{-i}) = \kappa \left(\theta_1 \left(E_i(a_i^p(s_i, m_{-i})) + E_i \left| \hat{z}_i(s_i, m_{-i}) - \tfrac{1}{2} \right| \right) + \theta_2 \right)$$

This shows the threshold strategy for citizens in their decision to vote or not. Citizens are more likely to vote when the benefits are higher or when the cost of voting are lower. The benefits of voting increase in sensitivity to pride and shame and in strength of opinion, just like in the first model. The benefits also increase in the perceived probability that you vote for the winning party. Compared to a model without a bandwagon effect ($\pi = \frac{1}{2}$) the benefits, and so voter turnout, increases as long as i is perceived to vote following the poll and it decreases if i votes for the other party.

5.2 Communication stage

Before deciding whether to vote or not, citizens receive signals and send messages which determine opinions. Opinions in turn determine strength of opinion and the perceived chance of voting for the winning party. In the model where pride only depends on strength of opinion there was no incentive to deviate, because stronger opinions positively influenced utility. This positive effect of stronger opinions is still relevant, but the bandwagon effect can disrupt the stability of the equilibrium by introducing an incentive to deviate. Because utility increases when you vote for the winning party there is an incentive to follow the voting poll regardless of your signal and received message. When the poll is uninformative ($\pi = \frac{1}{2}$), we essentially have a model similar to the first one discussed in this paper. The positive effect of strength of opinion on pride only creates an incentive to tell the truth and so there will always be a separating equilibrium.

For the following analysis I assume that $\pi > \frac{1}{2}$, because of the symmetry of the model the analysis for $\pi < \frac{1}{2}$ is similar, only with a bias in the other direction. Given we're in a separating equilibrium, the addition of an informative poll will create an incentive to always follow the poll, because this weakly increases the utility received through the bandwagon effect term. Whenever $s_i = 1$ citizen i has no incentive to lie, as the voting poll creates an incentive to tell the truth. However, when $s_i = -1$ the bandwagon effect creates an incentive to lie and send $m_i = 1$ to make the neighbor believe that i voted for the party more likely to win. Lying whenever $s_i = -1$ increases a_i from $(1 - \pi)$ to $\frac{1}{2}$ if $s_{-i} = -1$. In the case of congruent negative signals i is expected to vote for the party least likely to win. Lying leads to dissonant signals and the expectation that i votes according to the poll. If $s_{-i} = 1$ we are in a situation of dissonant signals and so lying would create positive congruent signals. In both situations i

is expected to vote for the likely winner and so lying does not affect the utility gained through the bandwagon effect. Because the signal of your neighbor is unknown and because lying increases utility through the bandwagon effect in one case and leaves it unaffected in the other, the bandwagon effect incentivizes citizens to lie whenever they receive a signal that is not in line with the voting poll. Therefore the introduction of the bandwagon effect makes the conditions for which an equilibrium exists in which information is shared more restrictive. Table 1 summarizes the effects of lying. Because the chance of voting for the likely winner does not depend on your own information, the bandwagon effect always creates an incentive to tell your neighbor that you support the expected winner.

Table 1 The Incentives to lie with the effects in parentheses (positive (+) or negative (-))

Probability of events	Signals	Effect of lying on $a_i^p(s_i, m_{-i})$
$\Pr(s_{-i} = 1 \mid s_i = 1)$	$s_i = 1, s_{-i} = 1$	$\pi \rightarrow \frac{1}{2}$ $(-)$
$\Pr(s_{-i} = -1 \mid s_i = 1)$	$s_i = 1, s_{-i} = -1$	$\pi \rightarrow (1-\pi)$ $(-)$
$\Pr(s_{-i} = 1 \mid s_i = -1)$	$s_i = -1, s_{-i} = 1$	$\pi \rightarrow \pi$ $(+/-)$
$\Pr(s_{-i} = -1 \mid s_i = -1)$	$s_i = -1, s_{-i} = -1$	$(1-\pi) \rightarrow \frac{1}{2}$ $(+)$

Whenever the conditions for a separating equilibrium do not hold, there will only be a babbling equilibrium. The messages that are exchanged are uninformative and so decisions are made using the information gathered from one signal only. The perceived strength of opinion is $e_i - \frac{1}{2}$ even without citizen $-i$ having any information about i's signal. Because in a babbling equilibrium a citizen can't have dissonant signals, he always follows his own signal. Without a situation of indifference between parties and without communication to manipulate perceived voting, the bandwagon effect does not influence voting behavior. This makes sense considering the assumption that the bandwagon effect is driven by perceived voting and not by actual voting. If there is no communication to influence perceived voting, there is no way for the bandwagon effect to affect voting behavior. You need credible communication about politics to make your neighbor believe that you voted for the winning party.

5.3 Expected voter turnout

The previous section has shown how a bandwagon effect can affect communication about politics. Because ultimately we are interested in what drives people to vote, we now turn to the influence of the bandwagon effect on the election. Expected voter turnout is equal to:

$$\hat{t}_i(0, s_i, s_{-i}) = \frac{\kappa\left(\theta_1\left(a_i(s_i, s_{-i}) + \left|\hat{z}_i(s_i, s_{-i}) - \frac{1}{2}\right|\right) + \theta_2\right)}{\bar{c}}$$

The cost of voting is unaffected by the addition of a bandwagon effect, however the benefits of voting do change. To compare the model with and without a bandwagon effect I compare a model where $\pi = \frac{1}{2}$ and so both parties have an equal probability to win the elections (just like in the first model) with a model where $\pi > \frac{1}{2}$; party $x = 1$ is more likely to win.

Without a bandwagon effect, or with an uninformative poll it doesn't matter who you are perceived to vote for, because both have an equal probability of winning the election. The chance that you vote for the winning party is equal to $\frac{1}{2}$, independent of communication. Whether you end up in a separating or a pooling equilibrium does not matter for the expected voter turnout, just like in the first model. Formerly the expected voter turnout in this case in a separating equilibrium is given by:

$$\frac{(e_i^2 + (1 - e_i)^2)\kappa\left(\theta_1\left(\frac{1}{2} + \left|\hat{z}_i(1,1) - \frac{1}{2}\right|\right) + \theta_2\right)}{\bar{c}} + \frac{2e_i(1 - e_i)\kappa\left(\frac{1}{2}\theta_1 + \theta_2\right)}{\bar{c}}$$

The first term denotes the expected voting turnout with congruent signals times the probability of this happening. The second term denotes the expected turnout with dissonant signals times the chance that one citizen is correct and the other is wrong. In a pooling equilibrium the strength of opinion is always the same. Therefore the expected voter turnout in the case of a pooling equilibrium is given by:

$$\frac{\kappa\left(\theta_1\left(\frac{1}{2} + \left(e_i - \frac{1}{2}\right)\right) + \theta_2\right)}{\bar{c}}$$

In a separating equilibrium opinions are stronger, which leads to a higher turnout, but in the case of dissonant signals citizens are indifferent between parties. These positive and negative effects cancel out and so, just like in model 1, expected voter turnout is the same in a separating and in a pooling equilibrium.

If the voting poll is informative and announces that $x = 1$ is more likely to win the election, the effects depend on the type of equilibrium we're in. If we're in a pooling equilibrium the strength of opinion is always the same, however the chance of voting for the winning party depends on who you vote for:

$$\frac{1}{2}\frac{\kappa\left(\theta_1\left(\pi + \left(e_i - \frac{1}{2}\right)\right) + \theta_2\right)}{\bar{c}} + \frac{1}{2}\frac{\kappa\left(\theta_1\left((1 - \pi) + \left(e_i - \frac{1}{2}\right)\right) + \theta_2\right)}{\bar{c}}$$

Because the prior chance of receiving a positive or a negative signal are equal, the chance of voting for the winning party is also equal. Without communication the voting decision is unaffected by the bandwagon effect. All three of the above equations can be simplified to:

$$\frac{\kappa(e_i\theta_1 + \theta_2)}{\bar{c}}$$

This makes sense, because in all three the bandwagon effect doesn't influence the benefits of voting. Just like in model 1, expected turnout increases in the probability that turnout is observed by neighbors, sensitivity to pride and shame and a higher probability of being right about the state of the world and it decreases when cost of voting increases.

The bandwagon effect does influence voter turnout when $\pi > \frac{1}{2}$ and citizens share information. Whenever citizens have congruent signals, unlike with an uninformative poll, the chance of voting for the winning party depends on the sign of the signals. The chance of receiving a negative signal is equal to the chance of receiving a positive signal and therefore the chance of receiving positive congruent signals equals the chance of receiving negative congruent signals. Therefore half of the time you receive congruent signals, you follow the voting poll and be right with probability π, the other times you are right with probability $(1 - \pi)$. This explains the first two terms of the equation below. In case of dissonant signals citizen i follows the voting poll, therefore the probability that he votes for the winning party is equal to π instead of $\frac{1}{2}$, like in the separating equilibrium with an uninformative poll. Expected voter turnout when sharing information and with an informative poll is equal to:

$$\frac{1}{2}\frac{(e_i^2 + (1-e_i)^2)\kappa\left(\theta_1\left(\pi + \left|\hat{z}_i(1,1) - \frac{1}{2}\right|\right) + \theta_2\right)}{\bar{c}} + \frac{(e_i^2 + (1-e_i)^2)\kappa\left(\theta_1\left((1-\pi) + \left|\hat{z}_i(1,1) - \frac{1}{2}\right|\right) + \theta_2\right)}{\bar{c}} + \frac{2e_i(1-e_i)\kappa(\pi\theta_1 + \theta_2)}{\bar{c}}$$

Expected voter turnout is increased by the bandwagon effect as long as the following equation holds:

$$2e_i\kappa\pi\theta_1 - 2e_i^2\kappa\pi\theta_1 + e_i^2\kappa\theta_1 + \kappa\theta_2 > \kappa(e_i\theta_1 + \theta_2)$$

With the left-hand side being a simplification of the equation before, denoting the expected turnout in a separating equilibrium with an informative poll and the right-hand side being any of the other three situations. This holds as long as $\pi > \frac{1}{2}$ (proof of this can be found in the appendix), which makes sense, because otherwise the left-hand side would become the situation where $\pi = \frac{1}{2}$ which is given by the right-hand side. So by definition, expected voter turnout increases when there's a bandwagon effect and citizens share information compared to situations where there is no bandwagon effect, or where there is no sharing of information. Taking the first derivative with respect to e_i of the above function tells us how the chance of being correct influences turnout. The right-hand side is positively influenced by e_i, as said before, a higher chance of being correct about the state of the world positively influences turnout. For the left-hand side there are two effects of a change in e_i. First of all, it has a positive effect on strength of opinion and on the probability of congruent signals, just like in the first model. However, the bandwagon effect introduces a second, negative effect of e_i on turnout, because the probability of dissonant signals decreases in e_i. As a result the chance of benefitting from the bandwagon effect in a situation of indifference between parties decreases in e_i as well. However, the first derivative with respect to e_i of the left-hand side of the equation shows that the positive effect always dominates the negative effect and therefore a higher probability of being correct about the state of the world still positively influences expected voter turnout. Formal proof of this can be found in the appendix.

Intuitively this makes sense as well; people whose signals are less reliable will rely relatively more on the positive utility of pride through the bandwagon effect. The utility of the bandwagon effect is the same for everyone as it is not dependent on any characteristics of citizens. If the utility to be gained through the bandwagon effect is the same for everyone, but the utility through strength of opinion is higher for people with a higher e_i, the bandwagon effect has a relatively stronger effect for people with a lower e_i. The probability of being correct about the state of the world can be interpreted in many ways, but if you interpret it as a level of education, with more educated people having a higher chance of being correct, this theory would fit the results found by Schmitt-Beck (1996), who found a stronger bandwagon effect through the media for less educated people.

5.4 Policy outcome

In a model without an informative poll, like the first model, the effects of social image concerns are symmetric towards both parties. Therefore social image concerns influence voter turnout and communication, but they leave the outcome of the policy unaffected. However, the bandwagon effect does create asymmetry and could bias the outcome towards the likely winner. For the poll not to bias policy outcome, the chance of a citizen preferring either party should be equal and the chance of them turning out should be equal. The chance that a citizen votes for the party preferred by the voting poll is higher than the chance that a citizen votes for the other party, because in the case of indifference between parties, citizens follow the poll. The turnout decision is also affected asymmetrically. When voting for the likely winner you receive more utility than when voting for the likely loser. Therefore citizens who were about to vote for the likely loser are less likely to cast their vote than citizens who are planning to vote for the likely winner. Both of these effects bias the outcome of the elections towards the party that was announced as likely winner by the voting poll. The magnitude of these effects in part depend on e_i. A lower e_i increases the chance of dissonant signals for which citizens follow the poll. A lower e_i also lowers strength of opinion, while leaving the bandwagon effect unaffected. The result is that the likelihood to vote, for citizens planning to vote for either party, decreases when e_i decreases. The decrease in strength of opinion relatively increases the bandwagon effect; the turnout decision is driven more by the bandwagon effect than by strength of opinion. Overall these two effects make that when e_i is lower, the bias in the election outcome that is created by the bandwagon effect is stronger. This also makes sense considering the results of Schmitt-Beck (1996), if less educated people are more likely to vote for the likely winner than a decrease in the chance that citizens are correct increases the bias of the election outcome.

This model, combining social image concerns with the bandwagon effect in large scale elections, provides possible explanations of the mechanisms behind many of the empirical results proving a bandwagon does exist in elections. The model explains how a bandwagon effect incentivizes not sharing information, how it can increase voter turnout and how it biases the election outcome. It also explains how strength of opinion and the chance of this opinion being correct influences political behavior and election outcomes.

6. Conclusion and Discussion

By extending the existing model of Karamychev and Swank (2019) I constructed two models using social image concerns to explain voting behavior. I show how pride can motivate people to vote and to share information with their neighbors. Even though whether citizens do or do not share information doesn't matter for expected turnout it does provide an explanation for why people vote and engage in any political activity in general, like conversations. Voting creates positive utility through pride and sharing information shows that you have a strong opinion about politics, which increases the feelings of pride. This model helps to understand why people vote and engage in political activity and could be used to explain some of the empirical results showing that people vote, because they are concerned with their social image (for example Dellavigna et al., 2016, Funk, 2005, Gerber et al., 2008).

For the second model I extend the first model with a pre-election voting poll which creates a bandwagon effect, increasing utility when a citizen votes for the likely winner. The bandwagon effect decreases the incentives to share information, because you have an incentive to support the likely winner instead of truly revealing your opinions. If people do share information the expected turnout increases, because there is extra utility to be gained by voting for the winner, otherwise it remains unaffected, because without communication there is no way to make people believe that you voted for the winner. This increase in turnout comes at the cost of biasing the election outcome in favor of the expected winner, because more people want to vote for the expected winner and because people who were going to vote for the other party are more likely to abstain from voting. The model also explains how people who are less likely to be correct about the policy are more likely to be biased in their voting and are more likely to vote in general. The model explains the bias reported in several empirical papers (for example McAllister & Studlar, 1991, Mehrabian, 1998, Morton et al., 2015, Morwitz and Pluzinski, 1996, Schmitt-Beck, 1996, Skalaban, 1988) and also explains the larger bias for less educated people found by Schmitt-Beck (1996).

The results of these models can be applied to many relevant settings. The model depicts large scale elections in which the effect of a single vote is negligible as are most political elections. Considering these results one can see why for example a policy like the one used in the natural experiment by Funk (2005) does not work. Raising awareness regarding doing your civic duty could influence peoples sensitivity of pride and shame, because their own views change, or because the expectations of one’s neighbors are affected. Additionally making sure that citizens are well informed, which could be represented by e_i in the model, would increase the strength of opinions which would increase voter turnout.

The results of the second model apply to the same kind of elections, but include a pre-election poll, which is very common in most large scale political elections. In the model this poll does not provide any information about whether a policy is good or bad for you, which is arguably true for most polls. The results of the empirical papers mentioned before and the explanations of this model could lead you to question the use of election polls. As long as they do not inform citizens about politics, but only about the likely outcome, election polls only bias the results of the election and crowd out certain groups of the population.

The model in this paper is fully focused on the expressive side of voting. Considering fully rational citizens this method is certainly justified for large scale elections, however it ignores the fact that many people still unjustifiably think they influence the results of an election. This could influence the accuracy of the model and lead to lower instead of higher turnouts, if people abstain from voting, because they see that the difference between candidates is too big anyway. This could explain why some papers (for example Morton et al., 2015) find a decrease in voter turnout as a result of a poll.

The model in this paper has examined what happens if people want to vote for the winning party. An interesting extension could be to see what happens if citizens prefer to have a similar opinion as their neighbors. Instead of wanting to belong to the winners, they would want to belong to their neighborhood. This would probably stimulate truthful communication as by telling the truth you have the biggest chance of having congruent signals. The turnout would probably be higher for people who are more likely to be correct, because they are more likely to have the same views. Without extra assumptions, this would leave the policy outcome unaffected, however if people with a higher chance of being correct are more likely to prefer one of the policies than people who are less likely to be correct the outcome would be biased in the direction of policy supported by citizens who are more likely to be correct about their state of the world.

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8. Appendix

Model 1: Strength of Opinion and Pride

Suppose we have an equilibrium in which citizens share information. Their turnout strategy is given by the condition from the main part and their beliefs about opinions and turnout strategies is given by lemma 1. I identify the conditions assuming $s_i = 1$, as the case where $s_i = -1$ is symmetric, the same conclusions hold. Messages do not influence policy outcome and so wx is not in the equations below. Citizen i has no incentive to lie as long as his utility from telling the truth is higher than his utility of deviating from this equilibrium.

Note that the expected turnout of citizen i is equal to

$$\hat{t}_i^p(0, s_i, s_i) = \frac{b^*(s_i, s_i)}{\bar{c}} \; and \; \hat{t}_i^p(0, s_i, -s_i) = \frac{b^*(s_i, -s_i)}{\bar{c}}$$

And the expected cost of voting is equal to $\frac{1}{2}b^*(s_i, s_{-i})$, because whenever the cost exceeds $b^*(s_i, s_{-i})$ citizen i does not vote. Because the cost is uniformly distributed it is multiplied by $\frac{1}{2}$ to get the expected cost of voting.

The expected utility of citizen i when sharing information equals:

$$Pr(s_{-i} = 1|s_i = 1)\frac{b^*(1,1)}{\bar{c}}\left(\kappa\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right| + (1-\kappa)\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|\frac{b^*(1,1)}{\bar{c}} - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right) - \tfrac{1}{2}b^*(1,1)\right) + Pr(s_{-i} = 1|s_i = 1)\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\left((1-\kappa)\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|\frac{b^*(1,1)}{\bar{c}} - \kappa\theta_2 - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\right) + Pr(s_{-i} = -1|s_i = 1)\frac{b^*(1,-1)}{\bar{c}}\left(-(1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right) - \tfrac{1}{2}b^*(1,-1)\right) + Pr(s_{-i} = -1|s_i = 1)\left(1 - \frac{b^*(1,-1)}{\bar{c}}\right)\left(-\kappa\theta_2 - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\right)$$

Sending $m_i = -1$ even if your received $s_i = 1$ yields an expected payoff of:

$$Pr(s_{-i} = -1|s_i = 1)\frac{b^*(1,1)}{\bar{c}}\left(\kappa\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right| + (1-\kappa)\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|\frac{b^*(1,1)}{\bar{c}} - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right) - \tfrac{1}{2}b^*(1,1)\right) + Pr(s_{-i} = -1|s_i = 1)\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\left((1-\kappa)\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|\frac{b^*(1,1)}{\bar{c}} - \kappa\theta_2 - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\right) + Pr(s_{-i} = 1|s_i = 1)\frac{b^*(1,-1)}{\bar{c}}\left(-(1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right) - \tfrac{1}{2}b^*(1,-1)\right) + Pr(s_{-i} = 1|s_i = 1)\left(1 - \frac{b^*(1,-1)}{\bar{c}}\right)\left(-\kappa\theta_2 - (1-\kappa)\theta_2\left(1 - \frac{b^*(1,1)}{\bar{c}}\right)\right)$$

Citizen i has no incentive to lie as long as the first equation is larger than the second one. The condition for truth telling can therefore be derived by subtracting the expected utility of lying from the expected utility from truth telling. To simplify the interpretation we first define the difference in the probability of congruent signals and dissonant signals in case $s_i = 1$:

$$\Delta_i = \Pr(s_{-i} = 1|s_i = 1) - \Pr(s_{-i} = -1|s_i = 1)$$
$$e_i^2 + (1-e_i)^2 - 2e_i(1-e_i) = 4e_i^2 - 4e_i + 1$$

By collecting the three terms derived above, we get the condition for which citizen i has no incentive to deviate. I collect the terms for pride and shame separately before adding them up, starting off with pride:

$$\Delta\frac{b^*(1,1)}{\bar{c}}\kappa\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right| + \Delta(1-\kappa)\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|\frac{b^*(1,1)}{\bar{c}}$$
$$= \Delta\theta_1\frac{b^*(1,1)}{\bar{c}}\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right| = \Delta\theta_1\frac{\kappa\left(\theta_1\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right| + \theta_2\right)}{\bar{c}}\left|\hat{z}_i^p(1,1) - \tfrac{1}{2}\right|$$

Collecting terms for shame:

$$\Delta\left(\frac{b^*(1,1)}{\bar{c}}-\frac{b^*(1,-1)}{\bar{c}}\right)\kappa\theta_2+\Delta\left(\frac{b^*(1,1)}{\bar{c}}-\frac{b^*(1,-1)}{\bar{c}}\right)(1-\kappa)\theta_2$$

$$\Delta\left(\frac{b^*(1,1)}{\bar{c}}-\frac{b^*(1,-1)}{\bar{c}}\right)\theta_2=\Delta\frac{\kappa\left(\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+\theta_2\right)}{\bar{c}}$$

Collecting terms for the cost of voting:

$$-\Delta\frac{1}{2}\frac{b^*(1,1)^2-b^*(1,-1)^2}{\bar{c}}=-\Delta\frac{1}{2}\frac{\kappa\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|\left(\kappa\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+2\kappa\theta_2\right)}{\bar{c}}$$

Collecting the terms above give the difference between sharing information and deviating from this. Citizen i has no incentive to deviate if:

$$\Delta\theta_1\frac{b^*(1,1)}{\bar{c}}\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+\Delta\left(\frac{b^*(1,1)}{\bar{c}}-\frac{b^*(1,-1)}{\bar{c}}\right)\theta_2-\Delta\frac{1}{2}\frac{b^*(1,1)^2-b^*(1,-1)^2}{\bar{c}}>0$$

$$\kappa\theta_1\left(\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+\theta_2\right)+\kappa\theta_1\theta_2-\frac{1}{2}\kappa\theta_1\left(\kappa\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+2\kappa\theta_2\right)>0$$

Differentiation of this function tells us how certain parameters influence the likelihood of ending up in an equilibrium with sharing information. The first derivative with respect to θ_1 is:

$$\left(\kappa\theta_1\left|\hat{z}_i^p(1,1)-\frac{1}{2}\right|+\kappa\theta_2\right)(2-\kappa)=b^*(1,1)(2-\kappa)$$

The first derivative with respect to θ_2:

$$\kappa\theta_1(2-\kappa)$$

$(2-\kappa)$ is always positive as $\kappa<1$ and so the effect of both on the likelihood of ending up in an equilibrium with information sharing is positive. Social image concerns only have a positive effect on sharing information and that's why there is no incentive to deviate from this equilibrium.

The first derivative with respect to e_i is equal to:

$$\kappa\theta_1^2\left(1-\frac{1}{2}\kappa\right)$$

This is always positive as $\left(1-\frac{1}{2}\kappa\right)$ is always positive. The likelihood of an equilibrium with sharing information increases in strength of opinion. Because e_i increases in strength of opinion, a higher chance of being correct about the state of the world makes a separating equilibrium also more likely.

Lastly I consider the voter turnouts for a separating and a pooling equilibrium. Expected voter turnout is the same in both equilibria as long as:

$$\frac{\kappa\left(\theta_1\left(e_i - \frac{1}{2}\right) + \theta_2\right)}{\bar{c}} = \frac{(e_i^2 + (1-e_i)^2)\kappa\left(\theta_1\left(\frac{e_i^2}{e_i^2 + (1-e)^2} - \frac{1}{2}\right) + \theta_2\right)}{\bar{c}} + \frac{2e_i(1-e_i)\kappa\theta_2}{\bar{c}}$$

Which always holds meaning that the expected voter turnout is the same in both equilibria.

Model 2: The Bandwagon Effect

Voter turnout is higher in a separating equilibrium with an informative poll than in a pooling equilibrium or without an informative poll as long as:

$$2e_i\kappa\pi\theta_1 - 2e_i^2\kappa\pi\theta_1 + e_i^2\kappa\theta_1 + \kappa\theta_2 > \kappa(e_i\theta_1 + \theta_2)$$

$$2\pi(1-e_i) > (1-e_i)$$

$$\pi > \frac{1}{2}$$

Which always holds as long as the voting poll is informative.

The first derivative with respect to e_i of the left and right-hand side of the equation above shows the effect of e_i on voter turnout in any equilibrium. The first derivative of the right-hand side is straight forward and is clearly positive: $\kappa\theta_1$. The effect of e_i on voter turnout is also positive for a separating equilibrium with an informative voter poll when the first derivative of the left-hand side is larger than zero:

$$2\kappa\pi\theta_1 - 4e_i\kappa\pi\theta_1 + 2e_i\kappa\theta_1 > 0$$

$$\pi < \frac{e_i}{2e_i - 1}$$

Which always holds with the assumptions of the model regarding e_i and π (both have to be smaller than 1).