

## “Personal Influence”: Social Context and Political Competition<sup>†</sup>

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*This paper studies the effect of social learning on political outcomes in a model of informative campaign advertising. Voters' communication network affects parties' incentives to disclose political information, voters' learning about candidates running for office, and polarization of the electoral outcome. In richer communication networks, parties disclose less political information and voters are more likely to possess erroneous beliefs about the characteristics of the candidates. In turn, a richer communication network among voters may lead to political polarization. These results are reinforced when interpersonal communication occurs more frequently among ideologically homogeneous individuals and parties can target political advertising. (JEL D72, D85, M37, Z13)*

The mass do not now take their opinions from dignitaries in Church or State, from ostensible leaders, or from books. Their thinking is done for them by men much like themselves, addressing them or speaking in their name, on the spur of the moment [ ? ] John Stuart Mill (2008, 80).

[ ... ] rational citizens will seek to obtain their free political information from other persons if they can. This expectation seems to be borne out by the existing evidence. Anthony Downs (1957, 229).

In modern societies, a large majority of individuals rely on others in order to obtain most of their political information. Empirical evidence of the importance of political information sharing in affecting individuals' voting behavior dates back to the early 1950s when, through a series of pioneering field experiments, Columbia University sociologist Paul F. Lazarsfeld and coauthors documented the primacy of face-to-face interaction in spreading political information and showed that this information was more likely to reach undecided voters.<sup>1</sup>

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<sup>1</sup>See, e.g., Lazarsfeld, Bernard Berelson, and Hazel Gaudet (1948); Berelson, Lazarsfeld, and William N. McPhee (1954); and Elihu Katz and Lazarsfeld (1955). The work of the Columbia sociologists is the “existing evidence” to which Downs refers in the quotation. See Downs (1957) pages 222 and 229.

In spite of the predominant role of the mass media in political advertising, recent empirical works show that word-of-mouth communication is still a fundamental input of the learning process of voters. For example, in an empirical study of the 1992 American presidential election campaign, Paul Allen Beck et al. (2002) conclude that interpersonal discussions outweigh the media in affecting voting behavior. In a recent study on political disagreement within communication networks, Robert Huckfeldt, Paul E. Johnson, and John Sprague (2004) observe that: “Democratic electorates are composed of individually interdependent, politically interconnected decision makers. [ . . . ] they depend on one another for political information and guidance.” Furthermore, there is evidence that interpersonal communication occurs more frequently among ideologically similar individuals, as documented by Miller McPherson, Lynn Smith-Lovin, and James M. Cook (2001).

In light of this evidence, understanding the relationship between interpersonal communication, individuals’ voting behavior, and political outcomes is of considerable interest. However, very little theoretical work has been done on this topic. This paper proposes a framework in which interpersonal communication between voters is embedded in a standard model of strategic electoral competition. We show that social learning has important effects on political outcomes. In particular, the structure of communication among voters is important in determining to what extent voters obtain information about candidates running for office and on the polarization of the electoral outcome.

We explore the implications of social learning within a citizen-candidate model where the policy space is unidimensional. There are three groups of citizens: leftists and rightists (the “partisans”), and independent voters. Citizens have distance preferences over policy, independents are decisive in the election, and the identity of the median independent voter is *ex ante* uncertain. There are two policy-motivated parties, representative of the left and right partisans, and their objective is to maximize the expected utility of their median member.

In the political game, parties select candidates running for office and the level of informative campaign advertising. Advertising is costly, and the information disclosed by a party perfectly reveals its candidate’s policy position to a fraction of voters.<sup>2</sup> Voters do not observe these decisions, so that *ex ante* they do not know the ideological position of the two candidates. However, voters may learn this information by directly receiving informative advertising from parties (*direct exposure*) as well as by talking about politics with other voters (*contextual exposure*). Based on the information a voter receives, he updates his beliefs about the position of the candidates and casts his vote. The candidate that wins a simple majority of votes is elected and implements his most preferred policy.

The novelty of our framework rests in the introduction of social learning in a political game, which is reflected in the fact that voters may learn through contextual exposure. Clearly, different assumptions on the structure of communication among voters may have different effects on the final political outcome. Our aim is to describe the communication structure in a simple and parsimonious way. Yet, we

<sup>2</sup>For evidence about the importance of political advertising in providing voters with information see, e.g., Milton Lodge, Marco R. Steenbergen, and Shawn Brau (1995), and John J. Coleman and Paul F. Manna (2000). See, also, John Zaller (1996) for evidence on the effect of media content on policy preferences.

intend to have a rich enough model which is able to incorporate different empirically relevant dimensions of political communication networks.

In the first part of the paper, we consider a model where the communication network does not entail any form of correlation between voters' communication links—*who interacts with whom*—and voters' ideologies. In particular, we assume that each independent voter randomly samples a finite number of other independents, who truthfully report the information they have obtained, if any, from parties' advertising.<sup>3</sup> Furthermore, we assume that parties advertise randomly. We believe that abstracting away from possible correlations between the communication network and the distribution of political ideologies, and from the possibility that parties strategically target their advertising based on such correlations, represents a useful benchmark model. In fact, within this model, the structure of communication between voters can be captured by a single parameter, which is the level of contextual exposure (i.e., voters' sample size), allowing us to derive a simple yet powerful comparative statics result. Indeed, by comparing the political outcome for different levels of contextual exposure we can study how the richness of communication networks affects the extent to which voters obtain information about candidates running for office as well as the likelihood that moderate policies are implemented.

In the benchmark model, our first result shows that when informative advertising is sufficiently expensive parties always select extremist candidates and do not disclose any political information. Otherwise, parties select a moderate candidate with positive probability and disclose political information only when the candidate is a moderate. Focusing on the interesting case where parties select moderate candidates with positive probability, our second result shows that an increase in the level of contextual exposure decreases the political information that parties choose strategically to disclose. This equilibrium effect has striking implications on social learning: when the network of communication between voters becomes richer, it is more likely that a voter holds incorrect beliefs about the ideological position of the candidates running for office. In other words, it is more likely that a voter believes that a candidate is a moderate (extremist) when in fact he is an extremist (moderate). An immediate consequence of this is that in the presence of a richer communication structure, it is more likely that an extremist candidate defeats a moderate candidate. Finally, we show that when the cost of advertising is sufficiently low, an increase in the level of interpersonal communication between voters also increases the probability that parties select extremist candidates. Overall, in the presence of richer communication networks, the (*ex ante*) expected probability that an extreme policy is implemented increases.

The second part of the paper extends our benchmark model to incorporate for the empirically relevant case in which parties can target political advertising to ideologically similar voters, and interpersonal communication occurs more frequently among ideologically similar individuals. The latter assumption is a very simple form of the so-called "value homophily," according to the original formulation of Lazarsfeld and Robert K.

<sup>3</sup>Our model of acquisition of political information formalizes the idea of "two-step flow communication," which played a central role in the analysis of the Columbia sociologists. They describe the two-step flow communication as a relay function of interpersonal relations, where political information flows directly from mass media to a subset of voters, the "opinion leaders" (which corresponds to direct exposure), and from them to other voters they are in contact with (which corresponds to contextual exposure). See Lazarsfeld, Berelson, and Gaudet (1948).

Merton (1954).<sup>4</sup> In our framework, absence of homophily corresponds to a situation in which the frequency of interpersonal communication between voters does not depend on their ideological similarity. In contrast, pure homophily subsumes a society in which communication links are only active within ideologically-homogeneous groups. In this sense, the level of homophily can also be interpreted as the level of segregation between different ideologically homogeneous groups.

We show that in the extended model, there exists an equilibrium in which parties choose to target only their ideologically closer subset of independent voters, both parties select a moderate candidate with positive probability, and they disclose political information only when the candidate is a moderate. An increase in the level of homophily harms social learning (i.e, voters are more likely to hold erroneous beliefs about the candidates' positions) and parties are more likely to select extremist candidates. Overall, as the structure of communication among voters entails a higher level of correlation between communication links and voters' ideologies, the expected probability that an extremist candidate wins the election increases.

This paper builds on two different strands of theoretical literature. The first strand focuses on the effects of political advertising on electoral competition and voters' welfare, e.g., Stephen Coate (2004a, 2004b) and Andrea Prat (2002a, 2002b). The second strand studies interpersonal communication and learning. We model electoral competition and direct exposure to political information following Coate (2004b), while the model of interpersonal communication follows the approach of Glenn Ellison and Drew Fudenberg (1993, 1995), and Galeotti and Sanjeev Goyal (2009). To the best of our knowledge, the present paper is the first to embed informal communication among voters in a political economy framework. Our results also relate to the existing empirical literature on polarization in US politics, e.g., Keith T. Poole and Howard Rosenthal (1997), and Nolan McCarty, Poole, and Rosenthal (2006). This literature documents an increase in polarization of the Democratic and Republican parties in the last 30 years, an increase that was not accompanied by a corresponding polarization in the preference of the electorate. Our analysis shows that changes in social context—an increase in the level of interpersonal communication and in the frequency of communication between ideologically similar voters—may be important to understand these empirical findings.

The paper is organized as follows. Section I presents the model. Section II studies the effect of the level of interpersonal communication on political outcomes. Section III extends the model to the case in which interpersonal communication is more frequent between ideologically similar individuals and parties can target political advertising. In Section IV, we conclude and suggest some avenues for future research. All proofs can be found in an online Appendix.

<sup>4</sup>The word "homophily" literally means "love of the same." The presence of homophily in social relations is a robust observation which applies very broadly. See, e.g., McPherson, Smith-Lovin, and Cook (2001) for a survey of research on homophily, and David P. Myatt (2007) for evidence on the effect of homophily on voting decisions. See, also, Sergio Currarini, Matthew O. Jackson, and Paolo Pin (2009) for a simple model in which homophily emerges as an equilibrium outcome.

## I. Model

### A. Voters and Parties

*Ideologies.*—There is a continuum of citizens of unit measure. The policy space is unidimensional, and citizens are exogenously divided into three groups: left partisans, right partisans, and independents. Partisans represent an equal fraction of the population, and their ideology is symmetrically distributed in  $[0, m]$  and  $[1 - m, 1]$ , respectively. The ideology of independents is uniformly distributed in the interval  $[\mu - \tau, \mu + \tau]$ , where  $\tau > 0$ , and  $\mu$  is drawn from a uniform distribution with support  $[1/2 - m, 1/2 + m]$ . Hence, the identity of the median independent is ex ante uncertain. We assume that  $m < 1/4 - \tau/2$  so that ideologies of independents are always between those of partisans.<sup>5</sup>

There are two, policy-motivated political parties: party *L* and party *R*. Party *L* (*R*) consists of a representative subgroup of the left (right) partisans. A representative of each party is selected to be a candidate in an election. For simplicity, we restrict the candidates' type space to be  $T = \{e, m\}$ , where  $e \equiv m/2$ . Let  $\mathbf{t} = (t_L, t_R) \in T \times T$  be a profile of types, where  $t_L \in \{e, m\}$  denotes the ideology of party *L*'s candidate, and  $1 - t_R$  denotes the ideology of party *R*'s candidate. Henceforth, a candidate is an extremist if his type is  $t = e$ , otherwise a candidate is a moderate. Figure 1 illustrates the ideologies of voters and parties.

*Preferences.*—Citizens have distance preferences over ideology and, in particular, a citizen with ideology  $i$  derives utility  $-|t - i|$  if a candidate of ideology  $t$  wins the election. The objective of each party is to maximize the expected utility of its median member.<sup>6</sup> Voters vote as if they are pivotal and partisans always support their own candidate.<sup>7</sup>

### B. Sources of Learning

A crucial element of our model is that independents are ex ante ignorant about candidates' types and they may learn this information from two sources: parties' informative advertising (direct exposure) and interaction with other voters (contextual exposure). Our model of social learning follows Ellison and Fudenberg (1993, 1995) and it captures the basic idea that the amount of learning does not only depend on the level of contextual exposure, but it also depends on the proportion of informed voters in the population, which is determined by parties' informative advertising. This natural interplay between contextual exposure and direct exposure

<sup>5</sup>For ease of exposition, we assumed that  $\mu \in [1/2 - m, 1/2 + m]$ . While under this assumption the parameter  $m$  captures both the extremism of the partisans and the uncertainty about the median voter, this is not needed for our results. Indeed, our analysis holds if we assume that  $\mu \in [1/2 - \epsilon, 1/2 + \epsilon]$  and require that  $\epsilon < 1/2 - \tau - m$ , as in Coate (2004b).

<sup>6</sup>Note that, when  $m$  is small, the assumption that  $t \in \{e, m\}$  is without loss of generality. Indeed, a party maximizing the expected utility of its median member will never select a candidate that is more extreme than its median member  $e$ . Moreover, as the uncertainty about the median voter is sufficiently small, i.e.,  $m$  is sufficiently small, it is possible to show that a party will never select a candidate with ideology lying in the interior of the interval  $[e, m]$ .

<sup>7</sup>For evidence about the fact that partisans tend to be little affected by campaigns, see, e.g., Zaller (1992), and Huckfeldt, Johnson, and Sprague (2004).

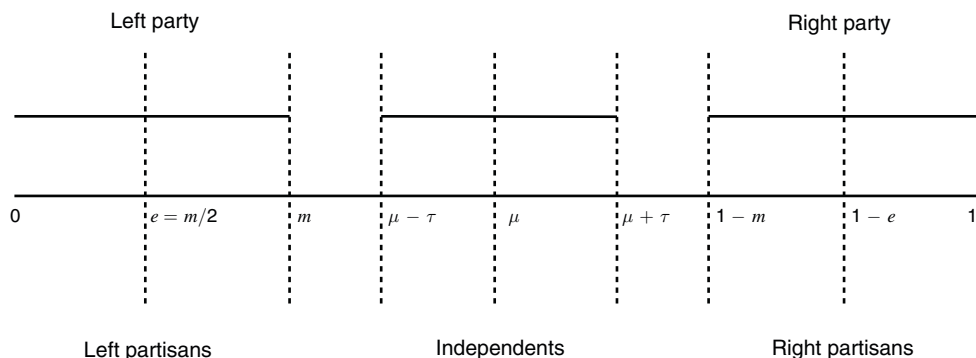


FIGURE 1. VOTERS' IDEOLOGIES AND PARTIES' IDEOLOGIES

is both analytically simple and rich enough, and it is the most important feature of our framework. We now specify the details of these two technologies.

*Direct Exposure.*—Each party  $j = \{L, R\}$ , after having selected its candidate, chooses a level  $x_j \in [0, 1]$  of campaign advertising. Advertising is truthful and fully informative. In particular, if a party chooses  $x_j$ , then a random fraction  $x_j$  of independents perfectly learn party  $j$  candidate's position. The cost of informing  $x_j$  voters is  $C(x_j) = \alpha x_j$ , where  $\alpha$  is a positive constant measuring the efficiency of the advertising technology. In the Appendix, we discuss the robustness of our results with respect to different specification of the cost function.

*Contextual Exposure.*—In addition to direct exposure, independents may learn candidates' types by talking to other voters. In particular, each independent randomly samples a finite number  $k > 0$  of other independents and each sampled independent truthfully reports the information obtained from parties' advertising.<sup>8</sup> We refer to the parameter  $k$  as to the level of contextual exposure and our main interest is to understand how political equilibrium outcomes are affected by different levels of  $k$ . As it is common in models of social learning, we take the informal communication structure, which in our case corresponds to the parameter  $k$ , as exogenously given.

### C. Timing of the Political Game

We study the following Bayesian game. In the first stage, parties simultaneously choose their own candidate and, conditional on the candidate selected, a campaign

<sup>8</sup>In our model, independents only communicate with other independents. Extending the basic framework to the case where independents sample other voters from the entire population of citizens is easy, and does not qualitatively affect our results. Furthermore, interpersonal communication only travels one step in the underlying social structure: if voter  $i$  samples voter  $j$ , then  $i$  obtains the information that  $j$  obtained from the parties, but not the information that  $j$  may have obtained by communicating with other voters. In principle, communication may also be indirect, and this can be formalized by assuming that information travels  $r \geq 1$  steps in the underlying communication networks. Allowing for indirect social learning will increase the complexity of the analysis, without adding new insights. In particular, the effect of an increase in the radius of information on political equilibria is analogous to the effect of an increase in the level of contextual exposure in our basic formulation.

advertising intensity. Independent voters do not observe these choices. In the second stage, independents may be exposed to political information either directly, or via interpersonal communication. Based on the information received, independents update their beliefs about candidates' types and cast their vote. In the spirit of the citizen-candidate approach, the candidate that wins a simple majority of votes is elected and implements the policy which corresponds to his ideology.

#### D. Parties' Strategies and Parties' Utilities

A strategy for party  $j$  is a probability distribution over candidates' types and an intensity of informative advertising for each candidate's type. Formally, let  $\sigma_j: T \rightarrow [0, 1]$ , where  $\sigma_j(t)$  denotes the probability that party  $j$  selects a candidate of type  $t$ , and  $\sigma_j(e) + \sigma_j(m) = 1$ . Analogously, let  $x_j: T \rightarrow [0, 1]$ , where  $x_j(t)$  denotes the intensity of informative advertising of party  $j$  when candidate  $t$  is selected. We denote a strategy of party  $j$  as  $s_j = (\sigma_j, x_j)$ , while  $s = (s_L, s_R)$  denotes a strategy profile for parties.

Let  $\pi_L(s | \mathbf{t})$  denote the expected probability that party  $L$  wins, given a pair of candidates  $\mathbf{t}$  and a strategy profile  $s$ . The expected payoff to party  $L$ , when its candidate is  $t_L$ , can be written as follows,

$$U_L(s | t_L) = \sum_{t_R \in \{e, m\}} \sigma_R(t_R) [\pi_L(s | \mathbf{t})(1 - t_R - t_L) - (1 - t_R - e)] - \alpha x_L(t_L),$$

where the first term is the expected benefit to party  $L$  from choosing candidate  $t_L$  and the second term is the cost of advertising candidate  $t_L$  policy position.

#### E. Voting Behavior of Independent Voters

Ex post, the information of an independent about party  $j$ 's candidate can be summarized by  $I_{k,j} \in T \cup \emptyset$ , where  $I_{k,j} = t$  means that the independent knows that party  $j$ 's candidate is  $t$ , while  $I_{k,j} = \emptyset$  indicates that the independent did not receive any information about party  $j$ 's candidate.

Let  $\rho_j(t | I_{k,j}, s, k)$  denote the belief of an independent that party  $j$ 's candidate is  $t$ , given  $I_{k,j}$  and  $s$ . Whenever possible,  $\rho_j(t | I_{k,j}, s, k)$  is derived using Bayes' rule. Hence,  $\rho_j(t | t, s, k) = 1$ ,  $\rho_j(t | t', s, k) = 0$ , for  $t \neq t'$ , and

$$(1) \quad \rho_j(t | \emptyset, s, k) = \frac{\sigma_j(t)(1 - x_j(t))^{k+1}}{\sum_{t' \in T} \sigma_j(t')(1 - x_j(t'))^{k+1}},$$

for every  $t \in T$  such that  $\sigma_j(t) > 0$  and  $x_j(t) > 0$ . We also assume that equation (1) holds at zero probability events, i.e., when  $\sigma_j(t') = 0$  and/or  $x_j(t') = 0$ .<sup>9</sup>

Since each independent votes as if he is pivotal, an independent with ideology  $i$  and information  $(I_{k,L}, I_{k,R})$  votes for party  $L$  if and only if  $i < i^*(I_{k,L}, I_{k,R})$ , where

<sup>9</sup>Note that this is a necessary condition for a Bayesian equilibrium to be a sequential equilibrium. See, also, footnote 11 for a discussion of the role of this condition in the characterization of equilibria.

$i^*(I_{k,L}, I_{k,R})$  is the identity of the indifferent independent voter with information set  $(I_{k,L}, I_{k,R})$ . The expression for  $i^*(I_{k,L}, I_{k,R})$  is given by:

$$i^*(I_{k,L}, I_{k,R}) = \frac{1}{2} + \frac{\sum_{t \in T} \rho_L(t | I_{k,L}, s, k) t - \sum_{t \in T} \rho_R(t | I_{k,R}, s, k) t}{2}.$$

Given  $(t_L, t_R)$  and  $s$ , and using the assumption that  $\mu$  is uniformly distributed, party  $L$ 's candidate gets at least half of the independents' votes if and only if  $\mu < \mu_L^*(s | t_L, t_R)$ , where:

$$\mu_L^*(s | t_L, t_R) = \sum_{(I_{k,L}, I_{k,R})} i^*(I_{k,L}, I_{k,R}) \Pr(I_{k,L} | s, t_L) \Pr(I_{k,R} | s, t_R).$$

Therefore,

$$\pi_L(s | \mathbf{t}) = \begin{cases} 0 & \text{if } \mu_L^*(s | \mathbf{t}) \leq \frac{1}{2} - m \\ \frac{\mu_L^*(s | \mathbf{t}) + m - \frac{1}{2}}{2m} & \text{if } \mu_L^*(s | \mathbf{t}) \in \left(\frac{1}{2} - m, \frac{1}{2} + m\right) \\ 1 & \text{if } \mu_L^*(s | \mathbf{t}) \geq \frac{1}{2} + m \end{cases}$$

### F. Political Equilibrium

A political equilibrium consists of (i) parties' strategies,  $s^* = (s_L^*, s_R^*)$ ; (ii) voter belief functions  $\rho_j^*(\cdot), j = \{L, R\}$ , and indifferent independent voters  $i^*(\cdot)$  such that:

1.  $(s_L^*, s_R^*)$  are mutual best responses given subsequent voting behavior;
2.  $\rho_j^*(\cdot)$  are consistent with  $s^*$  for all  $j = \{L, R\}$ , and  $i^*(\cdot)$  are consistent with  $\rho_j^*(\cdot)$  and  $s$  for all  $j = \{L, R\}$ .

## II. Characterization of Political Equilibrium

Our first result shows that there exists a unique symmetric political equilibrium. When the advertising technology is sufficiently inefficient (i.e., for high  $\alpha$ ), parties only select extremist candidates and they do not advertise. Otherwise, parties randomize between selecting a moderate candidate and an extremist candidate, and they only advertise moderate candidates. The characteristics of the political equilibrium are pinned down by a simple measure of voters' *misperception* about the types of candidates running for office. Slightly abusing the language, by voters' misperception we refer to the extent to which voters hold incorrect beliefs due to lack of



information and not to any sort of mistake made by the voter. This measure will prove useful, since in equilibrium it is proportional to the probability that a party wins election when selecting a moderate candidate instead of an extreme candidate. We now formally define voters' misperception.

For a symmetric strategy profile  $s$ , the fraction of independents who learn (directly or indirectly) that the leftist candidate is of type  $t$  is:

$$y_L(x_L(t), k) = 1 - (1 - x_L(t))^{k+1}.$$

We define the misperception of an independent about the leftist candidate  $t$  as the probability that a (randomly selected) independent believes that the leftist candidate is of type  $t' \neq t$ . Formally,

$$Q[t'|t, s, k] = [1 - y_L(x_L(t), k)]\rho(t'|\emptyset, s, k),$$

where  $1 - y_L(x_L(t))$  is the probability that an independent does not observe that the leftist candidate is of type  $t$ , and  $\rho(t'|\emptyset, s, k)$  (defined in equation (1)) is the probability that an uninformed independent places on the event that the leftist candidate is of type  $t'$ . Overall voters' misperception is then defined as the sum of the conditional probabilities that a randomly selected independent misperceives the type of the candidate running for office. Formally,

$$\Psi(s, k) \equiv Q[e|m, s, k] + Q[m|e, s, k].$$

In every pure strategy equilibrium the level of misperception is zero, while a mixed-strategy equilibrium always entails some positive level of misperception. Next we characterize symmetric political equilibria.

**PROPOSITION 1:** *A symmetric political equilibrium exists and it is unique. For every  $k$ , there exists a critical level  $\alpha^*(k) > 0$  such that in equilibrium:*

- (i) *If  $\alpha \geq \alpha^*(k)$  parties always select an extremist candidate and they do not advertise:  $\sigma^*(e) = 1$ , and  $x^*(e) = 0$ ;*
- (ii) *If  $\alpha < \alpha^*(k)$  parties randomize between selecting an extremist and a moderate, and they only advertise moderate candidates:  $x^*(e) = 0$ , and  $x^*(m)$  and  $\sigma^*(e)$  jointly solve*

$$(2) \quad (k + 1)(1 - x^*(m))^k \rho(e|\phi, s^*, k) \frac{2 - 4m + \sigma^*(e)}{16} = \alpha$$

$$(3) \quad 1 - \Psi(s^*, k) = \frac{4m + 16\alpha x^*(m)}{2 - 3m}.$$

Furthermore,  $\alpha^*(k)$  is increasing in  $k$ .

To see the intuition behind this result, first consider the case of symmetric pure-strategy equilibria.<sup>10</sup> Note that a profile in which parties always select a moderate candidate cannot be part of equilibrium. Suppose, in equilibrium, that voters would anticipate the two candidates are moderates, and therefore parties would not find it profitable to advertise. In this case, a party could increase its utility by selecting an extremist candidate. In fact, this would not change its expected probability of winning and, since each party prefers to implement the extreme policy, its utility would be higher.<sup>11</sup>

Next, consider the alternative scenario in which parties always select extremist candidates and they do not advertise. In this case a party could find it profitable to deviate from this strategy by selecting a moderate and informing some voters about its candidate. The benefit of such deviation is the increase in the probability of winning the election, which in turn is increasing in the proportion of voters that the party informs. Since disclosing information is costly, when the advertising technology is sufficiently inefficient ( $\alpha > \alpha^*(k)$ ), this deviation cannot be profitable. Furthermore, the lower the level of contextual exposure, the higher the level of advertising needed in order to make such a deviation profitable. This implies that when voters have higher chances to learn the candidates' types from communicating with other voters, the pure strategy equilibrium exists only for higher level of  $\alpha$ , i.e.,  $\alpha^*(k)$  is increasing in  $k$ .

We now consider the case of symmetric mixed-strategy equilibria. Clearly, in any equilibrium, parties only advertise moderate candidates. Moreover, when choosing their political strategy, parties face the following trade-off. Since they are policy motivated and they never advertise extremists, conditional on winning the election, they derive higher utility when they select an extremist candidate. However, since independents are decisive, a moderate candidate has a higher chance of winning the election relative to an extremist, and this advantage is higher the lower the voters' misperception. Indeed, in a symmetric mixed-strategy profile  $s$ , the difference between the expected probabilities of winning of, say, party  $L$  when choosing a moderate rather than an extremist candidate is

$$(4) \quad \hat{\pi}_L(s|t_L = m) - \hat{\pi}_L(s|t_L = e) = \frac{1}{2} - \hat{\pi}_L(s|t_L = e, t_R = m) \\ = \frac{1 - \Psi(s, k)}{8}.$$

In a mixed-strategy equilibrium, each party must be indifferent between selecting a moderate candidate and an extremist candidate, which requires that condition

<sup>10</sup>It is easy to see that pure-strategy asymmetric equilibria do not exist in this political game.

<sup>11</sup>This argument relies on the assumption that voters' beliefs are constant at zero probability events. There is only one equilibrium that does not satisfy this condition: parties always select a moderate, they set  $x(m) = 1$  and, out-of-equilibrium, an uninformed voter believes that the candidate is an extremist with strictly positive probability. This equilibrium exists for a value of  $\alpha$  sufficiently small and it is not robust to small imperfections of the advertising technology. For example, suppose that there is a positive probability that a voter remains uninformed even if parties set  $x(m) = 1$ . Given that parties always select moderate candidates, uninformed voters will always believe that the candidates are moderate and therefore setting  $x(m) = 1$  would not be optimal.

(3) holds. Furthermore, the equilibrium level of  $x^*(m)$  must equate marginal returns of advertising a moderate with marginal costs. This is summarized by condition (2), where the right-hand side represents the marginal cost  $\alpha$ . The left-hand side of (2) represents the marginal returns of advertising, which consist of the marginal decrease in the fraction of uninformed voters, weighted by their belief of facing an extremist candidate and by the increase in utility in case of electoral victory.

Proposition 1 states that a mixed-strategy equilibrium exists if and only if the advertising technology is sufficiently efficient. Furthermore, as we show in the online Appendix, a small marginal cost of advertising is also sufficient to guarantee uniqueness of the mixing probabilities between the two candidates. Since, for given mixing probabilities, there exists a unique level of optimal advertising, it follows that whenever the mixed equilibrium exists, it is unique.

We finally note that an interesting property of the model is that, whenever parties advertise, the level of advertising is always bounded away from zero. The reason is that advertising moderate candidates is profitable only if enough voters end up being informed about candidates' ideologies, which requires a sufficiently high level of advertising from the parties.<sup>12</sup>

#### A. *The Equilibrium Effect of Contextual Exposure*

We now explore the equilibrium relation between the level of interpersonal communication, voters' misperception, and policy polarization. In order to do so, we compare the political equilibrium when the level of contextual exposure is  $k$  with the political equilibrium when independents communicate with  $k + 1$  other voters. We focus on the case  $\alpha < \alpha^*(k)$  described in part (ii) of Proposition 1 since this is the only nontrivial situation.

As a measure of policy polarization, we define the ex ante expected probability that in equilibrium an extremist candidate is elected. This is denoted by  $\Pi(s^*)$  and it is equal to:

$$(5) \quad \Pi(s^*) = \sigma^*(e)^2 + 2\sigma^*(e)(1 - \sigma^*(e))\pi(s^*|e, m),$$

where the first term of the right-hand side of (5) is the probability that two extremist candidates compete in the election, while the last term is the probability that an extremist candidate wins against a moderate candidate.

The next proposition summarizes the results.

**PROPOSITION 2:** *Suppose that  $\alpha \in (0, \alpha^*(k))$ .*

- (i) *If  $k$  increases, then the equilibrium advertising of moderate candidates decreases, voters' misperception increases, and the probability that an extreme candidate wins against a moderate candidate increases;*

<sup>12</sup>We thank an anonymous referee for drawing our attention on this point.

- (ii) For every  $k$ , there exists  $\hat{\alpha}(k) \in (0, \alpha^*(k))$  such that, for all  $\alpha < \hat{\alpha}(k)$ , if  $k$  increases then parties select extreme candidates with higher probability and polarization increases.

The crucial step behind the result of part (i) in Proposition 2 is to show that the level of informative advertising is decreasing in the level of contextual exposure. Having established this property, the finding that voters' misperception increases, and that the probability that an extreme candidate wins against a moderate candidate increases, follow immediately from equations (3) and (4).<sup>13</sup> To understand why in equilibrium contextual exposure and advertising are substitutes, notice that an increase in  $k$  has two effects on parties' incentives to advertise.

The first effect is direct and it has two components. For given level of  $\sigma(e)$ , when voters are part of a richer communication network, an increase in advertising reaches an additional fraction of otherwise uninformed voters. This "network multiplier effect" increases the marginal return of advertising. However, when the voters' communication network becomes richer, it is also the case that the amount of "wasted" advertising reaching voters who would eventually become informed by communicating with others increases. This decreases the marginal return of advertising. Intuitively, the latter component dominates the former when informative advertising is high to begin with. Since from the parties' viewpoint selecting a moderate candidate is worthwhile only if voters' misperception is sufficiently low (which requires a high level of advertising), in a mixed-strategy equilibrium the level of advertising is bounded below. In particular, we can show that at this lower bound the direct effect of an increase in  $k$  decreases the marginal return of advertising.

The second effect is indirect and it alters the marginal return of advertising through the equilibrium response of  $\sigma(e)$ . Indeed, when  $k$  increases, the probability of facing a moderate opponent in the election changes as well, and this affects the incentives of the party to advertise. In particular, an increase in the probability of facing a moderate opponent decreases the marginal return of advertising, *ceteris paribus*. While the *overall* effect of  $k$  on  $\sigma(e)$  that takes into account the equilibrium adjustment can be positive or negative as we will explain shortly, in the proof we show that this indirect effect on the level of advertising is always second order with respect to the direct effect described above. We can then conclude that, overall, an increase in  $k$  reduces the level of informative advertising.<sup>14</sup>

The first part of Proposition 2 is silent about how an increase in the level of contextual exposure affects the probability that parties select extremist candidates and, therefore, how it affects the level of polarization. Note that, even if a larger value of  $k$  may increase polarization because the probability that an extremist defeats a moderate increases, if parties react to the presence of richer networks of communication by

<sup>13</sup>Indeed, note that if  $x(m)$  decreases, the right-hand side of equilibrium condition (3) decreases and therefore, to reestablish equilibrium, misperception must increase.

<sup>14</sup>In our model, total informative advertising and the level of interpersonal communication are substitutes. While in recent years we observed an increase in both interpersonal communication and in total campaign spending, only a fraction of this spending is devoted to informative advertising, which is the form of political advertising we are focusing on. In fact, part of the increase in campaign advertising is accounted for by an increased use of negative political advertising, see, e.g., Larry J. Sabato (1981), and Prat (2006).

selecting moderate candidates more often, overall, the level of polarization may still decrease. The extent to which parties adjust their equilibrium selection strategy, to a change in the level of contextual exposure, crucially depends on the change in the total fraction of informed voters in response to an increase in  $k$ . In particular, if the substitution effect between contextual exposure and informative advertising is large enough, parties may end up selecting extreme candidates more often in equilibrium. As we illustrate now, this latter equilibrium response depends solely on whether the marginal cost of total exposure is decreasing, or increasing, in the level of contextual exposure.

We start noticing that communication across voters corresponds to a more efficient advertising technology. Indeed, we can write the total advertising cost of reaching a fraction  $y(x(m), k)$  of independents as  $C(y(x(m), k)) = \alpha(1 - (1 - y(x(m), k))^{1/k+1})$ , where  $y(x(m), k) = 1 - (1 - x(m))^{k+1}$  takes into account both direct and indirect exposure. Hence, the marginal cost of total exposure is

$$\frac{\partial C(y(x(m), k))}{\partial y} = \frac{\alpha}{(k + 1)(1 - y(x(m), k))^{\frac{k}{k+1}}}.$$

Using the expression above, we can rewrite the equilibrium condition (2) as

$$\rho(e | \phi, s^*, k) \frac{2 - 4m + \sigma^*(e)}{16} = \frac{\partial C(y(x^*(m), k))}{\partial y}.$$

When  $\alpha$  is sufficiently low, parties advertise with relatively high intensity and therefore  $y(x(m), k)$  is large. In this case, an increase in  $k$  increases the marginal cost of total exposure, *ceteris paribus*. Formally, we have that:

$$\frac{\partial^2 C(y(x(m), k))}{\partial y \partial k} = - \frac{\alpha \left[ 1 + \frac{1}{k+1} \ln(1 - y(x(m), k)) \right]}{(k + 1)^2 (1 - y(x(m), k))^{\frac{k}{k+1}}},$$

which is strictly positive for sufficiently high  $y(x(m), k)$ . Intuitively, when many voters are already informed, a marginal increase in informative advertising will only have a relatively small effect on the total fraction of informed voters, i.e., the marginal cost of total exposure is very high. This implies that, when  $\alpha$  is sufficiently low, not only are the levels of informative advertising and of contextual exposure substitutes, but also total exposure and contextual exposure are substitutes. Hence, for low values of  $\alpha$ , an increase in  $k$  decreases the equilibrium level of informative advertising inasmuch that the total fraction of informed voters decreases as well. This unambiguously softens political competition and therefore parties select extremists more often. Overall, polarization increases.

We conclude this section with two observations. First, the second part of Proposition 2 does not hold for sufficiently inefficient advertising technology,

i.e.,  $\alpha \in (\hat{\alpha}(k), \alpha^*(k)]$ . In line with the intuition above, for sufficiently high  $\alpha$ , an increase in the level of contextual exposure leads parties to decrease the level of informative advertising only slightly, so that the total fraction of informed voters increases. As a result, parties select moderate candidates more often, and overall the level of polarization decreases.

Second, as noted above, an increase in the level of interpersonal communication corresponds to a more efficient advertising technology in the sense that it allows to inform the same fraction of independents at a lower cost. Similarly, a decrease in the marginal cost of advertising allows to reach the same fraction of independents at a lower cost. Despite this analogy, the effect of an increase in the level of interpersonal communication on the endogenous variables is rather different from the effect of a decrease in the marginal costs of advertising  $\alpha$  (i.e., direct exposure becomes less expensive). Indeed, a decrease in the marginal costs of direct exposure unambiguously leads parties to increase the level of informative advertising (which is exactly the opposite effect of an increase in the level of contextual exposure). Since parties advertise their moderate candidates more, it immediately follows that voters' misperception decreases, the proportion of informed voters increases, moderate candidates are selected with higher probability, and therefore the level of polarization decreases.

In the Appendix we discuss the robustness of the results presented in Proposition 2. We first focus on our assumption of linear advertising cost. Next, we provide a simple purification argument for the mixed equilibrium. This shows that our results in Proposition 2 are not driven by the mixed-strategy nature of the equilibrium. Finally, we elaborate on different possible assumptions regarding the technology of interpersonal communication.

### III. Homophily and Targeted Political Advertising

So far, we assumed that voters learn from randomly sampling other voters. However, a well-known, documented fact is that interpersonal communication occurs more frequently among similar individuals. One possible way to think about homophily in a political context is that individuals with similar political ideologies will have higher chances to interact and learn from each other. In our model, this phenomenon would entail a higher probability of interpersonal communication between voters with closer political ideologies. Note that if parties cannot target political advertising, our results will be unaffected by any form of such correlation. However, if parties are able to target advertising to ideologically similar voters, homophily will affect electoral competition and political outcomes. In this section, we modify our benchmark model in order to capture these additional features in a simple and parsimonious way.

First, we define group  $l$  as the group of independents in the interval  $[\mu - \tau, \mu]$ ; analogously, we call group  $r$  the remaining group of independents. Each independent samples  $k$  other voters. For each draw, a group- $l$  member samples a voter in his own group with probability  $\beta$ , while with the remaining probability he samples a group- $r$  voter. We assume that  $\beta \in [1/2, 1)$ , and we interpret this parameter as the level of homophily in the society. Absence of homophily corresponds to  $\beta = 1/2$ .

When instead  $\beta = 1$ , voters only communicate with members of their own group, which exemplifies a society in which ideology-based groups are totally segregated. Since the focus of this section is to study the effect of homophily on political outcomes, we set  $k = 1$ , hereafter.<sup>15</sup>

Second, we assume that a party can choose either to advertise its candidate at a cost  $\alpha > 0$  or not to advertise, and that advertising is targeted to the ideologically closer group of independents so that if the left party chooses to advertise its candidate, then all members of group  $l$  learn perfectly the type of the leftist candidate.<sup>16</sup> This is a simplified version of a more general model, where a party chooses whether to target advertising to one of the two groups (at a cost  $\alpha$ ), or to disclose political information to both groups (for example at a cost  $2\alpha$ ). In the online Appendix (Proposition 5), we show that the equilibria we characterize by assuming that advertising is targeted to the closer group of independents (see Proposition 3 below) are indeed equilibria in the more general model, where parties can choose where to target advertising.

In this context, we can define voters' misperception as follows. Consider a strategy profile in which party  $L$  selects an extremist candidate with probability  $\sigma(e)$  and advertises only a moderate candidate. Clearly, in equilibrium, all group- $l$  voters are informed about the position of the leftist candidate. However, the probability that a voter in group  $r$  believes that the leftist candidate is an extremist (resp. moderate) when in fact he is a moderate (resp. extremist) is  $\beta\sigma(e)$  (resp.  $\beta[1 - \sigma(e)]$ ). Hence, the level of voters' misperception is simply  $\Psi(s, \beta) = \beta$ . The next proposition characterizes the equilibrium.

**PROPOSITION 3:** *A symmetric political equilibrium always exists and it is unique. For every  $\beta$ , there exists  $\underline{\alpha}(\beta) < \bar{\alpha}$  such that in equilibrium:*

- (i) *For all  $\alpha > \bar{\alpha}$  parties select extremist candidates and they do not advertise;*
- (ii) *For all  $\alpha \in (0, \max[0, \underline{\alpha}(\beta)])$ , parties select moderates and they advertise;*
- (iii) *For all  $\alpha \in (\max[0, \underline{\alpha}(\beta)], \bar{\alpha})$  parties select extremist candidates with probability*

$$(6) \quad \sigma^*(e) = 1 - \frac{2 - 7m - 16\alpha}{\beta(2 - 3m)},$$

*and they advertise when they select a moderate.*

*Furthermore,  $\underline{\alpha}(\beta)$  is decreasing in  $\beta$  and  $\underline{\alpha}(\beta) > 0$  if and only if  $\beta < \frac{2 - 7m}{4m}$ .*

<sup>15</sup>We assume that  $k = 1$  merely for expositional reasons; all the results hold for arbitrary finite  $k$ .

<sup>16</sup>Here, we assume that advertising is discrete, i.e., a party can decide whether or not to advertise but not how much to advertise. This assumption is only needed for tractability. The fact that when a party advertises its candidate, then all ideologically close independents perfectly observe the candidate's ideology is not crucial for our results. Moreover, note that, abusing notation, we are denoting by  $\alpha$  the total cost of advertising, while in the benchmark model  $\alpha$  was the marginal cost of advertising.

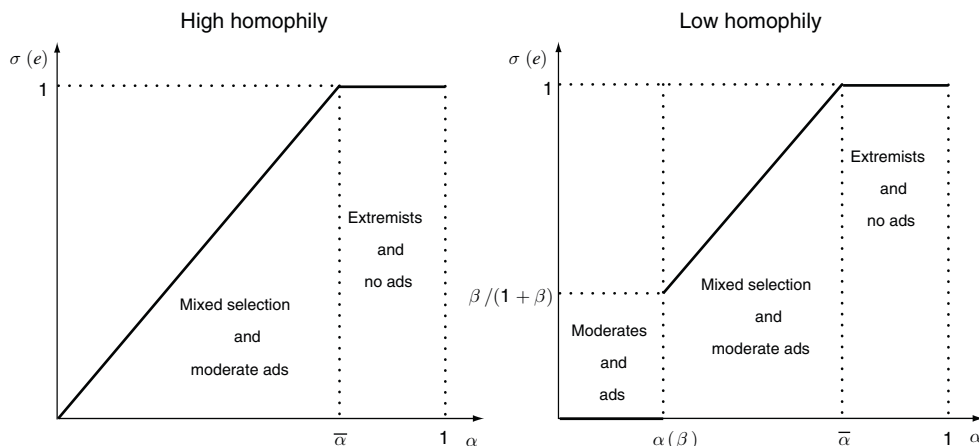


FIGURE 2. POLITICAL EQUILIBRIUM WITH HOMOPHILY

Figure 2 provides a graphical illustration of the equilibrium in the  $(\alpha, \sigma(e))$  parameter space.

The intuition of part (i) and part (iii) of Proposition 3, is analogous to the intuition of Proposition 1. When the level of homophily is sufficiently high, these are the only equilibria. However, when the level of homophily and the cost of advertising are low, a party cannot be indifferent between selecting the two candidates. Indeed, a low value of  $\beta$  implies that information often travels across groups, and therefore voters' misperception is low. In this case, a party has much higher chances of winning the election when selecting a moderate, rather than an extremist. Similarly, when  $\alpha$  is low, the cost of selecting a moderate candidate is also low. Hence, in equilibrium, parties always select moderate candidates and they advertise.<sup>17</sup> Our final result shows how the level of homophily affects political outcomes.

**PROPOSITION 4:** *Suppose  $\alpha \in (\max[0, \underline{\alpha}(\beta)], \bar{\alpha})$ . If  $\beta$  increases, then parties select extremist candidates with (strictly) higher probability, voters' misperception increases, and the policy outcome is more polarized.*

Figure 3 illustrates the comparative statics with respect to  $\beta$ .

The intuition for Proposition 4 is simple. Since parties target political information to distinct groups, an increase in homophily leads to a lower probability that a voter will possess information about both candidates. Hence, the level of voters' misperception increases, which softens political competition between parties. As a consequence, policy-motivated parties exploit an increase in voters' misperception

<sup>17</sup>This equilibrium requires specific out-of-the-equilibrium beliefs: when a voter in group  $l(r)$  is uninformed about party's  $L(R)$  candidate, then he believes that party  $L(R)$  selected an extremist.



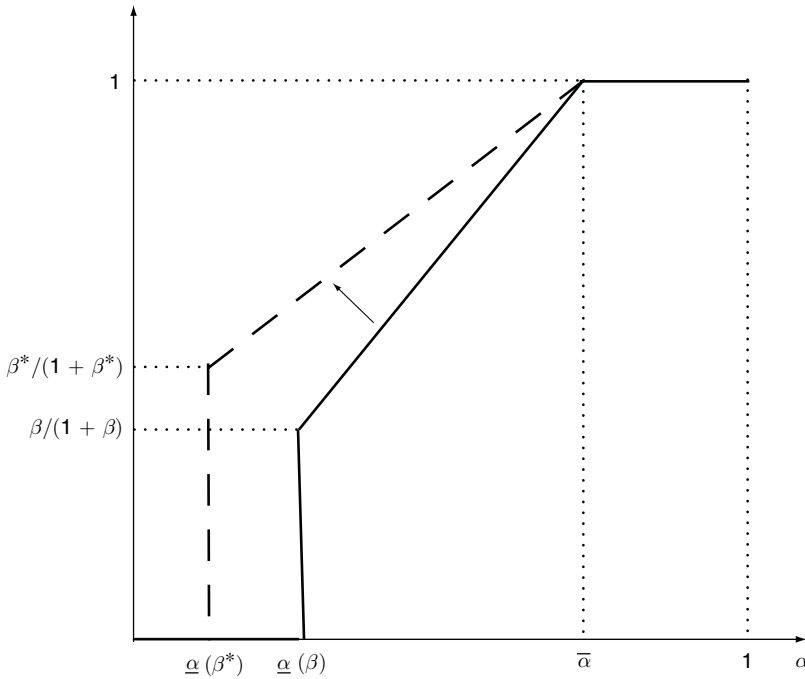


FIGURE 3. COMPARATIVE STATICS:  $\beta^* > \beta$

by selecting extremist candidates more often. Overall, the level of polarization increases with the level of homophily.<sup>18</sup>

#### IV. Conclusion

The importance of interpersonal communication in affecting voters’ choices has been empirically documented in economics, political science, and sociology. To the best of our knowledge, there is no theoretical model that examines how communication networks among voters affects social learning and its consequences on political equilibrium outcomes. This paper embeds social learning in a strategic model of informative political advertising, and it provides novel insights on the equilibrium relation between relevant aspects of interpersonal communication and electoral outcomes.

In our model, interpersonal communication is truthful. A first step toward relaxing this assumption is to consider the case in which voters can strategically choose to omit information. In this case, a voter who learns that the right (left) candidate

<sup>18</sup>In the context of the mixed-strategy equilibrium described in Proposition 3, we can compute the ex ante equilibrium probability that a randomly selected group- $l(r)$  independent votes for the left(right) party. This probability is increasing in  $\beta$ , meaning that the higher the level of homophily, the higher the correlation between vote choice and ideology. This result is consistent with empirical evidence suggesting that receiving information about the ideologically closer candidate reduces the probability that voters switch their votes from their initial disposition. See Daniel Velázquez-Núñez (2007), and Charles Pattie and Ron Johnston (1999).

is a moderate and who strictly prefers to vote for the left (right) candidate, will choose to omit information about the right (left) candidate. Preliminary work suggests that this extension does not qualitatively affect our results. In fact, if any, strategic communication endogenously creates homophily in the sense that “good” information will only be passed along to voters with a similar ideology, while “bad” information is only passed along to voters with a different ideology. In principle, this might decrease political competition between parties, thereby leading towards more polarized outcomes.

In our model, we abstract from the effect that social learning may have on electoral turnout. However, we believe this is an important issue, and one possible way to analyze the effect of interpersonal communication on turnout is to consider an expressive theory of voting. That is, each voter votes as if he were pivotal, provided that the increase in his expected utility when his most preferred candidate gets elected is above his private cost of voting. To see how interpersonal communication can affect the decision of turning out to vote, consider the case of a voter informed only about party  $L$ 's candidate. Conditional on remaining uninformed, an increase in the level of interpersonal communication increases the voter's posterior beliefs that the right candidate is an extremist. This reduces the voter expected utility were this candidate being elected, which makes it more likely that this voter would choose to turn out and vote. Hence, the overall effect on turnout will depend on the extent to which voters learn about electoral candidates, which, in turn, depends on the structure of the communication network. These and other extensions are the object of ongoing research.

#### APPENDIX

In this Appendix, we discuss the robustness of the results presented in Proposition 2. We first focus on our assumption of linear advertising cost. Next, we provide a simple purification argument for the mixed equilibrium. This shows that our results in Proposition 2 are not driven by the mixed-strategy nature of the equilibrium. Finally, we elaborate on different possible assumptions regarding the technology of interpersonal communication.

*Cost of Advertising.*—We start by noticing that the results in part (i) of Proposition 2 do not depend on the specific functional form of the cost function. Consider a general cost function  $C(\alpha, x)$ , which is increasing and convex in  $\alpha$  and  $x$ , respectively. The equilibrium condition (2) can be rewritten as:

$$(k + 1)(1 - x^*(m))^k \rho(e | \phi, s^*, k) \frac{2 - 4m + \sigma^*(e)}{16} = \frac{\partial C(\alpha, x^*(m))}{\partial x^*(m)}.$$

Following the same line of reasoning developed in Section II, we can conclude that the marginal return of advertising is decreasing in the level of contextual exposure.

Hence, the level of informative advertising is also decreasing in  $k$ . For a general cost function  $C(\alpha, x)$ , the equilibrium condition (3) reads as follows:

$$1 - \Psi(s^*, k) = \frac{4m + 16C(\alpha, x^*(m))}{2 - 3m},$$

and since  $x^*(m)$  decreases in  $k$ , it follows that  $C(\alpha, x^*(m))$  is also decreasing. Thus, the equilibrium level of voters' misperception is higher when voters belong to richer communication networks.

In contrast, the results in part (ii) of Proposition 2 depend on the specific formulation of the cost function. To see why this is the case, recall that the level of polarization increases with the richness of voters' communication network whenever total exposure and contextual exposure are substitutes. This requires that, in equilibrium, the marginal cost of total exposure is increasing in  $k$ . This relation holds more generally than for the linear cost function case, which we have considered before. For example, it holds for the family of cost functions  $C(\alpha, x) = \alpha x^\beta$ , where  $\beta \geq 1$ . However, it does not hold for all increasing and convex cost functions. For example, it does not hold for the cost function  $C(\alpha, x) = \alpha x / (1 - x)$ , which is the one used by Coate (2004b). Indeed, in this case the marginal cost of total exposure is

$$\frac{\partial C(y(x(m), k))}{\partial y} = \frac{\alpha}{(k + 1)(1 - y(x(m), k))^{\frac{k+2}{k+1}}},$$

which is decreasing in  $k$ . Hence, even if it is still true that an increase in the level of contextual exposure decreases the amount of information that parties strategically choose to disclose, the total fraction of informed voters always increases in  $k$ . Consequently, the higher the level of contextual exposure, the stronger the political competition between parties and therefore parties select moderate candidates more often. Overall, the level of polarization decreases. Table A1 summarizes these observations by showing how political equilibrium outcomes change with the level of contextual exposure for three different formulations of the cost function.

*A Simple Purification Argument.*—We can purify the symmetric mixed-strategy equilibrium described in part (ii) of Proposition 1 in the following way. Suppose that each party can be either a “high-cost” type, with probability  $\sigma$ , or a “low-cost” type with probability  $1 - \sigma$ . A “high-cost” party has a high marginal cost of advertising, say  $\alpha_H$ , while the marginal cost of a “low-cost” party is  $\alpha \ll \alpha_H$ . Each party observes its own type, but it does not observe the type of its opponent. If the difference between  $\alpha_H$  and  $\alpha$  is sufficiently large, in equilibrium the high-cost party selects an extremist candidate and does not advertise, while the low-cost party always selects a moderate and advertises with intensity  $x^*$ , which is the solution to equation (2). Using the same intuition developed in Section II, it can be shown that for a sufficiently low level of  $\alpha$ , both the level of informative advertising, as well as the total fraction of informed voters, are decreasing in the level of contextual

TABLE 1—THE EFFECT OF AN INCREASE  $k$  FOR DIFFERENT COST FUNCTIONS

$m = 0.1, \alpha = 0.01$	$C(\alpha, x) = \alpha x$	$C(\alpha, x) = \alpha x^2/2$	$C(\alpha, x) = \alpha x/(1 - x)$
$k = 1$	$\sigma^*(e) = 0.011$	$\sigma^*(e) = 0.008$	$\sigma^*(e) = 0.1542$
	$x^*(m) = 0.846$	$x^*(m) = 0.847$	$x^*(m) = 0.517$
	$\Psi^*(s) = 0.685$	$\Psi^*(s) = 0.731$	$\Psi^*(s) = 0.664$
	$\Pi^*(s) = 0.010$	$\Pi^*(s) = 0.008$	$\Pi^*(s) = 0.141$
$k = 2$	$\sigma^*(e) = 0.015$	$\sigma^*(e) = 0.009$	$\sigma^*(e) = 0.088$
	$x^*(m) = 0.672$	$x^*(m) = 0.703$	$x^*(m) = 0.465$
	$\Psi^*(s) = 0.701$	$\Psi^*(s) = 0.741$	$\Psi^*(s) = 0.686$
	$\Pi^*(s) = 0.014$	$\Pi^*(s) = 0.009$	$\Pi^*(s) = 0.082$

exposure. As before, this implies that when voters belong to richer communication networks the level of voters' misperception is higher. Furthermore, since now the probability that a party selects a moderate *versus* an extremist candidate is exogenously given, it immediately follows that polarization increases with the level of contextual exposure.

*The Technology of Social Learning.*—The social learning technology can be enriched in many ways without losing tractability and without changing the qualitative insights of our results. For example, we could allow for the realistic possibility that voters are heterogeneous with respect to their exposure to social learning. A simple way of capturing this feature is to consider that social ties are described by a distribution  $P: [0, \dots, k] \rightarrow [0, 1]$ , where  $P(k)$  indicates the fraction of voters who sample  $k$  other voters. In this case, the effect of an increase in the level of contextual exposure on political equilibrium outcomes can be studied by taking first-order stochastic shifts in the distribution  $P$ . While in this paper we presented the analysis for the case of homogeneous voters, all our results are robust to the introduction of heterogeneity in social-learning exposure.

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