한국경제학보 제32권 제2호
The Korean Journal of Economics Vol. 32, No. 2 (Autumn 2025)

Fake News and Political Polarization*

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Abstract

This paper presents a theoretical analysis of the impact of fake news on electoral campaigns within networked communication. The foundational model involves strategic candidate selection and campaign planning by two political parties, with voters categorized into partisan and independent groups. Partisan voters receive information directly from party campaigns, while independent voters rely on interactions with partisans, resulting in a nuanced learning process. Our findings demonstrate a positive association between intensified communication and an increased production of fake news, highlighting the role of misinformation in exacerbating political polarization. Specifically, heightened communication between independent and partisan voters correlates with a higher likelihood of selecting extreme candidates in elections, accompanied by an increased prevalence of misinformation in political campaigns.

KRF Classification : B030200, B030112, B030503
Keywords : Fake News, Polarization, Electoral Campaign, Network Communication.

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* This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2021S1A5A8068768).
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Ⅰ. Introduction

In the contemporary political landscape, characterized by the organized efforts of political campaigns, the overarching goal is to exert influence over specific groups of individuals. This influence is multifaceted, ranging from shaping policy preferences to mobilizing support for particular candidates. A longstanding debate within political discourse revolves around the nature and efficacy of these campaigns, especially in the context of electoral processes. Some argue that the essence of a political campaign lies in its ability to persuade voters, particularly in the lead-up to elections. However, an opposing perspective posits that the effectiveness of such campaigns diminishes when voters' preferences have solidified, as suggested by Granato and Wong's argument (Granato and Wong, 2004).

Within the realm of partisan politics, where affiliations with particular parties are often deeply ingrained, a unique set of challenges arises. Political polarization has become a defining feature of many nations, with partisan voters exhibiting increasingly crystallized and strengthened views. In this environment, the impact of political campaigns may be limited, primarily influencing independent or undecided voters. The prevalence of "extreme" political polarization further complicates matters, intensifying the depth and extent of partisan voters' views.

The advent of the Internet has ushered in an era of unprecedented growth in social media, transforming the landscape of political communication. The resulting increase in connectivity has made social learning a dominant mechanism for information acquisition. However, the proliferation of misinformation within these communication networks raises concerns about the potential consequences. Against this backdrop, understanding the implications of fake news, especially when disseminated through seemingly unsophisticated channels in social media, becomes a pressing area of academic inquiry.

This paper embarks on a comprehensive examination of the impact of fake news in electoral campaigns within the context of networked communication. The foundational model considers two political parties strategically selecting candidates and planning campaigns, with a continuum of voters engaging in the political process. These voters are categorized into partisan and independent groups, each with distinct roles in the information dissemination and belief-updating processes. Partisan voters receive information directly from party campaigns, while independent voters rely on interactions with partisan voters, creating a learning process characterized by a nuanced interplay of information advantage and assumed non-sophistication.

We show that intensified communication is positively associated with an augmented production of fake news. Moreover, our investigation elucidates the role of fake news in exacerbating political polarization. More precisely, heightened engagement in communication between independent voters and partisan counterparts correlates with an elevated probability of selecting extreme candidates in elections, concomitant with an increased incidence of misinformation in political campaigns.

In this paper, we use the term political polarization in a specific and operational sense. Political polarization refers to a divergence in electoral outcomes whereby parties increasingly nominate and voters increasingly elect extreme candidates rather than moderate ones. This definition aligns with our theoretical environment, in which the ideological distance of elected candidates serves as the primary observable manifestation of polarization. Accordingly, we distinguish between the absence of polarization—where both parties select centrist candidates—and extreme polarization—where equilibrium behavior results in the nomination or election of candidates located at the ideological extremes. Throughout the paper, “political polarization” denotes this equilibrium pattern of candidate extremism rather than mass ideological hostility or affective polarization in the broader electorate.

The current political landscape bears witness to a surge in extreme political polarization —characterized by the increasing electoral success of ideologically extreme candidates—across various nations, a trend corroborated by the Pew Research Center's survey highlighting the escalating polarization in the United States over the last few decades (Pew Research Center, 2014). Concurrently, fake news has emerged as a critical issue in contemporary politics, disseminating intentionally fabricated information through new media platforms like Facebook, Twitter, and YouTube. Social media's ascendancy as a primary source of political information is underscored by studies, with 62 percent of U.S. adults obtaining news from these platforms (Gottfried and Shearer, 2016). More than 40 percent of traffic to fake news websites originates from social media, emphasizing its pivotal role in the spread of misinformation (Allcott and Gentzkow, 2017).

Amidst this complex landscape, the study posits that partisan voters actively engage in campaigns not to update their beliefs but to reinforce existing convictions. In contrast, independent voters, exposed indirectly, rely on information garnered from word-of-mouth and social media interactions with partisan voters to shape their candidate perceptions. The study aims to unravel the intricate interplay between political campaigns, social media, and the dissemination of information, particularly fake news, within contemporary democracies. By examining the dynamics of communication networks, belief formation, and the impact of misinformation, this investigation seeks to contribute nuanced insights to the ongoing discourse surrounding the challenges and opportunities presented by modern political campaigns.

1. Related Literature

Galeotti and Mattozzi (2011) examine the dynamics of political campaigns orchestrated by two symmetric parties. Their analysis incorporates partisan voters, known for unwavering loyalty to their respective parties, and independents, who exhibit a desire to cast their votes based on candidate preferences. Their findings highlight a notable correlation between the richness of communication networks and the disclosure of political information by parties. Specifically, in more intricate communication networks, parties tend to divulge less political information, fostering an environment where voters are prone to harboring erroneous beliefs regarding candidate characteristics. Moreover, the study elucidates how denser communication networks among voters may contribute to heightened political polarization.

Building upon the foundational framework established by Galeotti and Mattozzi (2011), our study introduces a novel dimension by incorporating a fake news campaign. In their framework, parties decide whether to disclose information about their candidates. However, our extended framework empowers parties not only to withhold information but also to propagate misinformation regarding their candidate's ideology. This nuanced modification enables us to scrutinize the intricate relationship between communication intensity and political polarization in the presence of fake news.

By integrating the element of misinformation dissemination, our study seeks to unravel the intricate interplay between communication dynamics and political polarization. We aim to discern how the deliberate inclusion of misinformation in political campaigns shapes the information landscape, potentially exacerbating polarization among voters. This expanded analytical framework contributes to a more comprehensive understanding of the multifaceted interactions within political campaigns, shedding light on the implications of fake news in contemporary democratic processes. In the subsequent sections, we elaborate on the theoretical underpinnings of our model, the assumptions guiding our analyses, and the anticipated implications of our investigation in the broader context of political economy research.

Druckman et al. (2018) posit a compelling argument regarding the pervasive influence of partisan media, contending that its impact transcends its immediate audience through a two-step communication flow. Specifically, individuals who consume and are influenced by partisan media outlets engage in subsequent conversations with and attempt to persuade those who did not partake in the initial viewership. They provide empirical support for this phenomenon through experimental results, establishing a foundation for understanding the extended reach of partisan media influence.

This insight aligns with the conceptual framework of our study, which incorporates a two-step communication flow between partisan and independent voters. While our setting diverges from the traditional partisan media context, as we consider information dissemination through political campaigns rather than media outlets, their findings offer a relevant justification for our chosen communication dynamics. In our model, partisan voters receive information from political parties, analogous to individuals hearing from partisan media outlets in their study. Despite this distinction, we acknowledge the parallel between the two-step communication flows, where information transmitted to partisan voters may subsequently influence independent voters through interpersonal interactions. Furthermore, our conceptualization allows for a natural extension, where partisan media functions as an intermediary conveying information, possibly misinformation, on behalf of a political party to its dedicated audience.

Ⅱ. Model

1. Agents

The basic game setup is derived from Galeotti and Mattozzi (2011) in our model, featuring two political parties denoted as L and R, along with an infinite number of voters distributed within the policy space $[0,1]$. These voters are categorized into three distinct groups:

- **Partisan voters aligned with party** L: distributed in $[0,m]$
- **Partisan voters aligned with party** R: distributed in $[1-m,1]$
- **Independent voters**: distributed in $[\mu-\tau,\mu+\tau]$, where $\mu \sim U[\frac{1}{2}-m,\frac{1}{2}+m]$[1)]

To ensure non-overlapping voter groups, we impose the condition $m < \frac{1}{4} - \frac{\tau}{2}$. This guarantees that the intervals for partisan and independent voters do not intersect. The measures of the partisan groups align with m, while the measure of the independent voters is represented by 2τ.[2)] By design, $m+\tau$ is constrained to be less than 0.5.

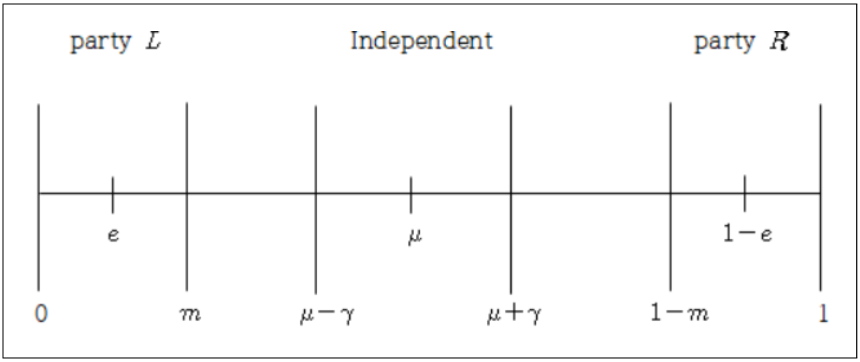
The median of the L-party is denoted as $e \equiv \frac{0+m}{2}$, and consequently, the median of the R-party is $1-e = \frac{1-m+1}{2} = 1-\frac{m}{2}$. Figure 1

1) The inclusion of uncertainty in the distribution of independent voters is motivated by its role in the model. Without this uncertainty, the observation of Galeotti and Mattozzi (2011) that the identity of the median independent is ex-ante uncertain lacks clarity. It is posited that if μ were fixed, the choice of candidate might become evident. For instance, if one party opts for an extreme candidate while the other selects a moderate candidate, and μ precisely equals $1/2$, the former party, choosing an extreme candidate, would lose the election with certainty. Consequently, both parties would avoid extreme candidates and consistently choose moderate candidates in equilibrium. Introducing uncertainty in μ serves to allow for the possibility of choosing an extreme candidate.

2) By design, $m+\tau$ is constrained to be less than 0.5.

visually elucidates the delineation of the policy space.

〈Figure 1〉 The policy space



2. Utility Functions

A voter enjoys the (dis)utility from the final voting outcome. The voter $i \in [0,1]$ has the utility:

$$u_i(w) = -|i-w|$$

where w represents the winning candidate's position.

Each party wants to maximize the expected utility of the median voter of the corresponding partisan group:

- L**-party**: $\max E\left[-\left|\frac{m}{2}-w\right|\right]$
- R**-party**: $\max E\left[-\left|1-\frac{m}{2}-w\right|\right]$

It means that each party would be better off by winning the election with the extreme candidate e than with the moderate candidate m.

3. Strategy

Each party selects its candidate $t_j \in \{e, m\}$ for the election, where $e = \frac{m}{2}$.[3] For the L-party (or R), the candidate position is represented as t_l (or $1 - t_r$).

Following the candidate selection, the parties embark on designing their respective political campaigns.[4] Specifically, we posit that:

- L-**party**: Straightforwardly determines the magnitude of its political campaign $x_l \in [0,1]$, signifying the proportion of partisan voters exposed to the truthful information about the party candidate.
- R-**party**: Decides on the accuracy of the information q, a choice that inherently determines the size of its political campaign, denoted as the proportion of partisan voters informed by the party's campaign, $x_r(q)$.[5]

Consequently, $x_r(q) \times m$ of R-partisan voters receive accurate information about the R-party candidate with a probability of q, while they encounter fake news or misinformation with a probability of $1 - q$.

Note that, in contrast to the R-party, the L-party does not engage in misinformation when its candidate is extreme. Even though campaign costs are normalized to zero, disseminating misinformation yields no strategic benefit for L. This is because, under our voting rule, partisan voters already support their party unconditionally, and independent voters treat missing information as the midpoint between −1 and +1. Therefore, if L were to fabricate a moderate message for an extreme candidate, independent voters would not mistakenly

3) It is essential to note that both parties are not obliged to choose a candidate whose ideology is less than e, given that the expected utility of the median voter of each party is maximized when the winning candidate's position is e.
4) We make the assumption that there is no explicit cost associated with the campaign.
5) The functional form $x_r(\cdot)$ will be discussed later in the article.

believe the candidate is moderate; they would instead discount uninformed signals and rely on their prior position. As a result, L gains no electoral advantage from producing fake news. The absence of campaign cost therefore does not generate an incentive for L to mimic R's misinformation strategy. We make this explicit by assuming L always conveys truthful information.

〈Figure 2〉 Political campaign of R-party

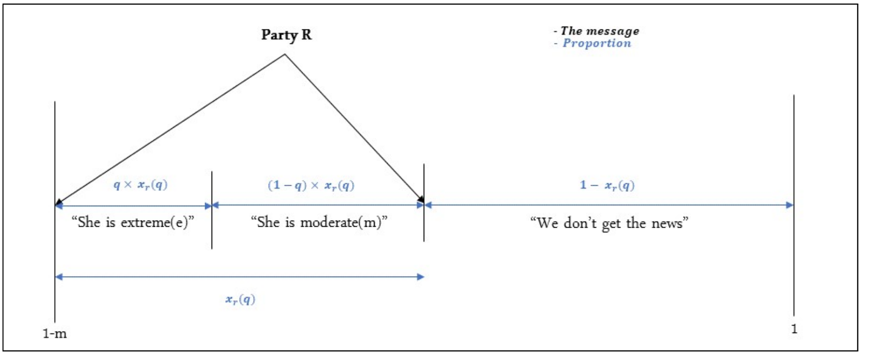


Figure 2 visually outlines the progression of the political campaign for the R-party. Each voter, irrespective of party affiliation, casts their vote for either candidate t_l or t_r as if they are perpetually pivotal.[6)] A partisan voter consistently supports the candidate from their party, and an independent voter votes for the candidate closer to their own ideological position.

4. Belief Updating and Fake News

To focus on the network effect in the communication between partisan voters and independent voters, our model posits that partisan

6) To streamline our focus on the strategic choices of parties, we assume that voters are nonstrategic agents who vote for the candidate whose ideology is closer to theirs. In other words, a partisan voter consistently supports the candidate from their party, and an independent voter votes for the candidate closer to their own ideological position.

voters unconditionally embrace whatever their party communicates if they happen to hear it.[7] Therefore, within our framework, partisan voters function as conduits, faithfully conveying their parties' messages to independent voters if they are privy to such information.

Nevertheless, we allow for a degree of critical discernment among partisan voters towards their own party's campaign, especially when the party resorts to disseminating fake news. Specifically, we assume that the R-party's campaign size $x_r(\cdot)$ is weakly increasing with the accuracy parameter q, where $x_r(0)=0$ and $x_r(1)=1$. In essence, as the R-party proliferates fake news, fewer partisan voters pay heed to the party's political campaign.

Each independent voter systematically selects k partisan voters from each partisan voter group, formulating their beliefs on the candidates' policy positions by averaging the information provided by attentive partisan voters. This approach underscores the respect accorded to the informational advantage of attentive partisan voters and the inclination of independent voters to conform to them, reminiscent of the social influence dynamics elucidated by DeGroot (1974).[8]

5. Behavioral Assumptions

A central ingredient of our analysis is the behavior of independent and partisan voters in the communication stage.

Independent voters as naive DeGroot learners: Whenever an independent voter talks to a partisan voter, she takes the partisan's

7) This simplifying assumption finds its rationale in the motivated reasoning argument: We assert that partisan voters engage in 'partisan motivated reasoning,' actively seeking to rationalize their alignment with the party's consistent positions (Leeper and Slothuus, 2014).

8) We assume that if independent voters exclusively communicate with k inattentive partisan voters, their belief is simply centered between m and e, i.e., $\frac{1}{2}m+\frac{1}{2}e=\frac{3}{2}e$

message at face value and updates her belief by averaging over all messages she hears.[9] They do not attempt to infer the equilibrium strategy of parties from the prevalence of misinformation.

This assumption reflects that independent voters have weaker partisan priors and pay lower attention to the strategic environment.[10] In a dense social network they may be flooded with heterogeneous content and may not invest enough effort to infer the overall reliability of the information they observe. Our results should therefore be interpreted as applying to environments where independent voters are relatively unsophisticated in their political inference.

Partisan voters and motivated reasoning: Partisan voters have strong affective ties to their party and engage in partisan motivated reasoning. When they pay attention to their party's campaign, they accept the party's message and subsequently repeat it in conversations with independents.[11] However, attention is not automatic: we assume

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9) Formally, if an independent voter meets k partisan voters and hears a messages that report the R-candidate as extreme e and b messages that report her as moderate m, she assigns the candidate position e with probability $\frac{a}{a+b}$ and mwith probability $\frac{b}{a+b}$, whenever $a+b>0$. If she interacts only with inattentive partisan voters, she places her belief at the midpoint between e and m, as described below.

10) Our assumption that independent voters take partisan messages at face value is deliberately stark. If independent voters were to discount messages from sources they perceive as unreliable, the scope for fake news would be more limited and its equilibrium prevalence would fall. In particular, one could extend the model so that independents attach a weight $\delta \in [0,1]$ to the partisan messages they hear and a complementary weight to their prior. As long as δ remains sufficiently large, the qualitative comparative static that more intense communication (a higher k) strengthens the incentive to bias messages toward moderation, and thus increases fake news, would survive. A full characterization of equilibria with partially sophisticated independent voters requires substantial additional notation and is left for future work. We view the present model as a benchmark that isolates the interaction between communication intensity and strategic misinformation under naive social learning.

11) This assumption follows the evidence that partisan identifiers often rationalize and defend their party's positions rather than update away from them; see, for example, Leeper and Slothuus (2014).

that the share of attentive R-partisan voters, $x_r(q)$, is weakly increasing in the accuracy q of the party's message, with $x_r(0)=0$ and $x_r(1)=1$. When the party relies heavily on fake news, some partisan voters rationally or emotionally disengage from the campaign and do not transmit the party's message.

Our formulation does not require that partisan voters are intrinsically harder to persuade than independents. Instead, partisans are more willing to accept their own party's message when they choose to pay attention, whereas independents treat the social information they receive mechanically and do not discipline parties by discounting noisy messages.

6. Timing of Game

The timing of a game is as follows:

1. Each party chooses a candidate (t_l, t_r).
2. Parties simultaneously design their political campaigns $(x_l, x_r(q))$.
3. Voters communicate with each other and form beliefs on the candidates.
4. Voters cast their votes to the candidates they prefer (in expectation).
5. Payoffs are realized.

Ⅲ. Analysis

In this section, we undertake an equilibrium analysis employing the concept of Bayes Nash equilibrium. It is imperative to recognize that the voters, in the context of this game, are non-strategic agents. Specifically, partisan voters consistently cast their votes for the candidate affiliated with their respective party, adhering to their predetermined alignment.

Conversely, independent voters vote for the candidate who is believed to be closer to them in expectation.

1. Parties' Campaign Strategies

As explained in Section 2.3, the L-party never fabricates fake news, even when its candidate is extreme, because misinformation does not shift independent voters' beliefs in its favor. That is, in our model, fake news is basically saying the candidate is moderate (m) when she is extreme (e). Second, it is optimal for L-party to set $x_l = 1$ for m and $x_l = 0$ for e.

Suppose the R-party chooses the extreme candidate e. An independent voter samples k partisan voters from the R side. Each such partisan voter can be in one of three states:

- Attentive and told the truth with probability $qx_r(q)$, in which case she reports the candidate as extreme e;
- Attentive and told the fake moderate position with probability $(1-q)x_r(q)$, in which case she reports the candidate as moderate m;
- Inattentive with probability $1-x_r(q)$, in which case she provides no informative message about the candidate.

Let a be the number of partisan voters among the k who report the candidate as extreme and b the number who report her as moderate. Conditional on (a,b) with $a+b>0$, our naive independent voter infers that the candidate is extreme with probability $\frac{a}{a+b}$ and moderate with probability $\frac{b}{a+b}$, and thus places the candidate at the expectation $\frac{a}{a+b}e+\frac{b}{a+b}m$. If all k sampled partisans are inattentive, the independent voter falls back to the midpoint between e and m, which equals $\frac{3}{2}e$ in our parametrization.[12)]

Averaging over all realizations (a,b) of this multinomial sampling

12) This corresponds to the midpoint between the party median e and the moderate candidate $m=2e$.

process yields the expected perceived position of the R-candidate for an independent voter:

$$I_r(q;e,k) = e \times \left[1(x_r(q)=1) + (1-1(x_r(q)=1))f(q;k)\right]$$

where $f(q;k)$ is defined as:

$$\sum_{(a,b)\in S}\left(\frac{a}{a+b}+2\left(1-\frac{a}{a+b}\right)\right)\frac{k!}{a!b!(k-a-b)!}(qx_r(q))^a((1-q)x_r(q))^b(1-x_r(q))^{k-a-b}$$

k is the number of R-voters that independent voters choose, a(or b) is the numbers of R-voters among k people who believe R-candidate's ideology is extreme e (or moderate m), and $S \equiv \{(a,b)\in Z\times Z \mid 0 \le a,b \le k, 0 < a+b \le k\}$.

In order to maximize the winning probability, R-party with the extreme candidate will choose the value of q which minimizes $1-I_r(q;e,k)$, which can be accomplished by maximizing $f(q;k)$. We denote the optimal q by $q^* = \arg\max_{q\in[0,1]} f(q;k)$.

The following lemmas describe the important properties of the optimal q^*.

Lemma 1 (Midpoint Property): $f\left(\frac{1}{2};k\right) = \frac{3}{2}$ for all $k \in Z^+$.

Proof of Lemma 1

Equation 1:

$$f\left(\frac{1}{2};k\right) = \sum_{(a,b)\in S}\left(2-\frac{a}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}\left(\frac{1}{2}x_r\left(\frac{1}{2}\right)\right)^{a+b}\left(1-x_r\left(\frac{1}{2}\right)\right)^{k-a-b} + \frac{3}{2}\left(1-x_r\left(\frac{1}{2}\right)\right)^k$$

$$= \frac{1}{2}\left[\sum_{(a,b)\in S}\left(2-\frac{a}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}\left(\frac{1}{2}x_r\left(\frac{1}{2}\right)\right)^{a+b}\left(1-x_r\left(\frac{1}{2}\right)\right)^{k-a-b} + \frac{3}{2}\left(1-x_r\left(\frac{1}{2}\right)\right)^k\right]$$

$$+\frac{1}{2}\left[\sum_{(a,b)\in S}\left(2-\frac{b}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}\left(\frac{1}{2}x_r\left(\frac{1}{2}\right)\right)^{a+b}\left(1-x_r\left(\frac{1}{2}\right)\right)^{k-a-b}+\frac{3}{2}\left(1-x_r\left(\frac{1}{2}\right)\right)^k\right]$$

$$=\frac{3}{2}\left[\sum_{(a,b)\in S}\frac{k!}{a!b!(k-a-b)!}\left(\frac{1}{2}x_r\left(\frac{1}{2}\right)\right)^{a+b}\left(1-x_r\left(\frac{1}{2}\right)\right)^{k-a-b}+\left(1-x_r\left(\frac{1}{2}\right)\right)^k\right]$$

$$=\frac{3}{2}\left[\left\{1-\left(1-x_r\left(\frac{1}{2}\right)\right)^k\right\}+\left(1-x_r\left(\frac{1}{2}\right)\right)^k\right]=\frac{3}{2}$$

Lemma 2 (Existence of Interior Maximum): There is a $\tilde{q}\in\left(0,\frac{1}{2}\right)a$ such that $\frac{\partial}{\partial_q}f(q;k)|_{q=\tilde{q}}=0$ for all $k\in Z^+$.

Proof of Lemma 2 We can easily obtain that $f(0;k)$ is also $\frac{3}{2}$ by the definition of $f(q,k)$. Hence, we obtain desired results by Rolle's theorem.

Lemma 3 (Monotonicity Around Midpoint): $f(q;k)>\frac{3}{2}$ when $q\in\left(0,\frac{1}{2}\right)$, and $f(q;k)<\frac{3}{2}$ when $q\in\left(\frac{1}{2},1\right)$. Therefore, for any q^*, $f(q^*;k)>\frac{3}{2}$.

Proof of Lemma 3 If $q\in\left(0,\frac{1}{2}\right)$, then we have

$$f(q;k)=\sum_{(a,b)\in S}\left(2-\frac{a}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}(qx_r(q))^a((1-q)x_r(q))^b(1-x_r(q))^{k-a-b}+\frac{3}{2}\left(1-x_r\left(\frac{1}{2}\right)\right)^k$$

$$=\sum_{(a,b)\in S}\left(2-\frac{b}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}(qx_r(q))^b((1-q)x_r(q))^a(1-x_r(q))^{k-a-b}+\frac{3}{2}\left(1-x_r\left(\frac{1}{2}\right)\right)^k$$

$$> \sum_{(a,b)\in S}\left(2-\frac{b}{a+b}\right)\frac{k!}{a!b!(k-a-b)!}(qx_r(q))^a((1-q)x_r(q))^b$$
$$(1-x_r(q))^{k-a-b}+\frac{3}{2}(1-x_r(q))^k$$

The last inequality is from the fact that $q<\frac{1}{2}$. By adding $f(q;k)$ to both sides, we obtain $2f(q;k)>3\{1-(1-x_r(q))^k\}+3(1-x_r(q))^k=3$. Thus $f(q;k)>\frac{3}{2}$. Also, if $q\in\left(\frac{1}{2},1\right)$, then we get $f(q;k)<\frac{3}{2}$ by the similar argument.

⟨Figure 3⟩ The graphs of f(q,k) represented by varying the value of k.

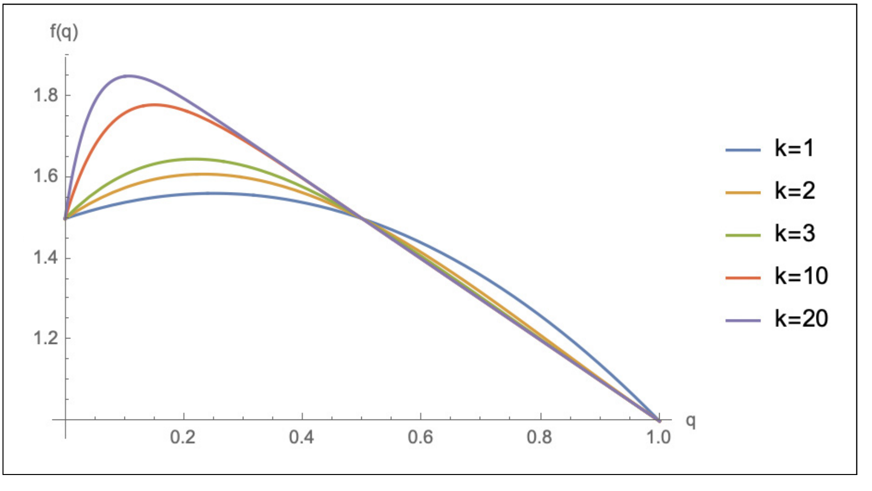

Figure 3 illustrates the relation between k (the intensity of communication) and q^* (the degree of accuracy), under a simplifying assumption that $x_r(q)=q$. It is evident from the visualization that an increase in k corresponds to a decrease in q^*.13) This observation implies that as independent voters engage in more active communication with partisan voters, the production of fake news by the party intensifies. The rationale behind this phenomenon lies in the dynamics of interaction: since independent voters accord significance

13) Furthermore, it becomes apparent that $f(q^*,k)$ converges to 2 as k increases.

to the opinions of attentive partisan voters and engage in more active communication with higher k, it becomes more advantageous for the R-party to propagate misinformation. Consequently, the R-party has a heightened incentive to produce fake news under these conditions.

Remark 1 (Comparative Statics on q^*: Numerical Example) Suppose $x_r(q) = q$.[14] Then, through numerical analysis, we can demonstrate that the optimal q consistently decreases with any positive integer k. In other words, as independent voters become more actively engaged in communication with partisan voters, the R-party is inclined to generate fake news more frequently.

The mechanism behind Remark 1 is simple. When the R-party chooses an extreme candidate, it wants the average message heard by independents to describe the candidate as close as possible to the moderate position m. The more often each independent voter talks with partisan voters (a larger k), the more precisely the average of the messages she hears reflects the party's underlying mix of truthful and fake reports. In that case, small deviations in q translate more sharply into changes in the perceived position of the candidate. To keep the perceived position close to m despite this stronger averaging effect, the party has an incentive to rely more on fake reports and chooses a lower q^*. Hence, as communication intensity increases, equilibrium messages become more distorted.

We will use this result in the remaining part of this paper.

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14) It is worth noting that this result holds true for various functional forms of $x_r(q)$, such as q^2 or $\sqrt{q}$, as long as they satisfy the conditions imposed on x_r. Notably, this encompasses convex, concave, and linear forms of x_r.

Ⅳ. Equilibrium Analysis

In this section, we examine the existence of Bayes Nash equilibrium. We consider every possible case with each party's candidate choice and campaign strategy.

Parties first choose candidates $(t_l, t_r) \in \{e, m\}^2$ and then select their campaigns. Given the campaign rules described above, there are four possible configurations of candidate choices:

Case	Candidate Profile
1	$(t_l, t_r) = (m, e)$
2	$(t_l, t_r) = (m, m)$
3	$(t_l, t_r) = (e, m)$
4	$(t_l, t_r) = (e, e)$

For each case, we first compute the beliefs of independent voters, then the probability that each party wins, and finally the expected utility of each party. We denote these utilities by U_c^l and U_c^r for case $c \in \{1, 2, 3, 4\}$. The candidate profile is part of a Bayes-Nash equilibrium if neither party can profitably deviate to the alternative candidate, given the optimal campaign choices in that case.

Note that L-party sets $x_l = 1$ for m and $x_l = 0$ for e. Naturally, the corresponding belief of the independent voters would be $I_l(x_l = 1) = m$ and $I_l(x_l = 0) = \frac{3}{2}e$.

1. Case 1: $(m, (e, q^*))$

In this case, we have $I_r = e \times f(q^*, k)$ and $I_l = m$.

Let $I^* = \dfrac{I_l + (1 - I_r)}{2}$. Note that L-party wins if and only if $\mu \leq I^*$. Since $I^* = \dfrac{m + 1 - e \times f(q^*, k)}{2} = \dfrac{1}{2} + \dfrac{e\{2 - f(q^*, k)\}}{2}$, we obtain $P(\mu \leq I^*)$ $= \left[\dfrac{1}{2} + \dfrac{e\{2 - f(q^*, k)\}}{2} - \dfrac{1}{2} + m\right]/2m = \dfrac{1}{2} + \dfrac{1}{8} \times \{2 - f(q^*, k)\}$.

The utility of L-party in case 1:

$$U_1^l = \left[\frac{1}{2} + \frac{1}{8} \times \{2 - f(q^*, k)\}\right] \times (-e) + \left[\frac{1}{2} - \frac{1}{8} \times \{2 - f(q^*, k)\}\right] \times (2e - 1)$$

The utility of R-party in case 1:

$$U_1^r = \left[\frac{1}{2} + \frac{1}{8} \times \{2 - f(q^*, k)\}\right] \times (3e - 1)$$

Now if L-party deviates to e, then $I_l(x = 0) = \dfrac{3e}{2}$. In this situation, since $I^* = \dfrac{1}{2} + \dfrac{e\{3 - 2f(q^*, k)\}}{4}$, we obtain $P(\mu \leq I^*) = \dfrac{7}{16} + \dfrac{1}{8} \times$ $\{2 - f(q^*, k)\}$. Thus, the expected utility of L-party is:

$$U_4^l = \left[\frac{9}{16} - \frac{1}{8} \times \{2 - f(q^*, k)\}\right] \times (2e - 1)$$

Since we know L-party does not deviate to e when $U_1^l \geq U_4^l$, we have the following inequality:

$$e \leq \frac{1}{14 - 2f(q^*, k)} \tag{1}$$

Similarly if R-party deviates to m, $I_r(q = 1) = x_r(1) \times 2e +$

$\{1-x_r(1)\}\times\frac{3e}{2}=\frac{e}{2}\times(3+x_r(1))$.[15)]

In this case, $I^*=\frac{1}{2}+\frac{e}{4}\times(1-x_r(1))$. Since the probability that R-party wins $=1-P(\mu\le I^*)=\frac{1}{2}-\frac{1}{16}(1-x_r(1))$. So the expected utility of R-party is:

$$U_2^r=\left[\frac{1}{2}-\frac{1}{16}(1-x_r(1))\right]\times(-e)+\left[\frac{1}{2}+\frac{1}{16}(1-x_r(1))\right]\times(3e-1)$$

Since R-party does not deviate to m when $U_1^r\ge U_2^r$, we have the following inequality:

$$e\ge\frac{x_r(1)-2f(q^*,k)+3}{4x_r(1)-6f(q^*,k)+16} \tag{2}$$

We can conclude that $(m,(e,q^*))$ can be equilibrium when $e\in\left[\frac{(x_r(1)-2f(q^*,k)+3}{4x_r(1)-6f(q^*,k)+16},\frac{1}{14-2f(q^*,k)}\right]$.

2. Case 2. $(m,(m,q^*))$

In this case, $I_l(x_l=1)=m$ and $I_r(q=1)=\frac{e}{2}(3+x_r(1))$ as we obtained above. The expected utility of L-party, denoted as U_2^l, is as follows:

$$U_2^l=\left[\frac{1}{2}+\frac{1}{16}(1-x_r(1))\right]\times(-e)+\left[\frac{1}{2}-\frac{1}{16}(1-x_r(1))\right]\times(3e-1)$$

15) Of course, $x_r(1)=1$, under our assumption.

If L-party deviates to e, $I_l(0)=\frac{3e}{2}$ and $I^*=\frac{1}{2}-\frac{e}{4}x_r(1)$. Since P (L-party wins) = $P(\mu \le I^*)=\frac{1}{2}-\frac{1}{16}x_r(1)$, we have

$$U_3^l=\left[\frac{1}{2}+\frac{1}{16}x_r(1)\right]\times(3e-1)$$

Since L-party does not have incentive to deviate to e when $U_2^l \ge U_3^l$, we have the following inequality:

$$e \le \frac{1}{12-x_r(1)} \tag{3}$$

Now if R-party deviates to e, the expected utility of R-party would be U_1^r. Since R-party does not have incentive to deviate to e when $U_2^r \ge U_1^r$, by inequality (2), we have

$$e \le \frac{x_r(1)-2f(q^*,k)+3}{4x_r(1)-6f(q^*,k)+16}$$

Moreover, we can observe that $\frac{1}{12-x_r(1)}=\frac{1}{11}$ since $x_r(1)$ is equal to 1. Then, note that $\frac{x_r(1)-2f(q^*,k)+3}{4x_r(1)-6f(q^*,k)+16} \le \frac{1}{11}$ because (by Lemma 3). Thus, we can conclude that $(m,(m,q^*))$ can be equilibrium when:

$$e \in \left(0, \frac{x_r(1)-2f(q^*,k)+3}{4x_r(1)-6f(q^*,k)+16}\right]$$

3. Case 3. $(e,(m,q^{*}))$

In this equilibrium, $I_l(x_l=0)=\frac{3e}{2}$ and $I_r(q=1)=\frac{e}{2}(3+x_r(1))$. Since $I^{*}=\frac{1}{2}-\frac{e}{4}x_r(1)$, we obtain the following:

$$U_3^l=\left[\frac{1}{2}+\frac{1}{16}x_r(1)\right]\times(3e-1)$$

$$U_3^r=\left[\frac{1}{2}+\frac{1}{16}x_r(1)\right]\times(-e)+\left[\frac{1}{2}-\frac{1}{16}x_r(1)\right]\times(2e-1)$$

If R-party deviates to e, $I_r(q^{*})=e\times f(q^{*},k)$ and $I^{*}=\frac{1}{2}+\frac{e}{4}(3-2f(q^{*},k))$. Since $P(R\text{-party wins})=1-P(\mu\le I^{*})=\frac{9}{16}-\frac{1}{8}\times\{2-f(q^{*},k)\}$, the expected utility of R-party in this situation, U_4^r, is as follows:

$$U_4^r=\left[\frac{7}{16}+\frac{1}{8}\times\{2-f(q^{*},k)\}\right]\times(2e-1)$$

Since R-party does not deviate to e when $U_3^r\ge U_4^r$, we have the following inequality:

$$e\le\frac{x_r(1)-2f(q^{*}\cdot k)+3}{3x_r(1)-4f(q^{*},k)+14}\tag{4}$$

We know that L-party does not deviate to m when $U_3^l\ge U_2^l$, which is equivalent to $e\ge\frac{1}{12-x_r(1)}$ by inequality (3). We can easily observe that $\frac{x_r(1)-2f(q^{*},k)+3}{3x_r(1)-4f(q^{*},k)+14}<\frac{1}{12-x_r(1)}=\frac{1}{11}$ because $f(q^{*},k)>\frac{3}{2}$ (by Lemma 3). Therefore, we can conclude that $(e,(m,q^{*}))$

can not be an equilibrium.

4. Case 4. $(e,(e,q^*))$

We know that R-party does not deviate to m when $U_4^r \geq U_3^r$, which is equivalent to:

$$e \geq \frac{x_r(1) - 2f(q^*,k) + 3}{3x_r(1) - 4f(q^*,k) + 14}$$

By inequality (4). Also, L-party does not deviate to m when $U_4^l \geq U_1^l$, which is equivalent to:

$$e \geq \frac{1}{14 - 2f(q^*,k)}$$

By inequality (1). Note that $\frac{1}{14-2f(q^*,k)} \geq \frac{x_r(1)-2f(q^*,k)+3}{3x_r(1)-4f(q^*,k)+14}$ because $f(q^*,k) \geq \frac{3}{2}$(by Lemma 3). Hence, $(e,(e,q))$ can be an equilibrium when:

$$e \geq \frac{1}{14 - 2f(q^*,k)}$$

We can conclude that $(e,(e,q))$ can be equilibrium when:

$$e \in \left[\frac{1}{14 - 2f(q^*,k)}, \frac{1}{8} - \frac{\tau}{4} \right)$$ 16)

5. Equilibrium Existence

The following proposition summarize the analysis above and discuss the existence of an equilibrium in terms of the parameter value $e = \frac{m}{2}$.

16) The upper bound is from our technical assumption on the value of m and τ.

Proposition (Existence of Equilibrium):

1. There is no equilibrium wherein only the L-party selects an extreme candidate.
2. There exists a lower threshold $\underline{e}$ such that for any $e \leq \underline{e}$, an equilibrium emerges where both parties opt for moderate candidates, and the R-party consistently conveys truthful information, resulting in $q^* = 1$.
3. There exists an upper threshold $\bar{e}$ such that for any $e \geq \bar{e}$, the R-party selects an extreme candidate and sporadically disseminates fake news $(q^* < 1)$ in all equilibrium configurations.

One may argue that, when e is sufficiently low, indicating substantial polarization between parties, the payoff difference between winning an election with an extreme candidate and winning with a moderate candidate diminishes. Consequently, a party may prioritize maximizing the probability of winning and opt for a moderate candidate. Conversely, if e is sufficiently high, suggesting limited polarization between parties, both parties might seek victory through extreme candidates. However, as the R-party intensifies the production of fake news alongside an extreme candidate, the likelihood of the L-party winning the election with a corresponding extreme candidate diminishes. This prompts the L-party to ultimately choose a moderate candidate to secure victory in the election.[17)]

Our primary interest lies in the comparative statics outcomes regarding q and the existence of equilibrium concerning k. Therefore, we present the following remark.[18)]

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17) It is essential to note that the analysis concerning k necessitates the assumption that q^* decreases as k increases.

18) Given its foundation in numerical analysis, this remark is conveyed in a relatively informal manner.

Remark 2 (Communication intensity and equilibrium: Numerical Analysis): Suppose $x_r(q)=q$. For a given value of e:

1. For a low value of k, an equilibrium emerges where both parties choose the moderate candidate m, and the R-party consistently communicates truthfully, yielding $q^*=1$: $(m,(m,q^*))$ can be an equilibrium when $f(q^*,k)\in\left[\frac{3}{2},\frac{2-10e}{1-3e}\right]$.
2. However, if k is sufficiently high, in any equilibrium configuration the R-party opts for the extreme candidate and disseminates fake news with $q^*<1$ to secure victory in the election: $(m,(e,q^*))$ can be an equilibrium when $f(q^*,k)\geq \max\left\{\frac{2-10e}{1-3e},\frac{14e-1}{2e},\frac{3}{2}\right\}$, and $(e,(e,q^*))$ can be an equilibrium when $f(q^*,k)\in\left[\frac{3}{2},\frac{14e-1}{2e}\right]$.

Note that, when the value of e is fixed, $(m,(m,q^*))$ can be the only equilibrium for a relatively low value of k. As k increases (so $f(q^*,k)$ increases), the possible equilibria become either $(m,(e,q^*))$ or $(e,(e,q^*))$. These findings imply that, if independent voters are more actively engaged in communication with partisan voters, extreme candidates are more frequently chosen in elections, and fake news is more prevalent in political campaigns. In other words, extensive (and relatively naive) communication may lead to polarization in electoral campaigns and the dissemination of fake news in a society.

The equilibrium consequences of communication intensity arise from how a decline in the optimal accuracy $q^*(k)$ alters electoral incentives. When independent voters communicate only sparsely with partisan voters (a low value of k), the average message they hear is noisy and only weakly reflects the party's intended mixture of truthful and fabricated reports. In such an environment, misinformation has limited influence: even if the R-party attempts to distort its candidate's position, independent voters do not systematically perceive an extreme candidate as moderate. Consequently, the electoral advantage of nominating an extreme candidate is small relative to the risk of losing the election, and both parties have incentives to choose moderate candidates. This supports equilibria of the form (m, m).

As communication intensity increases, however, each independent voter samples more partisan voters. Combined with previous remarks, this means that the R-party optimally relies more heavily on misinformation (a lower q^*), and this misinformation is transmitted more effectively through the communication network. Independent voters therefore become increasingly likely to perceive an extreme R-candidate as moderate. This increases the electoral viability of extreme candidates, making them more attractive to the R-party.

Once the R-party finds it optimal to choose the extreme candidate, the L-party's best response shifts. For intermediate parameter values, L may still select the moderate candidate, yielding an asymmetric equilibrium (m, e). For sufficiently high communication intensity, however, the L-party must also choose its extreme candidate to avoid consistently losing to the strategically disguised extremist nominated by R. As a result, for large values of k, moderate-moderate equilibria disappear and only equilibria involving extreme candidates, either (m,e) or (e,e), remain.

Ⅴ. Conclusion

With the burgeoning growth of the Internet, social media has experienced a tremendous expansion, leading to an undeniable increase in communication between individuals. Consequently, social learning has emerged as a substantial source of information acquisition. Against this backdrop, there is a critical need to analyze the impact of fake news, particularly in the context of political deception, on elections when disseminated through social media.

This paper studies the impact of fake news in electoral campaigns within the context of networked communication. Our model substantiates the finding that heightened communication correlates with an increased production of fake news. Additionally, our study reveals that fake news contributes to political polarization. Specifically, when independent voters engage more actively in communication with partisan voters, there is a higher likelihood of extreme candidates being chosen in elections, accompanied by an increased prevalence of fake news in political campaigns. In essence, extensive (and relatively naive) communication among electorates can lead to polarization in electoral campaigns and the widespread dissemination of fake news in society.

Our results have direct implications for policy. Because the model shows that polarization increases when independent voters mechanically accept messages without evaluating their credibility, policies that enhance the sophistication of information acquisition are crucial. Media literacy programs that train citizens to evaluate sources, identify misinformation, and understand partisan messaging would reduce the effectiveness of fake news in our model. Likewise, platform-level regulation—such as algorithmic transparency, limits on automated amplification, and labeling systems for political content—can weaken the strategic incentive for parties to rely on misinformation. These policies reduce the informational advantage that fake news exploits, thereby moderating electoral outcomes and diminishing polarization.

These outcomes stem from the inherent lack of sophistication among independent voters in acquiring political information. If independent voters were more sophisticated in their information-seeking behavior—directly and critically engaging with political information—it is anticipated that the influence of fake news would diminish. One might argue that it is natural for independent voters to adopt a critical stance when acquiring information through communication with partisan voters. Such considerations impact the updating of independent voters' beliefs regarding the expected ideology of the candidate. Moreover, one might contemplate scenarios where both parties can produce some fake news. Exploring such situations could be avenues for future research.

Received: November 26, 2025. Revised: December 6, 2025. Accepted: December 6, 2025.

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논문초록

본 논문은 네트워크 기반 소통 환경에서 가짜 뉴스가 선거 캠페인에 미치는 영향을 이론적으로 분석한다. 기본 모형은 두 정당의 전략적 후보 선정과 캠페인 계획을 포함하며, 유권자를 당파적 유권자와 독립적 유권자로 구분한다. 당파적 유권자는 정당 캠페인에서 직접 정보를 받지만, 독립적 유권자는 당파적 유권자와의 상호작용을 통해 정보를 획득하며, 이에 따라 미묘한 학습 과정이 형성된다. 우리의 분석 결과, 소통의 강도가 높아질수록 가짜 뉴스 생산이 증가하는 양의 상관관계가 관찰되며, 이는 잘못된 정보가 정치적 양극화를 악화시키는 역할을 강조한다. 구체적으로 독립적 유권자와 당파적 유권자 간의 통신이 강화될수록 선거에서 극단적 후보 선출 가능성이 높아지고, 정치 캠페인에서 오정보의 확산이 더욱 두드러진다.

주제분류 : B030200, B030112, B030503
핵심 주제 : 가짜뉴스, 정치 양극화, 선거 캠페인, 네트워크

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* 이 논문은 2021년 대한민국 교육부와 한국연구재단의 지원을 받아 수행된 연구임 (NRF-2021S1A5A8068768).
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