Polarization, News Sharing, and Gatekeeping:
A study of the #Bolsonaro Election

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Abstract

The increasing importance of news sharing as a digital business model raises new questions about content creation in polarized environments. In this article, we propose a model where news organizations, concerned with maximizing market shares, select editorial lines that cater to politically polarized consumers. Our model shows that positive reputation assessments by readers will be associated with media moderation while low reputation outlets will benefit from publicizing more extreme positions. The model provides a road map to researchers interested in the relationship between two major theories in political communication, news sharing and editorial gatekeeping. We test the proposed theory with Twitter data collected during the election of populist leader Jair Bolsonaro in Brazil.

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Introduction

In today's social media environment, the activation and propagation of content requires users to share posts published by their peers. A substantive fraction of these social media posts include hyperlinks to content created by news organizations and, as users activate these posts, they make its content available to a wider readership. News organizations, therefore, are now more attentive to the preferences of users, with journalists and editors being rewarded for solid digital metrics that report on a job well done (Vu, 2014; Shoemaker and Reese, 2013).

The increasing importance of news sharing as a digital business model raises new questions about content creation in polarized social media environments.[1] If media organizations seek to maximize readership and if readership increases with news sharing, the preferences of users should affect the editorial line of these organizations. There is, therefore, a clear causal chain that connects current theories of *news sharing* (Kümpel et al., 2015; Bright, 2016) with theories of *gatekeeping*[2] (Shoemaker et al., 2017; Shoemaker and Vos, 2009).

The integration of *news sharing* and *gatekeeping* models is a required step to answer two important questions: Will news organizations create content that caters to extreme users in distinct social media communities? And, consequently, will a polarized readership polarize news organizations further? In this article, we provide a qualified affirmative response to both questions. We propose a theory that explains why news sharing should increase polarization. However, we also explain why polarization incentives will be very significant among low reputation news outlets and more modest among high reputation ones.

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[1]For a review of the effect of social media in polarization see Tucker et al. (2018).

[2]As described by Shoemaker et al. (2001), "gatekeeping is the process by which the vast array of potential news messages are winnowed, shaped, and prodded into those few that are actually transmitted by the news media."(page 233). With the advent of news sharing as a research problem, the question of how users influence gatekeeping has become particularly relevant.

Our theory describes the expected effect of user polarization on media polarization. We consider a model where users activate news content, consumption is reported to editors through dashboards and social media metrics, and where editors and journalists adapt their *gatekeeping* strategies to maximize readers. We then ask what is the effect of user polarization on the optimal editorial line of news organizations. Will populist appeals to ideologues polarize media organizations? If so, which media organizations will be most sensitive to demands by polarized readers?

Research on polarization and the media very seldom inquires on the effect of readers on the ideological makeup of news organizations. In the political science literature, there is vastly more research on the effect of media on readers than on the market share maximization of news organizations. In political communication, the editorial line of the media (*gatekeeping*) is generally described as the result of journalistic practices, organizational pressures, and ownership preferences (Shoemaker and Reese, 2013).

There is, however, a long lineage of spatial models of voting that expects voter preferences to influence the positions advertised by candidates (Adams and Merrill III, 2009; Calvo and Murillo, 2019; Schofield, 2006; Ezrow et al., 2014; Stone and Simas, 2010). We borrow a page from this literature and model the effect of user polarization on media organizations.

Results from our analysis show that, even if all editors are equally determined to maximize readership, not all news organizations will polarize equally. Higher reputation outlets will be sensitive towards intense ideologues, but they will still maintain centrist positions. Smaller and less reputable outlets, on the other hand, will take on more extreme positions and will publish content that closely aligns with the users in well defined communities. Moderation by high reputation organizations and extremism by those with low reputation, we show, are optimal

strategies when users are deeply polarized.

To assess the effect of user polarization on media polarization we present a model that takes as input observational social media data and extracts three parameters that describe the news sharing behavior of users ([*Omitted Reference*]). We show that observational data can be used to map the (i) users' preferences for news that are ideologically closer; the (ii) users' attention to an issue; and the (iii) reputation of media organizations.

We then use these parameters to compute the optimal editorial line of media organizations. We provide theoretical results using synthetic data and test for the implications of our model using news embeds in Twitter. We analyze 2,943,993 tweets published by 162,107 high activity accounts during the election of Jair Bolsonaro in Brazil, collected from September 26 through October 02 of 2018.

Brazil, one of the largest economies in World, has high rates of Twitter penetration, ranking 7th in total number of accounts.[3]. Further, Brazil displays high levels of political polarization, not unlike those observed in the United States and the United Kingdom. The victory of Jair Bolsonaro in the 2018 presidential election closed a long period of electoral dominance by the leftist workers party (PT) (Hunter and Power, 2019; Levitsky and Roberts, 2013). As in other countries that in recent years elected far-right populist leaders, Bolsonaro built a fateful following in social media. The election of Bolsonaro provides a perfect case to study news sharing in polarized media environments. While Brazil has generally been described as a country with weak ideological attachments and low levels of party identification, recent scholarship has challenged some of these preconceptions, showing that partisan and anti-partisan sentiments do matter and that informed dialogue facilitates the ideological placement of candidates (Samuels and Zucco, 2018; Baker and Renno, 2019; Power and Rodrigues-Silveira, 2018; Baker et al., 2016). Indeed,

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[3]https://www.statista.com/statistics/242606/number-of-active-twitter-users-in-selected-countries/

although left and right have been considered weak predictors of party vote in Brazil, polarization between progressive and conservative voters have dominate national level politics for much of the last two decades. The model proposed in this article explores the implication of such polarization on the editorial choices of news organizations.

Sharing news in polarized environments

In the last fifteen years, a significant literature has sought to explain news sharing in social media. News sharing has upended previous notions of gatekeeping, raising questions about the editors incentives to excercise editorial discretion (Shoemaker et al., 2017). It has also challenged existing models of journalistic practice, with revealed consumption by users altering perceived journalistic reputation and the financial bottom line of media organizations. From Jarvis (2006) "networked journalism" to Reese and Shoemaker (2016) "networked public sphere," new theoretical efforts have sought to clarify the relationship between users preferences and journalistic practices. The effect of news sharing on gatekeeping has become all that more relevant with the advent of social media, with motivated reasoning and cognitive congruence featuring prominently in the decision to activate content among interconected peers.

Gatekeeping for the Choir

As political polarization increases, gatekeeping decisions by editors need to consider the benefits of catering to the ideological extreme as well as the expected reputation costs of their ideological positions. There is little doubt that news social media technologies have exacerbated the difficulties of balancing the preferences of users and the editorial decisions of news organizations. In a recent article, Shoemaker et al. (2017), posited the following question about the

future of gatekeeping theory: "How can scholars study political questions that involve multiple levels of analysis, the changing technology of creating and sending messages, characteristics of senders and receivers and forces of varying strengths and polarities, all of which interact within the parts of a dynamic political field?". Indeed, a critical aspect of theory development is to clearly delimit how information circulates within and across levels of analysis. The effect of news consumption and news sharing on journalistic practices, for example, should be affected by the intensity of the ideological preferences by users. For example, readers will be unlikely to demand position taking by journalists on *real state* news. Therefore, the effect of user demands on journalistic practices will be sensitive to weaker or stronger cognitive dissonance by issue. The circulation of information and the gatekeeping behavior that connects users and journalist practices, therefore, is a "level of analysis" problem that depends on the issues that receive coverage.

Let us provide a stylized description of the gatekeeping problem using Brazil as an example. During the last election cycle, two very active communities in Brazil, one favorable to Jair Bolsonaro and another one in opposition, were interested in disseminating very different news about the candidate. Users in both communities focused heavily on the pro-military stance of Bolsonaro, who made no secret of his support for the Junta that ruled Brazil between 1964 and 1985. However, while users in the anti-Bolsonaro community emphasized Bolsonaro's public support for torture, those who favor the president-elect emphasized his pro-order and anti-leftist positions.

News sharing on Twitter was significantly higher within each community. That is, the number of social media posts with hyperlinks on the election was significantly higher among users in the pro- and anti-Bolsonaro communities. Other users, by contrast, shared but a fraction of

tweets with links to news articles. Consequently, targeting articles to *intense* readers increased circulation above and beyond the articles circulated by moderates.

Consider the problem as seen from the editor of a major news organization (i.e., Folha de Sao Paulo), who publishes a variety of news articles on Bolsonaro. Being branded as pro- or anti-Bolsonaro will limit news sharing in one of the two communities. Not catering to the preference of either community, however, will result in a significantly lower exposure for the newspaper. What should then be the optimal editorial line of the newspaper? Should editors emphasize the public stance of Bolsonaro on torture? Should journalists investigate the law-and-order stance of the president-elect?

If the news sharing behavior of users is vital for the newspaper, editors need to account for the higher propensity of partisans to share news that they like, even if this is done on purely ideological grounds. Editors also need to consider the costs of not being shared by moderates or by users of a different political color as well as the reputation costs of being perceived as biased by potential readers, professional peers, and/or vendors. Therefore, what is the optimal editorial line of a news organization during the 2018 Presidential Election?

To answer this question we need a news sharing model for users and an optimal response model for the editors. As proposed by Shoemaker et al. (2017), we need a model that connects the different levels of analyses and clarifies how they interact with each other.

In the next section, we present one alternative solution to the news sharing/gatekeeping problem. We present a formal description of news sharing by users and an optimal gatekeeping response by editors. Finally, we evaluate the effect of polarization on position taking by media organizations.

News Sharing: a model

Our model considers two types of actors, social media users $i \in I$ and organizations $j \in J$. We expect that the users' propensity to share news will decrease monotonically as the cognitive dissonance between preference on issue k, x_i^k, and the editorial line published by an organization, L_j^k. Publications that are further removed from the user will be less likely to be shared, both because users doubt of its validity and because they are reluctant to communicate a dissenting opinion to peers. Therefore, we expect user to share news because they "like" the content of the publication, where "like" describes content that is cognitively congruent with their views.

While users favor content that agrees with their beliefs, they also perceive a higher utility from news published by a reputable outlet. That is, users attach value to the content because it is "credible", where "credible" describes content published by news organizations that a larger set of readers consider of higher quality (i.e. more investment, more infrastructure, longer time since the creation of the organization, etc). While cognitive congruence indicates agreement between the user and the news, reputation increases the external validity of the news that is shared with peers.

Finally, users share publications because they pay "attention" to the issue being reported, where "attention" describes the perceived salience of the issue. Users do not consider all publications to be equally important, both to them and to their contacts. Such attention varies from issue to issue as well as from user to user.

We define polarization as a distribution of voters that is bi-modal (e.g. there is a higher numbers of users on the left and right of the political spectrum). Left- and right-leaning communities may vary in size as well as in regards to the weight or importance that their users attach to ideology, reputation, and attention when sharing news. In other words, they vary in

the extent to which they "like" content; the extent to which they find different news organizations "credible"; and the extent to which they pay "attention" to issues being reported.

Exogenous constraints on the users' preferences

For consistency, we consider the preferences of users as given. While preferences may change over time and issue salience may be altered by the coverage it receives from the media, we assume that editorial choices are instantaneous while preferences changes are always in the future. Our objective is to assess the best decision of news organizations if they are only interested in maximizing readers at the current time, t_0. Therefore, in a pure demand model, editors consider the preferences of readers as exogenous.

A different way of describing this assumption is that preferences are short-term fixed for news being published today, even if preferences change over time (Calvo and Murillo, 2019). Therefore, consumption today depends on preferences that are revealed to the editor in real-time, rather than created by the news that editors publish.

Retrieving preferences from observational data

The previous model description gives an equation where user i's utility from sharing news on issue k by organization j is:

$$U_{(ij)}^k = -\alpha_{q(i)}^k \left(x_i^k - L_j^k \right)^2 + A_{q(i)}^k + R_{q(i),j}^k + \gamma_{ij}^k \tag{1}$$

In Equation (1), the quadratic term $\alpha_{iq} \left(x_i - L_{jq} \right)^2$, describes the disutility of a post that is further removed from the reader's preferred ideological position, x_i. For every unit of increase in cognitive dissonance, the utility of reader i declines by $-\alpha_q$. The parameter $-\alpha$ also has a

natural interpretation as the weight that a reader attaches to the ideological leaning of a media organization. For example, for a Brazilian reader, ideology will likely weigh less when browsing soccer news than when browsing Bolsonaro news.

Equation (1) also indexes the parameter $-\alpha$ by q, allowing cognitive congruence to have a heterogeneous impact in different regions of the social media network. In our empirical application, we create $q - bins$ by splitting the network into one hundred equally sized squares, capturing two-dimension deciles of the network layout. That is, we allow cognitive dissonance to vary according to where in the network the user is. Therefore, the proposed model is local in two different ways: it is local because estimates of ideological congruence will vary within a particular topic (*statistically local*) and it is local because it varies across different regions of the social media network.

Equation (1) also shows that news published by a more reputable actor, $R^k_{q(i),j}$, increase the utility of reader i. Reputation also varies by the location of users in different regions of a network [4]. Finally, users may also give different attention to an issue, $A_{q(i),j}$, sharing a higher than the average number of post with social media peers. Equation (1) also includes a stochastic term that captures overdispersion, γ^k_{ij}, by user and media outlet.

The choice function for equation (1) describing the likelihood of clicking in a particular news produced by media j out all organizations is described in Equation (2):

$$S^k_{ij} = \tau_i \frac{e^{U^k_{ij}}}{\sum_{j=1}^J e^{U^k_{ij}}} \ \forall \ i, j, k \tag{2}$$

In equation 2, the total number of shared news is a function of the probability that a user will select a post by agent j in the decile q, subject to the user's time constraints, τ_i, which

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[4]The empirical model presented in the following sections assumes Reputation vary only by media simplifying the estimation for each user.

describes the total number of times a user will share news. That is, some readers may share a large set of news while others may do so sporadically.

In [ommitted authors] we show that these parameters can be retrieved from a matrix of observational data with rows by user and columns by media organizations. The statistical model is described in the supplemental information file.

The editor's decision: Comparative Statics of the Gatekeeping Model

Equations (1) and (2) describe the users' decision to share news in social media, conditional on cognitive congruence, media reputation, and issue attention. We now focus on the editor's optimal editorial decision, which is a maximization problem that considers the revealed preferences of users as well as the editorial decision by other news media organizations. We solve for the optimal editorial line (ideological position) of each media k, such that L_j^{k*} provides the largest share of readers.

Adams et al. (2005) provide an algorithm to solve this problem. Extensive discussion about the algorithm can be found in [omitted from this version]. Let us know provide a streamlined description, with numerical optimization taking as input the parameter estimates of equations (1) and (2), used iteratively to find the optimal ideological leaning of an editorialized news, L_j^{k*}.

Once equation (1) and (2) are estimated, we follow Adams et al. (2005) and iteratively compute the equilibrium parameter $\mathbb{L}_j$, substituting the ideology, reputation, and attention parameters by those in equation 1.

$$U_{(ij)} = -\widetilde{\alpha_{q(i)}} \left(x_i - \mathbb{L}_j\right)^2 + \widetilde{A_{q(i)}} + \widetilde{R_{q(i),j}}^k \tag{3}$$

The algorithm maximizes the expected market share of each news organization, $E(LS)_j$

conditional on the vector of equilibrium news locations L and the weight parameter $\widetilde{\alpha_{q(i)}}$, $\sum_j \pi_{ij}(\mathbb{L}, \widetilde{\alpha_{q(i)}})$. Adams et al. (2005) differentiate (4), solving for the last occurrence of $\mathbb{L}$:

$$\mathbb{L}_j(0) = \frac{\sum_j \pi_{ij}(\mathbb{L}, 0)[1 - \pi_{ij}(\mathbb{L}, 0)]x_i}{\sum_j \pi_{ij}(\mathbb{L}, 0)[1 - \pi_{ij}(\mathbb{L}, 0)]} \tag{4}$$

The model then iterates over each news organization until convergence is achieved. Following Calvo and Hellwig (2011), we estimate the comparative statistics of the model thorough simulation, mapping the effect of three parameters of interest over approximately two million solutions to the different combinations. [5]

To assess the effect of polarization on the optimal decision by editors, we consider a bimodal distribution of ideological preferences, where users sort themselves into two different communities with mean left (-0.5) and right (0.5). The set of two million simulations provides a full description of the comparative statics of the model, showing the effect of user preferences on the optimal editorial location that maximizes readership for each news organization.

Gatekeeping: The equilibrium solutions to the model

After running equilibrium models for all parameter permutations, we post-process the data to assess the effect of users' preferences on the optimal ideological content published by media organizations. We then compare how organizations react under two different distributions of the users' preferences. We consider both a normal distribution (non-polarized media market) and a bimodal distribution (polarized media market). Most applications of Adams et al. (2005) consider a voting population with preferences normally distributed.[6] As we will show, in po-

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[5] See the appendix for a full explanation of the values employed in the simulations, and for a more exhaustive discussion of the comparative statistics of the model.

[6] We combine two normal distributions, mean-centered on the left, 2.5, and the right, 7.5, of the political spectrum.

larized political environments there is a stronger centrifugal effect that pushes high reputation organizations to the region that falls between the overall median voter and the high-density regions on the left and right.

The effect of cognitive congruence on media polarization

Let us begin by holding the importance that readers attach to ideology and reputation to their median levels, $\alpha = -0.06$ and $\beta = 0.6$. We also allow the $cov(\alpha, \beta) > 0$ to be strictly positive, with readers on the left having higher assessments of reputation for Media A and B, while readers on the right have higher assessments of reputation for Media D and E. We also set reputation values for all organizations to be identical, $R_1 = R_2 = ... = R_5$.

Figure 1 provides visual representation of the effect of user polarization on social media polarization. Each plots describes the ideological position of media organizations on the horizontal axis and the corresponding share of users (market share) in the vertical axis. In equilibrium, all news organizations produce moderate content in non-polarized environment (right plot) while news organizations spread in the ideological space in polarized environments. The direction of ideological change for each media is driven by the relationship between perceived reputation and ideological preferences for distinct groups of voters $cov(\alpha, \beta) > 0$. However, the same underlying $cov(\alpha, \beta) > 0$ has little effect in non-polarized environments.

Given that readers with different ideological leanings have heterogeneous assessments of each media's reputation, changes in the distribution of the readers' preferences yield changes in the optimal editorial line of media organizations. The left plot shows how polarization among readers pulls media organizations away from the center of the distribution. When the social media environment is not polarized, by contrast, the centrifugal effects on the optimal editorial strategic positioning is weaker.
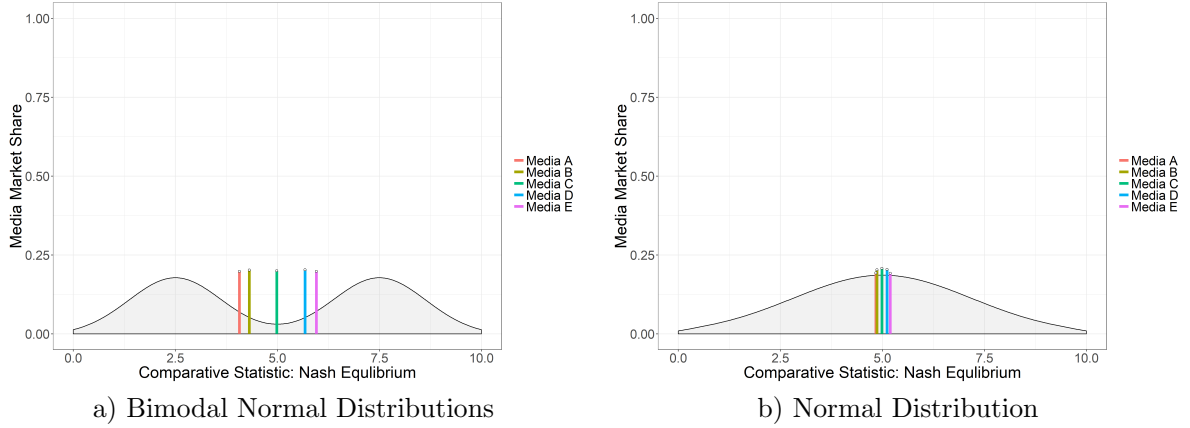
12

Figure 1 Comparative Statistics: Impacts of readers' ideological polarization

Consider now the situation in which readers increase the weight or importance of ideological concerns when sharing news content. Figure 2 presents the optimal gatekeeping strategy for media organizations, holding all parameters to their median values except for the weight of ideology ($alpha$), which is increased from -.06 to -.12. The optimal gatekeeping strategy is for media organizations to cater more clearly to ideologues in each community, moving away from the global median voter, to the inner hillside of each mode and closer to the leftist or rightist median voter. That is, away from the moderate voters and towards the local median user in the left and right of the political spectrum. Notice that more ideological readers does not mean more extreme readers but, instead, that they care more about cognitive dissonance when activating content. In fact, the underlying distribution of readers has not changed in this example, but only the intensity of readers ideological considerations on issue k.

Larger negative values of $alpha$ indicate a sharp decline in the activation of content as the post moves away from a reader. Consequently, in more ideological environments (right plot), media organizations move to the median voter on the left and right of the political spectrum as ideology (cognitive congruence) weighs more heavily on the decision of readers to activate content. In conclusion, as ideological attachments increase the overall median user thins out.
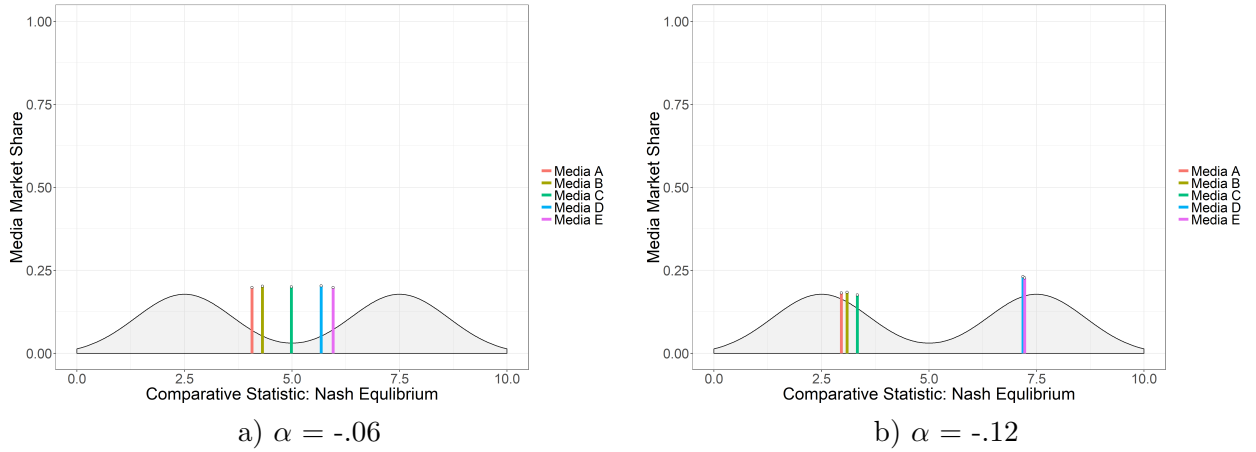
13

a) α = -.06   b) α = -.12

Figure 2 Comparative Statistics: Effect of the weight of ideology, α, on the media's equilibrium positions

Increased salience on issues that weigh heavily on ideological considerations, therefore, will more forcefully pull media away from centrist positions. When cognitive dissonance matters, media organizations should cater to their ideologies. That is, to the ideologues that already give them high reputation marks for the news they deliver.

Therefore our first hypothesis:

H1: An increase in the weight that users attach to ideological considerations will result in media organizations advertising more extreme ideological positions.

The effect of reputation on media polarization

In the previous example, the mean reputation score across media organizations was identical. That is, each of the media organizations was perceived as equally "capable" by users. Therefore, only the weight that readers attached to ideological congruence or dissonance mattered. However, both on the left and right of the political spectrum, there are news organizations that are perceived as having a higher or lower reputation than their competitors. Indeed, a key feature of our model is that the users assessment of media reputation varies among news outlets and has

a positive effect on news sharing. Our second hypothesis evaluates the effect of such reputation on the optimal editorial decision of news organizations.

What is the effect of having news organizations that have different "reputation" values? The comparative statics show that organizations with a higher overall reputation (e.g., the average reputation of Media A for all readers is higher than the reputation of Media B for all readers) will take more moderate ideological positions. Meanwhile, news organizations with comparatively lower reputation will be crowded out to more extreme locations.

Figure 3 presents the equilibrium location of media organizations under *parity* and *asymmetric* reputation. In the asymmetric reputation context, Media A and Media E are recognized as having higher overall quality (Reputation) than Media outlets B, C, and D. Notice that Media A and Media E also had a more ideologically extreme readers, which resulted in those media organizations been to the further left and right when all organizations have equal reputation. The comparative statics of the model provide clear evidence of a centripetal shift by high-quality outlets. In the reputation symmetry case, the left plot on figure 3, all the outlets have equal reputation and they are distributed from left to right as a linear function of $cov(\alpha, \beta) > 0$.

On the other hand, higher reputation yields a wider readership for the high reputation outlets which shift towards the median user and maximize sharing by both communities. That is, high reputation organizations can take advantage of their reputation surplus, moving further away from their natural readership (readers with higher assessments of the reputation for that media) towards the overall median reader. The result is that reputation advantages lead to moderation (Calvo and Murillo, 2019). The smaller outlets, on the other hand, are forced into smaller niche locations, most of which are on the ideological extremes. In other words, Media outlets with low reputation have a stronger ideological decay, therefore, remaining closer to their median

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ideological user. The effect of reputation holds in normally distributed media environments, even if there is a stronger drive by all media organizations, gravitates towards the overall median reader.
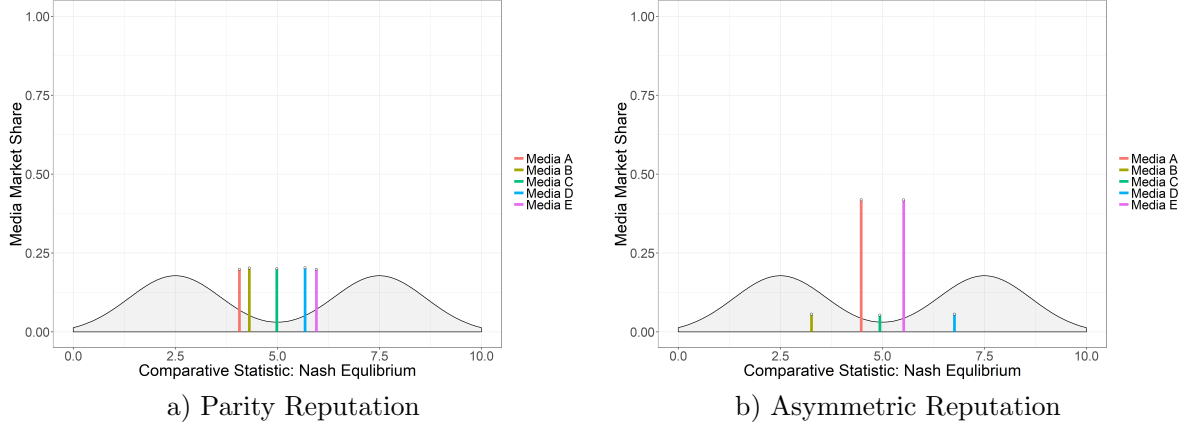

| a) Parity Reputation | b) Asymmetric Reputation |

Figure 3 Comparative Statistics: Impacts of Asymmetric Reputation

Therefore our second set of hypotheses:

H2a: When Reputation is Asymmetric, organizations with a reputation advantage take on more central or moderate ideological positions.

H2b: When Reputation is Asymmetric, organizations with a reputation disadvantage take on more extreme or fringe ideological positions.

In the next section, we empirically assess the model using observational data from Twitter from the #Bolsonaro election in Brazil. We examine the rate at which users embed links to different media organizations and estimate the ideological weight and reputation parameters that explain the centripetal or centrifugal placement of media organizations. We present some descriptive information of the network and different patterns of activation across the polarized communities in #Bolsonaro. Finally, we show how more reputable media occupy the center of the network and are less dependent on ideological proximity to activate their readers.

Embedded links in the Bolsonaro election

Jair Bolsonaro, a captain in the Brazilian Army, won his first election as a local councilor for the city of Rio de Janeiro in 1987, just two years after Brazil emerged of two decades of brutal dictatorial rule. An interview in the prestigious Brazilian Magazine *Veja* launched the political career of Jair Bolsonaro, when he demanded higher wages for members of the military while Brazil was democratizing. Four years later, in 1990, the former captain won a seat in the Brazilian House, a post to which he would be reelected five times. In 2018, in a context of profound economic crises and intense ideological polarization, Bolsonaro won the presidential race.

While Jair Bolsonaro build a niche legislative career by focusing on support for the military, his presidential bid advanced a more complex conservative coalition. The campaign presented Bolsonaro as a legitimate far-right candidate, with bombastic quips demeaning women, gays, and people of color. He publicly threatened his opponents, expressed support for the use of torture, praise the Brazilian military for their past human right violations, and proposed controversial policies to fight crime predicated on the use of lethal force by the police. He openly embraced trumpism as a philosophy, denying the existence of global warming and celebrating a nationalist and isolationist agenda to "make Brazil great again".

Much of the social media effort of Bolsonaro relied in relatively new news outlets that lack the funding, staff, and reputation that characterizes Brazil's traditional media (Teixeira et al., 2019). Despite polling high in early surveys, mainstream news organizations expected him to lose both the general election and the run-off. In consequence, Bolsonaro remained an underdog for most of the campaign cycle, supported by a small coalition of fringe parties, limited campaign donations, and no support from the traditional media. Indeed, after his three first choices for

vice-president declined, Bolsonaro settle for Hamilton Mourão as his running mate, a vocal anti-worker's party General that retired in 2018.

How did a fringe far-right underdog win the Presidency of one of the world's leading economies will remain a salient research question for years. In this article, we focus on a narrow question: how did users share campaign news in social media and what was the optimal response of these organizations given the sharing preferences of voters. These news organizations competed for the attention of users with Bolsonaro's direct and personal relationship with the far-right, which was amplified by an emerging cast of new outlets.[7]

The Data

From September 26 through October 02 of 2018, we gathered 5,325,240 posts that included the characters *"Bolsonaro"* using Twitter's search API. We then created a network that included all retweets from the original data, with dyads of all *authorities* and *hubs*. We then thinned down the network, eliminating singletons by removing users that retweeted fewer than three times. Finally, we retain the largest connected cluster of the network, holding 196,066 high activity users who posted 2,943,993 tweets.

For descriptive purposes, we draw users' [x,y] coordinates implementing the Fruchterman-Reingold algorithm in igraph-R (Csardi et al., 2006). We then ran the walk.trap algorithm in *igraph* to identify the users' communities. The walk.trap algorithm identified two large communities aligned with the opposition (91,116 users) and the Bolsonaro campaign (62,289 users). The remaining 8,702 accounts were placed in smaller communities weakly connected to the core

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[7]Similar to Donald Trump Jr., Jair Bolsonaro maintained during the campaign a very active presence on Twitter and Facebook. He also held public live online video calls and promoted personal videos through youtube. His social media activity increased dramatically after a life-threatening attack early in the campaign, which restricted his public appearances. The Brazilian 2018 election was also flooded by false rumors, manipulated photos, decontextualized videos, and audio hoaxes in a variety of social media environments (Tardaguila et al., 2018). Much of the social media presence was carried out through recently created news outlets, part of a widespread astroturfing campaign that included hundreds of thousands of face WhatsApp accounts.

of the network.

Figure 4 lists the top authorities of the two largest communities. In the anti-bolsonaro camp, eight of the top ten users had *verified* accounts that included well-known politicians, such as two of the Presidential candidates from center-left parties, Ciro Gomes (@cirogomes) and Guilherme Boulos(@GuilhermeBoulos), and the senator Lindbergh Farias from the Workers Party (@lindberghfarias). The list of authorities also includes some left-wing news organization as Midia Ninja (@MidiaNINJA), a network of media activism in Brazil, and *Diario do Centro do Mundo* (@DCMonline), a well-known blog aligned with the Workers Party (PT). There are also unexpected authorities in the anti-Bolsonaro community, such as the Magazine *Veja* (@VEJA) and the newspaper *Folha de Sao Paulo* (@folha). Both major outlets were rarely shared by users aligned with the Workers Party and they had adamantly opposed PT candidates in social media during the impeachment proceedings aganst former president Dilma Rousseff (Calvo et al., 2016). The presence of *Veja* and *Folha* underscores how unique was the election of Bolsonaro.

By contrast, only three of the top ten users in the Pro-Bolsonaro community had *verified* accounts. By contrast, *fakes*, *trolls*, and anonymous websites figured prominently in the pro-Bolsonaro community, such as @JoelAlexandreM, @conexaopolitica, @RenovaMidia. Among the verified profiles leading the pro-Bolsonaro community are those of the elected senator @FlavioBolsonaro and the Federal Deputy @BolsonaroSP, sons of the Jair Bolsonaro, the journalist @BlogdoPim who is one of the founders of @Oantogonista, and @filgmartin, the leading authority who currently serves as the special foreign affairs' assistant to the administration.

The comparison between the two communities is striking. While well known and highly visible politicians and journalists lead the anti-bolsonaro effort, the pro-Bolsonaro campaign was driven by anonymous political operatives and relatively new media organizations.[8]

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[8]Indeed, a front-page report from Folha de Sao Paulo on **18 October,2018** described financial support for
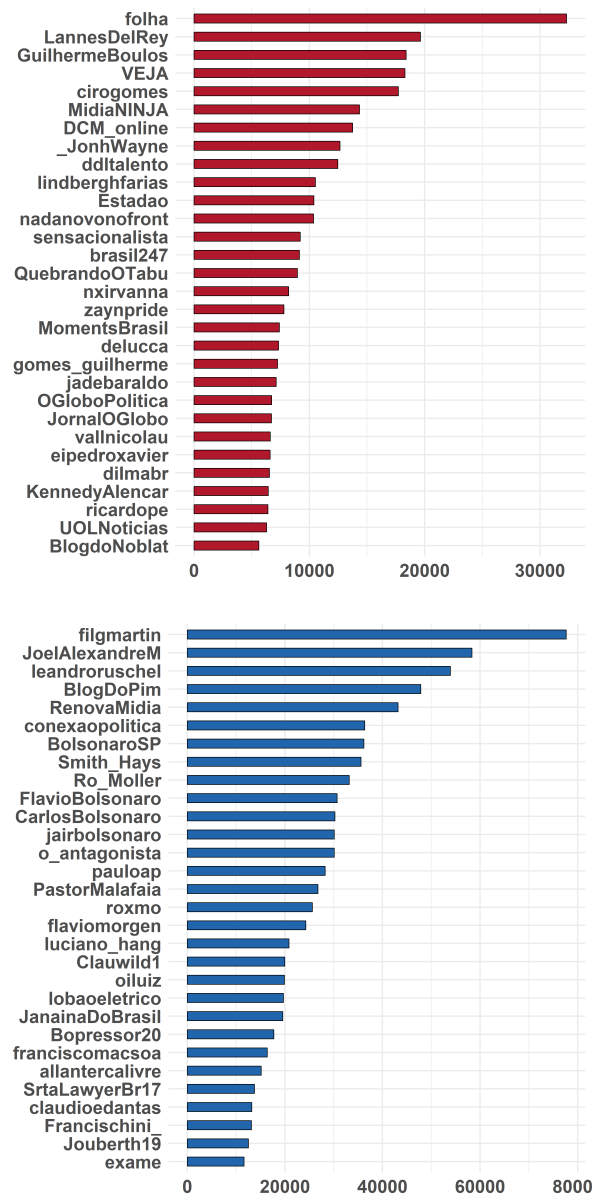
Figure 4 Authorities in the sub-networks aligned with the the Anti-Bolsonaro Communitiy (red) and the Pro-Bolsonaro users (blue)
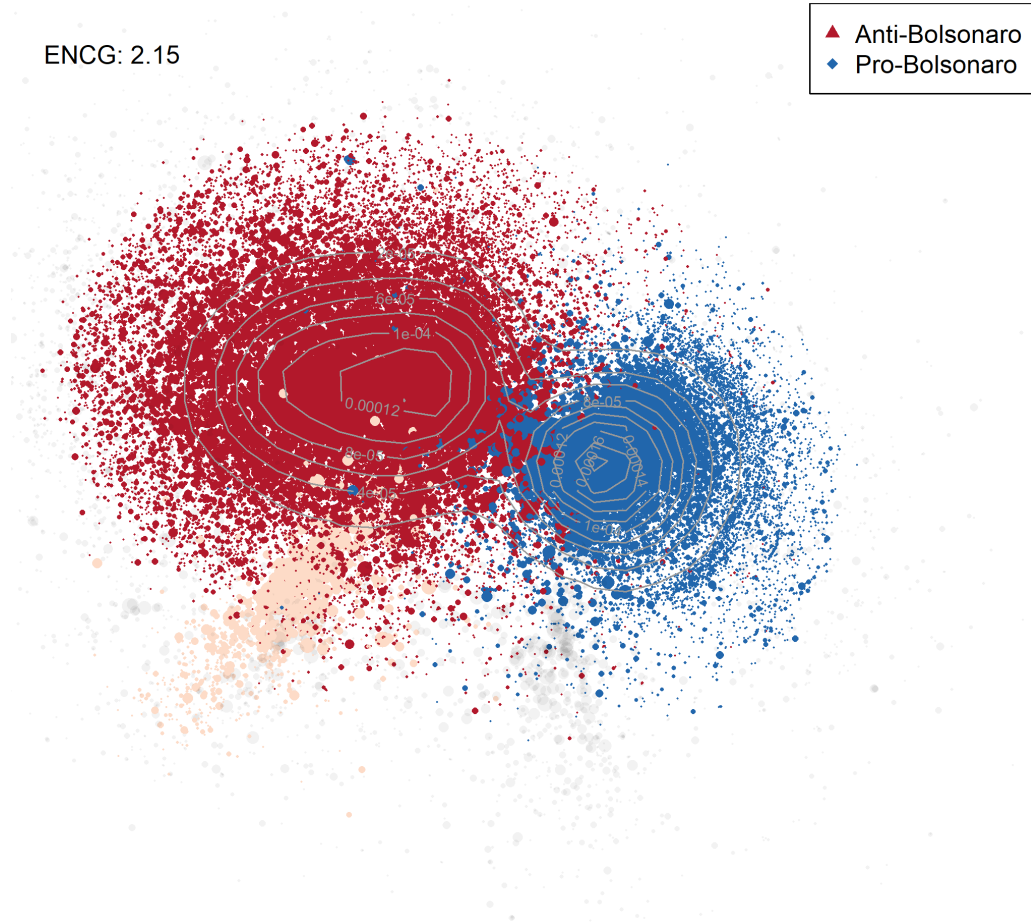
Figure 5 Primary Connected Network of #Bolsonaro. Blue dots describe users aligned with the Bolsonaro. Red dots describe users aligned with the opposition. Layout of users estimated using the Fruterman-Reingold algorithm in *IGraph*. Community detection using Walktrap algorithm in *IGraph*, (Csardi et al., 2006)

Figure 5 describes the full #Bolsonaro network, with users aligned with the President-elect in

Bolsonaro that illegally bankrolled WhatsApp and YouTube fake news operations. This includes an intensa campaing against Bolsonaro's front-runner opponent, Fernando Haddad. Significant research, in consequence, has been directed to explain the spread of false information by the Bolsonaro's campaign. Considerable less research, however, has analyzed how traditional media outlets positioned themselves during the campaign.

blue circles, users aligned with the opposition in red diamonds, and the rest of the users in gray dots. The size of the nodes describes the in-degree of each user, with larger nodes indicating accounts that were re-tweeted more often. The community of the opposition is 30% larger than that of Bolsonaro's supporters.

Out of the 5,325,240 million tweets in the #Bolsonaro network, slightly over 15.3% included hyperlinks to content already published online, $816,694/5,325,240 = .1534$. Links to the top 24 media outlets represented 78% of all hyperlinks, 640,595/816,694, with almost a third of them connecting to existing twitter posts and the other two-thirds directing readers to news organizations. While only 15% of tweets included hyperlinks to other media, it is worth noting that 97,160 accounts out of the 196,066 tweeted or re-tweeted content with hyperlinks to news organizations. Therefore, over 45% of the users activated news content from other sources.

Descriptive Information on News Sharing in the *Bolsonaro*

Visual inspection of Figure 6 shows that media organizations were activated to a different extent by Pro-Bolsonaro (blue) and opposition users (red). Each plot in Figure 6 describes the region of activation of a different media outlet, measured by the number of times that users posted or retweeted content from each media source. Wider plots indicate that a larger set of users activated that content. For example, the upper left plot in Figure 1.a shows that Folha was shared by a sizable number of users in both the pro- and anti-Bolsonaro communities. Plots show significant variation in activation, with some news organizations such as the *Folha de Sao Paulo*, *Veja*, *Estadao*, and *Globo*, shared wildely while others were narrowly linked by one of them, as was the case for *O Antagonista*, *Brasil247*, *Gazeta do Povo* and *Conexao Politica*.

There are some insightful considerations about the activation maps provided in figure 6. First, larger outlets, as our theory expects, tend to be shared more broadly by both communities. In
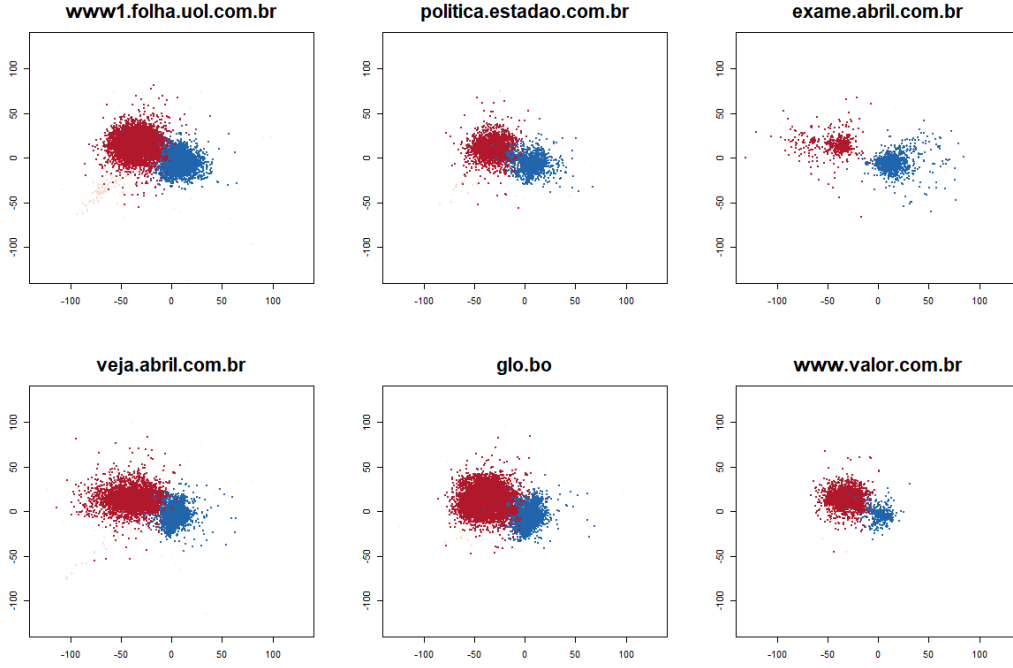
(a) More Reputable News Organizations
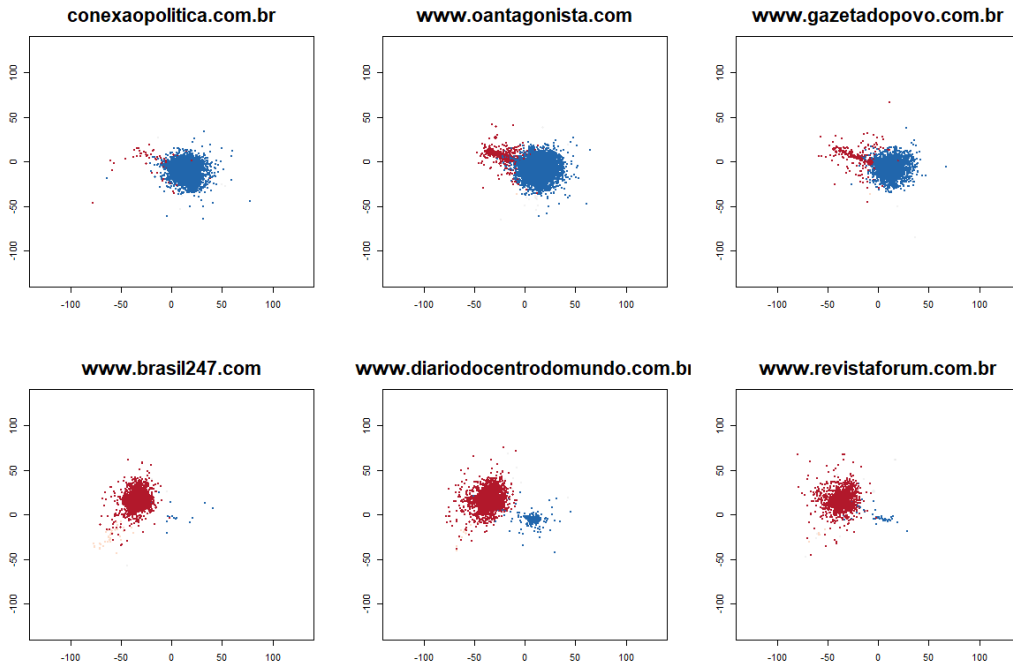
(b) Less Reputable News Organizations

Figure 6 Embedded news in the Primary Connected Network of #Bolsonaro. Blue dots describe Pro-Bolsonaro users. Red dots depict Anti-Bolsonaro accounts. The graph represents the activation of each news on both communities

our theory, reputation concerns might explain this behavior. Users are more likely to embed links from more reputable outlets, moderating their ideological proximity when deciding which news to activate. Second, the figure gives a clear picture of the polarized environment of the Brazilian election. Beyond the more reputable outlets, most of the other source of news, such as *O Antagonista*, *Brasil 247*, and *O Sensacionalista*, are shared exclusively by one of the communities with very littler cross-community exchange of embedded links.

Finally, returning to the issue of activation and propagation of false information in the Bolsonaro's community, figure 6 allows us to make some additional considerations. One of the differences between both communities is precisely the degree to which Pro-Bolsonaro users embed links from anonymous political operatives online. *Conexao Politica*, *Tribuna do Ceara*, *Republica de Curitiba*, *Jornal Cidade On line* are all examples of unknown websites who work, in general attacking progressive social movements and politicians in Brazil, but that in the 2018 election, as ammunition for Bolsonaro's campaign strategy of propagating fake news. We do not observe these operatives with the same centrality in the opposition network of embedded links. In the latter group, the propagation of news comes mostly from left-wing journals and website, which are not anonymous sources, and also from more reputable, well-known outlets.

To be precise about our argument, we do not argue that the use of false information, trolls, and anonymous websites were a strategy adopted only by one side battling in the electoral dispute; previous research has already shown that, despite being framed in distinct ways, fake news were quite spread among different communities (Tardaguila et al., 2018). What we do argue is that the relevance of these machines producing daily amounts of fake news is notably higher among the users clustered in the community of supporters to the President-elect Bolsonaro compared to the other groups of our network.

To provide descriptive evidence on distinct news sharing behavior by the different communities, we estimate a model with the count of embeds as our dependent variable. Figure 7 provides separate Poisson estimates by news outlet and community, with pro and anti Bolsonaro accounts dummied out and 95% confidence intervals around the estimates [9].

In Figure 7, blue dots describe parameter estimates for Bolsonaro's followers and red dots describe parameter estimates for the opposition. Given that larger coefficients describe higher numbers of links embeds, we can readily compare media outlets more frequently linked by Pro-Bolsonaro users, such as *Youtube*, *Tribuna do Ceará*, *República de Curitiba*, *O Antoganista*, *Jornal Cidade On Line*, *Istoé*, *Gazeta do Povo*, *Exame Abril*, *O Estado de Minas (EM)*, and *Abril (abr.ai)*, to media outlets more frequently linked by the opposition, such as *Valor*, *O Sensacionalista*, *Revista Forum*, *Noticias Uol*, *Globo*, *Diário do Centro do Mundo*, *Brasil 247*, and *Folha* .

Figure 7 provides similar findings related to the centrality of anonymous outlets among the Bolsonaro's community. The majority of the relevant links shared by this community comes from small, anonymous websites. As mentioned before, *Tribuna do Ceará*, *República de Curitiba* and *Gazeta do Povo* are example of these operatives. Meanwhile, the opposition cluster of users tends to rely more frequently on more reputable outlets. The difference of the activation of Youtube is also interesting since this platform works as a repository for videos made to propagate fake news, also more activated by Bolsonaro's community.

Additionally, Figure 7 provides insights about heterogeneous propagation of outlets across the communities. Take for example the *Revista Forum*, an outlet traditionally more aligned with the opposition of Bolsonaro, and controlled by the Journalist Renato Rovai, a long-age

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[9]The model links from *F5.folha.uol* as the dependent variable ran into separation issues due to lack of variation; therefore, we did not add the parameters to Figure 7

supporter of the Workers Party. The results for the Poisson model show a sharp difference between links from *Revista Forum* embedded by users more aligned with the opposition and the Bolsonaro's community. The same division occurs with *Diário do Centro do Mundo* in favor of the opposition and with the Pro-Bolsonaro operatives mentioned earlier.

An additional finding of these models relates to the comparison between smaller and larger media outlets. For the cases of links from the *Folha's* organization, *Istoé*, *Veja*, and *Estadão*, all more prevalent organizations, the gap between the point estimates is not as large as when compared with the smaller outlets and the fake news websites we discussed above. Finally, the figure also predicts how polarization between the communities is more significant among Bolsonaro's supporters; the gap between red and blues dots tends to be more significant for outlets more aligned to Bolsonaro than when compared to the gap of outlets more activated by the opposition.

The basic Poisson model, however, does not allow us to precisely discriminate how much of the count rate is explained by cognitive congruence/dissonance and how much is to be explained by the media's reputation. In the following section, we advance a more complete estimation of our theoretical model for news sharing and gatekeeping behavior of media outlets.
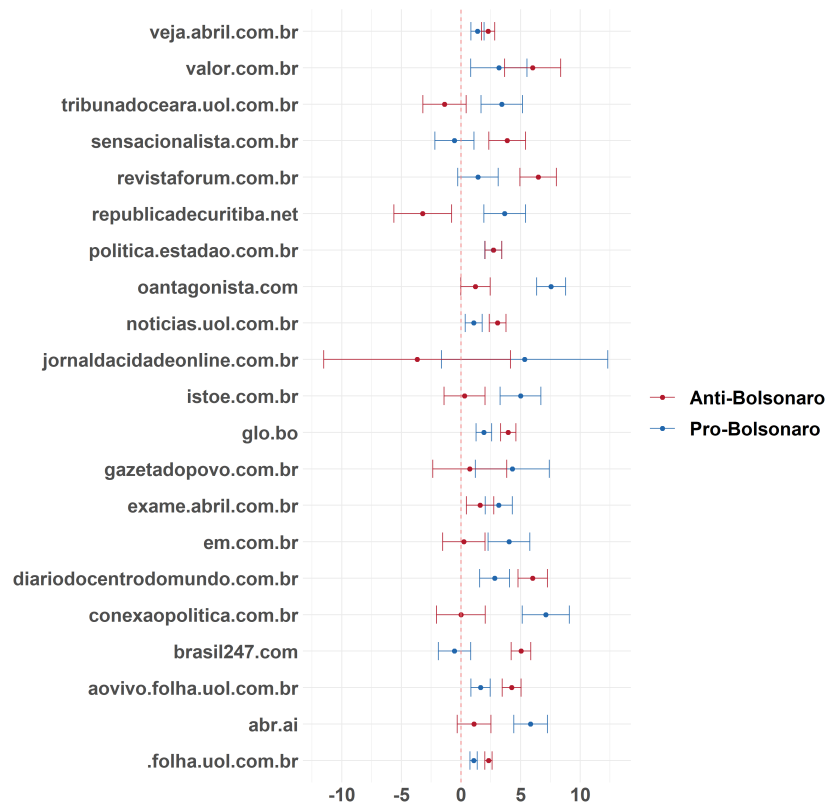
Figure 7 Estimates of Media Embeds (Poisson) for Pro-Bolsonaro and Anti-Bolsonaro users

News sharing and gatekeeping in #Bolsonaro

We model the utility function from equation (1) as a multilevel specification. We use a random slope, α, and two random intercepts, A and R, where α captures the weight that readers attach to ideological congruence, while the A and R describe the importance of user attention and reputation of the outlet in the #Bolsonaro network. We focus our discussion here in the importance of ideology and reputation to explain news sharing by the users and the gatekeeping decision by editors. We estimate a generalized linear binomial count model using a logistic transformation with an overdispersion parameter for user and media outlets, as suggested in Zheng et al. (2006). The inputs of the model take the form of a i by j matrix in which the rows represent the users, the columns the media outlets, and the cells, our dependent variable in the empirical model, the number of times user i embedded a link from the outlet j. Our input matrix results in 686,428 observations that report counts of embedded links by 74169 users, and 24 media organizations.

Given that the highest density point of each media organization $\mathbb{L}_j$ is unobserved, we need some approximation to calculate the parameter α. We approximate the location $\mathbb{L}_j$ using deriving a weighted average of each user i location using the first dimension of the network by the number of links embedded from each organization j. After estimating these points, we calculate the distance between the user location and the highest density point of each media in the network. We model the parameters for cognitive congruence/dissonance by deciles across the network. The motivation for binning the network by quantiles is twofold; first, it makes the model computationally less intense [10], second, it provides us theoretically interesting parameters allowing for the identification of heterogeneous values for ideology in different parts of the

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[10]See here [ommitted authors] for a complete explanation of the computational gains of binning the network

#Bolsonaro network. In the appendix, we provide the results for a simpler model estimating the effects of cognitive congruence using the two dimensions of the network and binning the estimation by quantiles on both directions.

Figure 8 presents estimates for the weight of cognitive congruence/dissonance (ideology) for the users estimated by quantiles in the #Bolsonaro network. The plot indicates where proximity between the user and Media matters more/less, with larger negative values indicating more salience for ideology. In other words, the graph documents in which areas of the network the decay to embedding links from sources far away from the user position is greater. Figure 8 reveals two things. First, users in the extreme of the network weight heavily cognitive congruence in their decision to share the news. This behavior appears on both communities of supporters and opposition of Bolsonaro with the 1th, 2th and 9th and 10th quantiles exhibiting more negative values.

Second, the importance of ideological congruence in #Bolsonaro tends to decrease when moving to the center of the network. This finding related to research using survey data (Calvo and Hellwig, 2011), and also replicates when analyzing different networks [ommitted authors]. The exception here locates at the quantile 6, which represents precisely the division between both communities, as the reader can visualize on figure . Users located in the crack of this polarized environment act as ideologically as the extremes sharing news mostly from outlets located closer to them in the network. In the extreme, users interact with polarized outlets demanding news with high congruent news; in the crack of the polarization, users work to differentiate themselves in the polarized environment, therefore, interacting with outlets ideologically distant to both sides of the polarization.

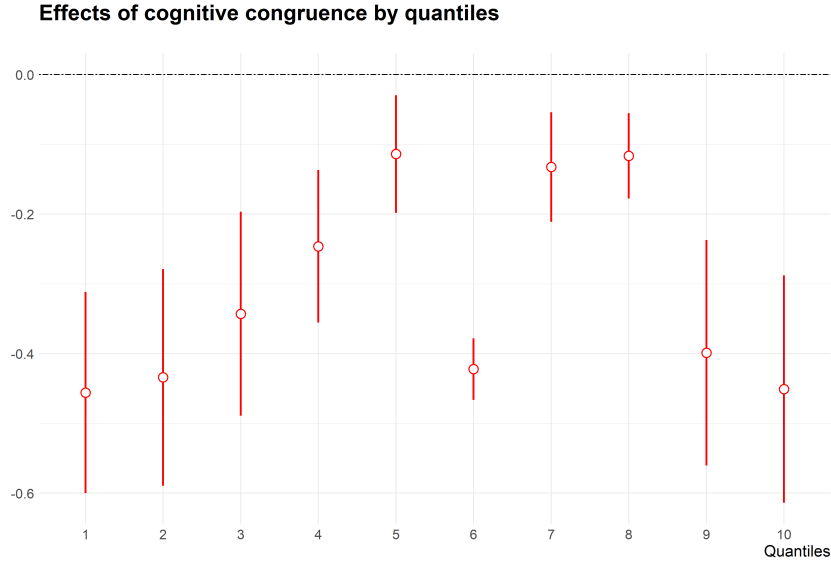Next we turn to the estimates for reputation. Figure 9 presents the point estimates for each of

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Effects of cognitive congruence by quantiles

Figure 8 Point estimates from the multilevel model for the effects of ideology for the users by quantiles in the #Bolsonaro network.

the 24 outlets in the model. The results converge relatively well with our qualitative argument about the media market in Brazil. Larger outlets in Brazil, as we expected, depend less on congruence and dissonance of the ideological preferences from the users, for example, *Folha de Sao Paulo*, *Abril*, *Globo*, and *Uol*. The exception here is the website O Antagonista that appears as one of the outlets leading our estimation for reputation. This finding is driven by the high activation of O Antagonista in the community in support of Bolsonaro receiving high and equally shared attention on most of the space occupied by these users. Therefore, despite not figure as a traditional outlet in Brazil, in the #Bolsonaro network, O Antagonista appears as the broadest source of news in one the leading group engaging in the debates in this network.

In the other side, smaller news organizations, such as *Jornal da Cidade On Line* and *Republica de Curitiba*, two of the fake news operative highly activate among Bolsonaro's supporters are on the other extreme of the reputational scale, as well as *Revista Forum* and *Brasil247*. The results indicate that the latter outlets derive their attention mostly by the user who cares about congruent news and are activated in minimal areas of the network.
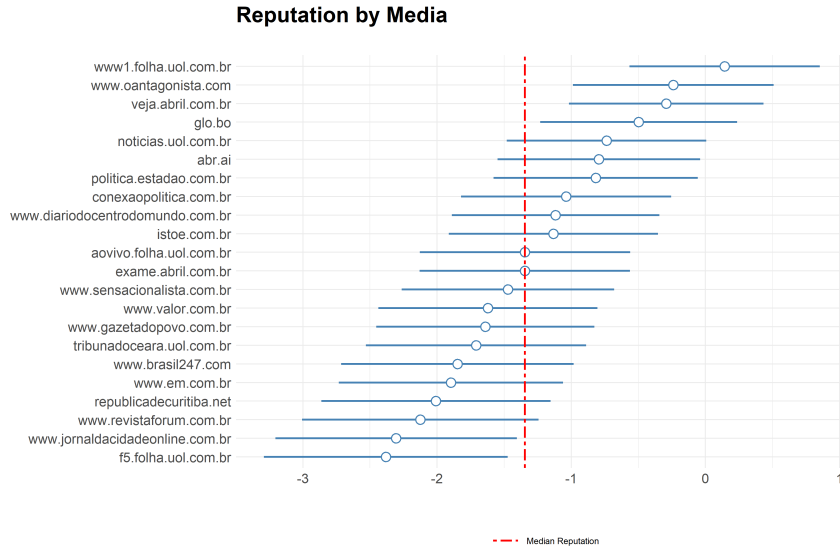
Reputation by Media

Figure 9 Point estimates from the multilevel model for the effects of reputation by media outlets in the #Bolsonaro network.

After estimating the parameters of the model, we can use them to find the optimal ideological placement of the media if they were only interested in maximizing readership(Adams et al., 2005). This exercise provides a comprehensive assessment, using observational data, of our theoretical prediction using the synthetic data discussed previously. We present the results six cases for more/less reputable outlets combining the results from figure 9 and our qualitative assessments of the media market in Brazil.

Figure 10 documents three important findings. First, the outlets located farther away to the median location of the user in the network are mostly among those allied with Bolsonaro's community. The media outlets aligned with the opposition are, in fact, way closer to the center than their counterparts in the Bolsonaro's community which suggest radicalization in this issue is mostly driven by Bolsonaro's supporters. These findings converge with research survey and legislative data showing increasing levels of polarization among conservative users in the United States context (Bartels, 2008; McCarty et al., 2006; Mann and Ornstein, 2016; Theriault and Rohde, 2011).
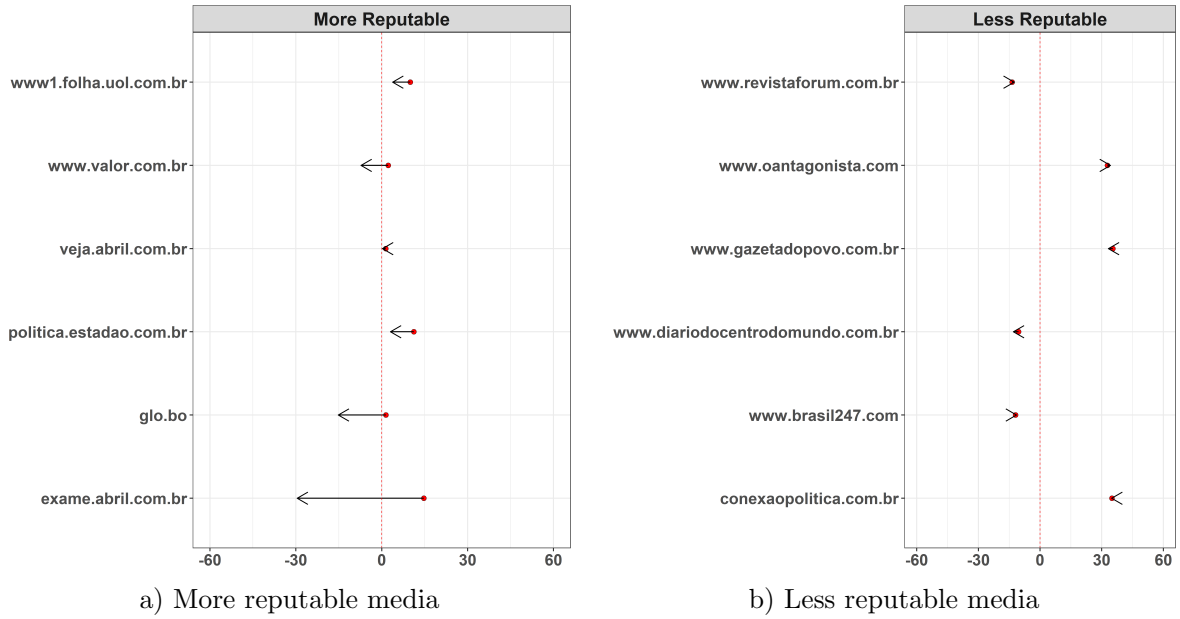
31

Figure 10 Horizontal arrows describe the difference between the observed location and the optimal location of each news outlet. We derive the positions implementing Adams, Merrill, and Grofman's algorithm (2005) using Winbugs.

Second, asymmetry in reputation renders distinct gatekeeping decisions by the editors, as our theory predicts. Larger outlets with a broader audience optimize their readership by moving to the center of the #Bolsonaro network on the right plot, are crowded out. All the outlets on the left of figure 10 would receive greater attention from the user when moving to the center of the network, while the smaller, more ideologically committed outlets on the right plot, maximize appealing to users on the fringe. This finding goes in the direction of our hypothesis 2a and hypothesis2b about the effects of asymmetric reputation.

Finally, figure 10 also reveals how more reputable outlets have more significant incentives to maximize their editorial decision towards the center, while less reputable outlets in this polarized environment are already sending messages highly congruent to their preferred user. As the reader can observe, the length of the arrows between the left and right plot differ consistently, which indicates that smaller outlets are already located at their sweet-spot in this polarized

#Bolsonaro network. In the direction of our hypothesis 2c, high demand for congruent news, and asymmetric reputation produce incentives for smaller outlets to stay closer to the local median in this polarized network.

To ensure the robustness of our findings, we provide in the appendix further evidence connecting news sharing behavior and editors' gatekeeping decisions but implementing distinct modeling decision. Using both dimensions of the #Bolsonato network, we also show: i) smaller outlets are crowded out to the fringe while larger news sources locate more to the center of the network, ii) the decay of activation moves at a faster pace for smaller outlets, which replicates the findings on figure 10 indicating how less reputable outlets pay higher costs for moving and maximize their position attending high ideologically congruent users, iii) larger outlets have higher spread of activation across distinct areas of the network which we explain as a consequence of their reputational advantage.

Concluding Remarks

Will user polarization further polarize media organizations? Why do users share news in social media? What should be the optimal editorial line of a news organization if the owners and journalists are only interested in maximizing readership? In this paper, we develop a theory to answer these three questions.

First, we show that if editors are interested in maximizing readership and news sharing increases news exposure, an increase in voter polarization will result in further media polarization. Second, our theory proposes that high reputation and low reputation news outlets will behave differently. Indeed, we expect high reputation news organizations to moderate their editorial line and low reputation news organizations to become more extreme. As reputation increases, news

organizations converge towards the median voter. As reputation declines, news organizations cater to the local median voter of each community.

To test our model, we estimate the determinants of news sharing among Twitter users during a major political event in Brazil, the presidential election of Jair Bolsonaro. Our model provides new insights into the behavior of news organizations in a very divisive election.

In our framework, the reader's decision to share content with friends is explaining by the (1) cognitive congruence/dissonance of readers with the ideological leaning of a post; as well as the benefits of relying on information from more prevalent outlets. As we posit that reputations are difficult to alter in the short term, we describe the challenges of an editor as an optimization problem where they can only adjust the ideological leaning (editorial) or the topic (gatekeeping) of the news they publish. Editors that hope to maximize readership, consequently, are pushed towards more centripetal locations if their reputation is already high among readers; or they are pushed towards more extreme positions when their reputation among readers is low.

Theoretically, our paper extends spatial voting models common in political science to shed light on an exciting communication's problem. The logic of the model relates to ideologically motivated readers and media organizations with a distinct journalistic prevalence rate in the network. We show that the users' decision to embed links to these news organizations should affect the extent to which these organizations moderate or radicalize their editorial lines. For our empirical case, the results show how the communities involved in the political presidential debate in Brazil interacted with different sources, how cognitive dissonance is larger on the extremes of each community, how larger outlets found their sweet-spot in the center of an extremely polarized network, and show how the community of the supporters of the President interacted mostly with extremely ideological, online political operatives.

Our results also speak to the central contemporary issue of polarization in the social media environment. We document how polarization, in particular, the driven by extremely ideological users in the fringe of both communities produce centrifugal effects on editors strategic positioning in this environment. Our findings provide a road map to understand how polarization in demand for content by social media users polarize even further media outlets with low reputation and reduce any incentive to moderation. In conclusion, writing to bubbles is a optimal editorial strategy for smaller outlets, and the increasing formation of bubbles in social media open a until recently closed market for more radical sources of news. Meanwhile, larger and more reputable organizations gain with moderation by using their non-policy advantage to gain the support of the median user.

So far, our model describes media organizations that have no ideological preferences of their own. Many spatial models in political science take into consideration the policy preferences of politicians. In the communication's literature, we need to consider both the existence of partisan media as well as the economic benefits of higher reputations, which increase the returns that media organizations perceive from vendors and donors. Future extensions of our model will incorporate discount functions for these economic considerations. It will also incorporate the potential benefits of endorsing politicians that could facilitate the expansion of an organization income even at the expense of suboptimal editorial positions.

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Supplemental Information File: News sharing and Editorial Gate-keeping in polarized media environments

Appendix A: Estimation of Equilibrium location of News Organizations

We begin describing the main model specification in "Writing for the Bubble", which includes ideological proximity terms, reputation terms, and issue attention terms[11].

$$U_{(ij)}^k = -\alpha_{q(i)}^k \left(x_i^k - L_j^k \right)^2 + A_{q(i)}^k + R_{q(i),j}^k + \gamma_{ij}^k \tag{5}$$

In Equation (1), the quadratic term $\alpha_i^k \left(x_i^k - L_j^k \right)^2$, describes the disutility of a publication by media j on issue k, with ideological leaning L that is further removed from the reader's preferred ideological position, x_i^k. Equation (1) also shows that news published by a more reputable actor, R_j^k, increase the utility of reader i. Finally, users may also give different attention to an issue, A_i^k, sharing a higher than average number of post with social media peers. Equation (1) also includes an stochastic term that captures overdispersion, γ_{ij}^k, by user and media outlet. The subscript k might be dropped since the issue remains constant.

The statistical model maximizes the probability that a reader i will share a news published by news organization j. As described in the "News by Popular Demand", we estimate this model using a Poisson approximation on equation:

$$\pi_{ij} = \frac{e^{U_{(ij)}}}{\sum_{j=1}^{J} e^{U_{(ij)}}} \tag{6}$$

Once the model parameters are estimated, we follow Adams, Merrill, and Grofman 2005 and iteratively compute the equilibrium parameter $nash_j$, substituting the ideology, reputation, and

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[11]In the paper, we only analyze the first two terms. The complete results are avaiable upon request

attention parameters by those estimated in equation 1.

$$U_{(ij)} = -\widetilde{\alpha_{q(i)}} \left(x_i - \mathbb{L}_j\right)^2 + \widetilde{A_{q(i)}} + \widetilde{R_{q(i),j}}^k \tag{7}$$

The algorithm maximizes the expected market share of each news organization, $E(LS)_j$ conditional on the vector of equilibrium news locations L and the weight parameter $\widetilde{\alpha_{q(i)}}$, $\sum_j \pi_{ij}(\mathbb{L}, \widetilde{\alpha_{q(i)}})$. Adams et al. (2005) differentiate (4), solving for the last occurrence of $\mathbb{L}$:

$$\mathbb{L}_j(0) = \frac{\sum_j \pi_{ij}(\mathbb{L}, 0)[1 - \pi_{ij}(\mathbb{L}, 0)]x_i}{\sum_j \pi_{ij}(\mathbb{L}, 0)[1 - \pi_{ij}(\mathbb{L}, 0)]} \tag{8}$$

The model then iterates over each news organization until convergence is achieved. Following Calvo and Hellwig 2011, we write this model in WinBUGS 1.4.1:

```
model
  {

    for (t in 1:K) {
    #Nash Equilibrium Algorithm 1
          nash[t]~dnorm(nash.mu[t],100)
          nash.mu[t] <- mean(w1[,t])/mean(w2[,t])+xbar
          probp[t]<- mean(p[,t])
      }

    for (i in 1 : N) {       # loop around Individuals
    #x[i] ~ dnorm(mu[i],.001)
    #mu[i] <- alpha

          for (k in 1 : K) {     # loop around Media

          #Nash Model 1
          p[i,k]          <-   phi[i,k] / sum(phi[i,])
          log(phi[i,k]) <-   reputation[k] + attention[i]
                               + alpha[i]*log(pow(l1[i]-nash[k],2))

            w1[i,k] <- p[i,k]*(1-p[i,k])*(l1[i]-xbar)
            w2[i,k] <- p[i,k]*(1-p[i,k])

      }
  }
```

Figure 11 Winbugs Equilibrium Model

Appendix B: Robustness checks: Modelling predicted probabilities of activation in two dimensions

In the main model of the paper, we estimate equation (1) reducing the information only to the first dimension of the network. This technique allows us to easily map the algorithm on 2005 and Calvo and Hellwig (2011) to our application focused on the editor's strategic positioning and polarization in social media. To provide further evidence of our argument, and to increase the robustness of our findings, we provide in this appendix a different estimation strategy.

In this appendix, we estimate the model using both dimensions of the network. Although we do not provide a solution for the optimal position of the editors, as we do in the main model of paper, we use the observational data of the #Bolsonaro network to map areas of activation for each media outlet. We read these areas as an observational representation of our findings on figure 10. We approximate the location $\mathcal{L}_j$ deriving a weighted average of each user i location in the two dimensions of the network by the number of links embedded from each organization j. After estimating these points, we calculate the Euclidean distance between the user location and the highest density point of each media in the network. We further divide the network space in quantiles on each dimension of the network space allowing our parameters for ideology to vary spatially. We use the same generalized linear binomial count model using a logistic transformation in the multilevel framework described in the paper.

With the parameters of the model in hand, We estimate the probability of observing an embedded link in the #Bolsonaro network for each of the top 24 news organizations. Figure 12 and 13 presents the results plotted in a two dimensional space that replicates the network environment. We calculated the predicted probabilities from the estimates on the model and

the mean value of the distance of use i to media j in each grid. More black quadrants on figures 12 and 13 represents news organization's density peak; in other words, the area of the network where the media has higher ideological congruence.

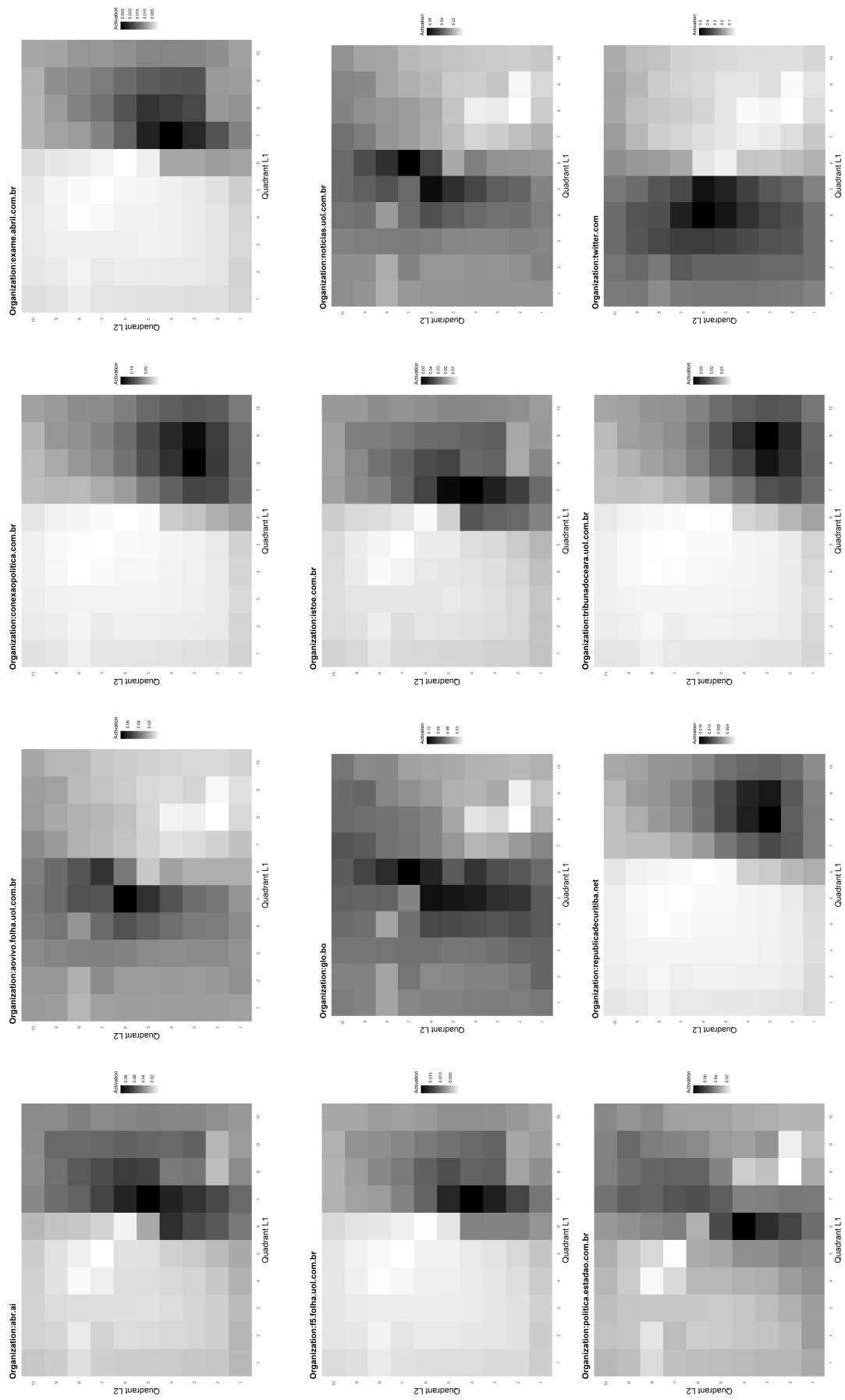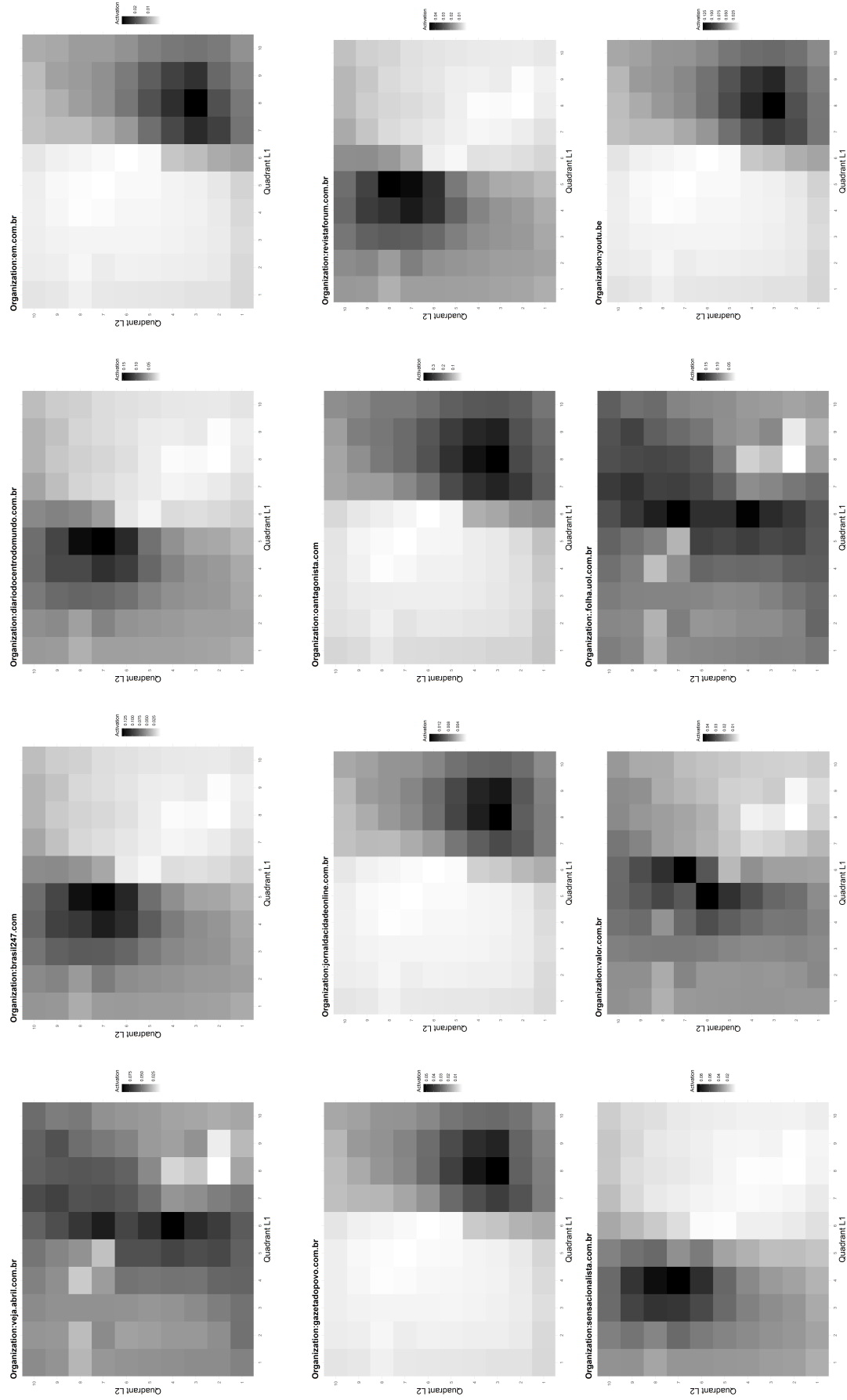**Figure 12** Predicted Rate of Embeds by Media

Figure 13 Predicted Rate of Embeds by Media

Small black grids located limited to small areas of the maps represent outlets in which the cognitive dissonance is more costly activation is not spread around the entire network. For these cases, their density in the network is concentrated on a small area with a sharp decay as one moves further away. The outlets with such a reduced area of activation converge to findings of the main paper in which we indicate some media sources with low reputation, and low incentive to moderation. In the other side, larger and more reputable outlets occupy mostly the center of the network, exhibit a wider area of activation, and lower rate of decay.

Consider for example the news organization *Revista Forum*, led by the opposition journalist Renato Rovai. At the core of the opposition, *Revista Forum* concentrates close to 8% of all embedded links. However, links to this newspaper rapidly drop to zero as we move to users that are not closely connected to the opposition. The same occurs in the cases of *Diario do Centro do Mundo*, *O Sensacionalista* and *Brasil 247*, all smaller organization more aligned to the opposition. In the other side, pay attention to the cases of the fake news operatives more popular in the Bolsonaro's community: *Jornal da Cidade On Line*, *Republica de Curitiba*, and *Conexão Política* occupy a quite isolated black area in the extreme of the bottom left quadrants of the network activating the core users of this community solely due to their strong ideological connections.

By contrast, consider now the case of *Globo* and *Folha* [12], the largest TV channel and newspaper in the country, respectively. The most active area in the map for both, where close to 20% of all the embedded links are located, is left to the center of the network. The position is closer to the opposition community, as we would expect, but not exactly in the core of the community, and closer to the median user as our formal model predicts.

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[12]The group Folha has some distinct branches as one can see by the different links. Here, I am considering the figure related to link aovivo.folha.uol.com.br that comes directly from the leading newspaper's website

The findings in this appendix largely converge to the theoretical expectations, as well as with the more complete solution provided in the main paper.