Media Proliferation and Partisan Selective Exposure*

Jimmy Chan†

Daniel F. Stone‡

December 2011

Forthcoming, *Public Choice*

Abstract

The number of Internet news media outlets has skyrocketed in recent years. We analyze the effects of media proliferation on electoral outcomes assuming voters may choose news that is too partisan, from an informational perspective, i.e. engage in partisan selective exposure. We find that if voters who prefer highly partisan news–either because they are truly ideologically extreme, or due to a tendency towards excessive selective exposure–are politically "important," then proliferation is socially beneficial, as it makes these voters more likely to obtain informative news. Otherwise, proliferation still protects against very poor electoral outcomes that can occur when the number of outlets is small and the only media options are highly partisan. Our model's overall implication is thus that, surprisingly, proliferation is socially beneficial regardless of the degree of selective exposure.

*A previous version of this paper was titled "Media proliferation and electoral outcomes with quasi-rational voters." We thank Nathan Larson, Alessandro Lizzeri, Matthew Nagler and participants at the 2010 Econometric Society World Congress, 2010 Western Economic Association Conference and numerous seminars for helpful comments. The first author acknowledges the support of Shanghai Dongfang Xuezhe Program, 211 Project for the Shanghai University of Finance and Economics, and the Shanghai Leading Academic Discipline Program, Program No. B801.

†Professor, Shanghai University of Finance and Economics; jimmy.hing.chan@gmail.com.

‡Assistant Professor of Economics, School of Public Policy, Oregon State University; dan.stone@oregonstate.edu; 541-737-1477; 303 Ballard Hall Ext, Corvallis, OR 97331 (corresponding author).

1 Introduction

It is well known that the advent of the Internet has had tremendous impacts on both media market structure and news content.[1] Traditional media markets are mainly comprised of large outlets that appeal to wide audiences across the political spectrum. By contrast, the online news market contains a much larger number of smaller outlets, with a greater variety of political views.[2]

The seminal economic analysis of democracy, Downs (1957), implies these changes are likely socially beneficial. Downs argues that a rational voter should delegate the task of evaluating political platforms to a well-informed third party that shares the voter's ideological view. Thus rational voters likely benefit from having greater media choice. Of course, in reality voters may not be as rational as the Downsian view assumes. In fact, there is now a large literature on the phenomenon of selective exposure–that individuals tend to seek information confirming their prior beliefs and/or avoid information challenging those beliefs for psychological reasons–suggesting voters indeed generally do not choose the most informative news sources.[3] Moreover, there is substantial concern that the interactions between selective exposure and the recent growth of Internet media may be harmful for democracy.[4]

In a recent paper, Chan and Suen (2008) (henceforth CS) formalize the Downsian view of news consumption. In this paper we adapt their model to examine the effects of media proliferation on electoral outcomes and social welfare allowing voters to consume news that is too partisan from an informational perspective, i.e. engage in (excessive) partisan selective exposure. We assume this tendency results from voters being quasi-rational in their understanding of media partisanship–that voters underestimate how extreme the media outlets really are.

[1] See Massing (2009) for a nice discussion of the decline of the traditional newspaper industry and growth of Internet news media outlets.

[2] Seventeen distinct websites were "most frequented" by at least two percent of readers of online news in 2008 (Pew Research Center (2008)), and according to Drezner and Farrell (2008) there were an estimated 70 million blogs worldwide in May 2007. Although the majority are likely personal and not focused on news, there are likely thousands that mainly discuss politics. Baum and Groeling (2008) discuss specific evidence showing blogs are more partisan than traditional news sources.

[3] See Iyengar and Hahn (2009) and Garrett (2009) for recent studies, both of which include fairly extensive literature reviews. Actually, even the introduction of Downs acknowledges the limitations of the rational choice assumption in the context of political analysis.

[4] See, e.g., Sunstein (2001), Drezner and Farrell (2008), Pariser (2011), or Obama (2010), who says, "Whereas most Americans used to get their news from the same three networks over dinner, or a few influential papers on Sunday morning, we now have the option to get our information from any number of blogs or websites or cable news shows. And this can have both a good and bad development for democracy."

This assumption is convenient in our set-up and provides a novel explanation for selective exposure.[5] But our results would not change substantially if we assumed it was caused by other factors, e.g., reinforcement-seeking or entertainment value. We refer to the general tendency to consume "too partisan" news loosely as quasi-rationality, but acknowledge it may be individually optimal to choose an uninformative, but belief-reinforcing news source.

While there has been a great deal of recent research on partisan selective exposure and the growth of Internet media, much of the work has been empirical.[6] The existing theory literature on media markets and politics mostly considers settings with a small number of firms, often just one or two.[7] We believe our paper is the first to provide a theoretical framework for analyzing the electoral effects of the number of media outlets becoming arbitrarily high when voters make quasi-rational news choices.[8] See Leeson (2008), Leeson and Coyne (2005) and Coyne and Leeson (2004) for examples of papers from the media economics literature that take a specifically public-choice perspective.[9] Prat and Strömberg (2011) provide a recent survey of the political economics literature on media.

We model the media market as a multi-round entry game. In each round, firms can enter the market by incurring a fixed cost and choosing an editorial position that determines which of two political parties it is more likely to support. Once in the market, an outlet's editorial position becomes fixed and known to subsequent entrants. After the entry process stops, voters with heterogeneous political preferences (ideologies) decide whether and from which

[5]It is also worth noting our assumption is consistent with the results of DellaVigna and Kaplan (2007), who discuss how voters may be unduly influenced by partisan media due to what they call "nonrational persuasion."

[6]In addition to the studies cited above, see, e.g., Mutz and Martin (2001), Stroud (2008), Nie et al. (2010) and Gentzkow and Shapiro (forthcoming). A related, but distinct, literature studies how changes in media technology may enable people to avoid political news altogether; see, e.g., Baum and Kernell (1999) and Prior (2005).

[7]Contributions include Strömberg (2004), Besley and Prat (2006), Andina-Díaz (2007), Bernhardt et al. (2008), Gasper (2009), Kendall (2010) and Duggan and Martinelli (2011). Bernhardt et al. study markets with many firms but do not focus on the welfare effects of the number of firms increasing. Other formal models of media markets that do not analyze political outcomes include Mullainathan and Shleifer (2005) and Gentzkow and Shapiro (2006).

[8]The framework of Nie et al. (2010) is very similar, but not formalized, and does not directly address electoral outcomes. Anand et al. (2007) consider a two-stage entry game that is similar to ours. Nagler (2007) analyzes Internet media assuming consumers face cognitive costs that increase with the size of the choice set, causing them to choose well known brands as the number of media choices grows. Neither of these papers analyze the electoral consequences of media proliferation.

[9]These papers focus on the role of media in providing incentives for government officials to take socially optimal actions, and the importance of the media's independence from government for this role to be served.

outlet to consume news to learn which party better serves their interests. Finally, an election is held and the voters' payoffs are determined by the winning party's policy.

Our entry game captures four important features of the Internet news market. First, news is free. Each outlet's revenue depends only on the size of its readership. Second, there is no entry barrier. Potential outlets can always enter after incumbent outlets have chosen their positions. Third, the political reputation of a media outlet is a crucial product characteristic and is hard to change. Hence, an incumbent outlet cannot change its position to compete with later entrants. Fourth, the number of firms in the market is unbounded.

Although the model is constructed to reflect Internet news competition, our characterization of subgame perfect Nash equilibrium in a Hotelling-type game for an arbitrary number of firms is another, more general contribution of the paper. In static models of spatial competition, pure-strategy Nash equilibrium often fails to exist when there are more than two firms. Our model avoids this problem by incorporating the dynamic incentive for firms to locate in a way to deter future entry. Firms in our model behave in the same way as in the (static) entry-deterring equilibrium proposed by CS in an extension to their basic model. We develop the game theoretic foundations for this behavior by making the competition multi-round. Prescott and Visscher (1977) is the most similar previous work that we are aware of; their paper informally discusses an entry process in which firms also choose locations to deter entry, but only one firm at most can enter in each stage.

In our model, when voters are fully rational, welfare is maximized as the news choice set grows very large due to optimal Downsian delegation. Liberal voters are most informed when they get liberal news, and conservatives most informed when they get conservative news. The reason is that only a liberal news source can credibly convince a liberal voter to change her vote and support the conservative candidate. If there are no partisan news sources, partisan voters are never persuaded to change their votes by the media, and so essentially vote in an uninformed way. This result follows directly from CS.

While this is perhaps counter-intuitive, even more so is our finding that media proliferation is also socially beneficial both *despite*, and *because of*, voter quasi-rationality. The details depend on whether voters with extreme news preferences are important to the political process (technically, whether one of them can be the median voter). Voters may have these preferences for two reasons: 1) their ideologies are extreme, or 2) their ideologies are moderate, but they make too partisan news choices. In either case, these voters would never consume moderate news. They are thus completely uninformed when the media choice set is limited to only moderate news options. When there is a more diverse set of media choices, these voters are more likely to consume news. Although the partisan outlets chosen may be too partisan, given the voters' true political preferences, getting some news is always better than no news. As a result, welfare increases when the number and diversity of media outlets increases.[10] The increase is actually monotonic for comparative statics for the particular market equilibrium we study; this is a very interesting feature of the result, but likely not robust.

The situation is different when the election is determined only by voters with more moderate news preferences. These voters would consume moderate news when there is no other choice, and so having more diverse media outlets only causes these voters to switch outlets. Since voters tend to select outlets that are excessively partisan, voter welfare may decline as a result of the switching. We provide numerical examples showing welfare changes in a cyclical manner as the fixed cost declines, and analytically show the overall effect of going from a monopoly market to one with many firms may be harmful if rationality is low.

However, even in this case there are clear social benefits to having many media choices rather than few. We show that welfare with unlimited media choice is guaranteed to be greater than the minimum equilibrium duopoly welfare, for all levels of voter rationality. The intuition is duopoly welfare can become very low when market forces cause the two outlets to widely differentiate. When this occurs the median voter is forced to get news from an extreme, relatively uninformative outlet. When the number of media outlets is large, there always exist relatively moderate outlets in the market as well as extreme ones. Having many media outlets thus offers insurance, in a sense, against very poor welfare outcomes that may occur when the number of outlets is small.[11] Moreover, this result holds when comparing more general duopoly outcomes (and not just those that occur in the equilibrium we focus on) to outcomes

[10]The prediction that extreme voters are more likely to get news when the media choice set expands is (admittedly somewhat loosely) consistent with the work of Nie et al. (2010), who find people who consume Internet news are relatively ideologically extreme. Nie et al. also find Internet media consumers are more likely to be interested in niche issues, which our model does not account for. We discuss this further in the concluding remarks.

[11]The intuition for why welfare is potentially very low with two outlets is robust to the number of outlets being generally "small;" the key is that the number of firms is not high enough to guarantee coverage of moderate editorial positions. The proof for this result is only for particular conditions on the model's primitives, but numerical examples show the idea holds more generally.

with unlimited media choice.

Thus, our model implies welfare improvement due to increasing media choice is robust to, or even enhanced by, a tendency towards partisan selective exposure. We certainly do not claim to have the last word on this topic, however. There are many mechanisms outside our model that could lead to harmful proliferation effects. We discuss our model's limitations and directions for future research, including empirical issues, in the final section.

2 The Model

2.1 Voting Behavior and the Electoral Outcome

There are two political parties, liberal (L) and conservative (R), which are competing for electoral office. Each party is committed to a fixed policy. The electoral outcome is determined by majority vote. There is a continuum of voters of unit mass. The utility function of voter i is

$$u_i(y, \theta) = \begin{cases} \theta - \beta_i & \text{if } y = L, \\ \beta_i - \theta & \text{if } y = R, \end{cases}$$

in which θ is a random variable distributed uniformly on $[0, 1]$ that denotes the unobserved political-economic state of the world, and y is the election winner. The parameter β_i represents voter i's preference for the conservative party; voter i prefers R to L if $\beta_i > \theta$. We call β_i voter i's ideal cutoff. Voter preferences are subject to a random aggregate shock Δ that is uniformly distributed on $[-\delta, \delta]$, with $0 < \delta \leq 0.5$. Given Δ, the fraction of voters who prefer R when the state is x (i.e., with ideal cutoffs less than x, the realization of θ) is $F(x - \Delta)$.[12] We assume that the distribution function F has a support on $[-0.5, 1.5]$ and a density f that is symmetric over 0.5, strictly increasing (decreasing) when the argument is less (greater) than 0.5.

Given Δ, the political preference of the median voter, denoted by β_m, is $0.5 + \Delta$. Unconditional on Δ, β_m is distributed uniformly on $[0.5 - \delta, 0.5 + \delta]$. Thus the larger δ is, the more partisan the median voter may be. Since the median voter determines the election outcome (as we show below), larger δ implies a more partisan voter can determine the electoral outcome.

[12] To be clear, β_i is voter i's preference after the realization of the shock Δ. β_i can be thought of as the sum of a latent variable b_i and Δ, in which the distribution of b across voters is $F()$.

The shock can be interpreted literally; for example, there appeared to be a leftward shock to American voters after the Watergate scandal as only 22% identified as Republicans in 1974, as compared to 44% Democrats; usually the percentages are close to even (Pew Research Center (2010)). But there may be other reasons why the election may be affected by the degree to which more extreme voters are informed. Perhaps they contribute to campaigns, or have strong influence over the parties, or because turn-out is uncertain. We interpret δ as a modeling tool that captures the range of partisanship of voters who are "important," i.e. those who may influence the election outcome for a variety of reasons.

While θ is modeled as a real number, it denotes complicated policy issues that are costly to learn. For example, few voters are willing to spend the time to read enough about the science, economics, and politics of global warming to decide whether a cap-and-trade program is optimal policy. Instead of reporting the "whole unbiased truth" that no consumer will read, a media outlet must select the news that is most relevant to its readers. To capture this idea, it is assumed all media outlets observe θ but only report whether θ is greater than some strategically chosen threshold that, once chosen, is fixed and publicly known. We refer to θ_j, the threshold of media outlet j, as the outlet's editorial position, and we say the outlet reports l, or endorses L, when $\theta \geq \theta_j$ and r (endorses R) when $\theta < \theta_j$. Thus, outlets with editorial positions below 0.5 are liberal in the sense that they are more likely to endorse L than R, and outlets with editorial positions greater than 0.5 are conservative in an analogous sense. We require each $\theta_j \in (0, 1)$ so that media reports cannot be completely one-sided. By contrast, each party produces "news" that always supports its own policy. Parties L and R, therefore, are like news outlets with editorial positions 0 and 1, respectively. We refer to this party-produced news as propaganda.

Since there is a continuum of voters, there is zero probability that an individual vote is pivotal. To get around the "paradox of voting," we follow CS in assuming that each voter cares about voting "correctly." This means each voter acts as if he were the median voter, consuming media and voting to maximize utility accordingly. It is also assumed that although the explicit price of news is zero, a voter consumes news if and only if he perceives doing so strictly improves his voting decision.[13] There must at least be some psychological benefit

[13]It would not affect the welfare analysis if we instead assumed any voter for whom no news outlet improves his voting decision–i.e. the most extreme voters–gets news or propaganda from the outlet or party whose editorial position is closest to his ideal cutoff.

to becoming more informed to compensate for the time and effort cost of consuming news. This means that if a voter consumes news from an outlet, then he must vote according to its recommendation.

If the median voter plans to consume news from outlet j, she has expected utility:

$$\begin{aligned} E[u(y,\theta|\theta_j)] &= E[u(R,\theta|\theta<\theta_j)]Pr(\theta<\theta_j)+E[u(L,\theta|\theta\geq\theta_j)]Pr(\theta\geq\theta_j) \\ &= \left(\beta_m^2-\beta_m+0.5\right)-(\beta_m-\theta_j)^2 \,. \end{aligned} \tag{1}$$

Since the first term in (1) is a constant, the voter's objective is to choose j to minimize the second term. Intuitively, the voter wants to vote for party L when $\theta \geq \beta_m$. But if she follows the recommendation of outlet j, he votes for party L when $\theta \geq \theta_j$ instead. When θ_j and β_m are further apart, the voter suffers from a greater information loss, and thus utility loss.

It is consequently straightforward to derive the voting and news consumption behavior of rational voters. Suppose there are n distinct editorial positions $\theta_1 < \theta_2 < ... < \theta_n$. Extreme voters with ideal cutoffs weakly less than $\theta_1/2$ or weakly greater than $(1+\theta_n)/2$ do not consume any news, since these voters are unwilling to vote according to any outlet's recommendation.[14] The first group always votes for L while the second always votes R. Moderate voters with ideal cutoffs between $\theta_1/2$ and $(1+\theta_n)/2$ consume news from the outlet whose editorial position is closest to their political preference.[15] Note that since the voting decision is binary, a voter would not gain from consuming news from more than one outlet.

If voters were fully rational, a standard revealed-preference argument would suggest voters are better off when they can choose from a bigger set of news outlets. But, as we argue above, concerns over a proliferation of media choice stem in part from worries that voters are less than fully rational. We assume voters misperceive the editorial position of each outlet j as

$$\widetilde{\theta}_j \equiv \rho\theta_j + (1-\rho)\frac{1}{2}, \tag{2}$$

[14]We assume if a voter is indifferent between two media options, the voter chooses the more partisan option.

[15]This is a way of formalizing the Downsian idea that rational voters delegate the evaluation of policies to experts with goals similar to their own. The news consumption rule for moderate voters is linear, in the sense of being independent of the value of the particular political preference and whether the closest outlet is located to a voter's right or left, due to the linearity of the utility function.

with $\rho \in (0,1)$.[16] If ρ were 1, voters would be fully rational; if ρ were 0, voters would treat all outlets as neutral, equally likely to report l or r. Quasi-rational voters with $\rho \in (0,1)$ perceive the media positions in a way biased towards 0.5, causing the voters to underestimate their partisanship. If voters misperceive the positions of news outlets, it is natural that they misperceive the positions of the parties as well, hence we assume voters perceive party L's position as $0.5(1-\rho)$ and party R's position as $0.5(\rho+1)$.[17]

Our quasi-rationality assumption can be directly interpreted as voters not sufficiently adjusting their beliefs regarding the positions of partisan outlets from the perfectly centrist position. This may be due to voters "satisficing" and simply not exerting the effort needed to learn or understand the exact positions of partisan outlets. The centrist position of 0.5 is the natural starting point, and it is indeed the average position in all equilibria we analyze. Very similarly, voters may adjust insufficiently due to the "anchoring" bias, with the position 0.5 being the anchor in this context.[18] Operationally, however, what is most important is the assumption's implication: that voters choose outlets that are too partisan (i.e., too likely to confirm the voters' prior preferred party), given the voters' actual political preferences. As discussed above, this behavior is supported by the large literature on partisan selective exposure.

Except for their misperception of the parties and news media, quasi-rational voters are just like fully rational voters. Thus, quasi-rational voters also choose the outlet that offers highest (perceived) expected utility, and vote according to the outlet's endorsement, or choose no outlet. Far left voters with ideal cutoffs less than $0.25(1-\rho)$ do not consume any news; those with ideal cutoffs between $0.25(1-\rho)$ and $0.5\left(0.5(1-\rho)+\widetilde{\theta}_1\right)$ consume liberal propaganda. Both groups always vote for L. Far right voters behave analogously. Moderate voters consume news from the outlet whose perceived editorial position is closest to their own. Compared to fully rational voters, quasi-rational voters are less likely to consume news as they are more

[16] We write $\widetilde{x}$ to denote the voters' misperception of the variable x in general, so $\widetilde{x} = \rho x + (1-\rho)/2$.

[17] This assumption might seem more natural if we replaced the parties with extreme media outlets with editorial positions of 0 or 1. Allowing for these outlets would complicate the equilibrium analysis, but would not affect the welfare results, as these outlets would serve the same purpose as the (uninformative) parties and thus not affect the information received by any voter. Thus our assumption that only parties take extreme positions, and voters misinterpret these positions, is without loss of generality for the welfare analysis.

[18] See, e.g., Simon (1987) and Kahneman et al. (1982) for background on satisficing and anchoring, respectively.

susceptible to party propaganda, and when they do consume news, they tend to choose outlets that are more partisan due to their misperception of the media positions.

Voters' news consumption behavior satisfies a monotone sorting property: more liberal voters consume news from more liberal news outlets. Since media reports are also monotone, if the median voter votes L, voters more liberal than the median voter must also vote L. Likewise, if the median voter votes R, more conservative voters must also vote R. The electoral outcome, therefore, is indeed determined by the median voter.[19]

Before proceeding, a few remarks are in order regarding the differences between our model and that of CS. We simplify their model by assuming the political platforms are fixed. We extend their model by allowing for quasi-rationality, making media competition a multi-round game, and focusing our analysis on equilibrium outcomes with many media firms. We also modify their assumption regarding the shock to voter preferences.

2.2 Media Competition

We model the entry process to the news market as a multi-round entry game. There is an infinite number of potential media outlets. In each entry round $t = 1, 2, ...$ each outlet that has not entered so far independently decides whether to enter the market and, if it chooses to enter, selects an editorial position in $(0, 1)$ and incurs a fixed cost S. Once an outlet has entered, it cannot exit, incurs no additional costs, and its editorial position becomes public and fixed. The entry process stops when no firm enters in some round.

To summarize, the timing of the model is:

1. Given S, the potential media outlets enter the market according to the process described above. The editorial positions of all outlets in the market are observed by all voters.

2. The random variables θ and Δ are realized; the former is observed only by the media outlets and the latter is observed by all voters (and the outlets, but this does not matter).

3. Given $(\theta_1, ..., \theta_n)$ and ρ, voters choose which outlet or party, if any, to consume news from, and observe the outlets' news reports.

4. All voters vote; the party with the majority of votes is elected, and voters obtain their

[19] Unless the median voter's outlet is the most conservative outlet that reports l, and the median voter is the most conservative reader of that outlet, at least some voters who are more conservative than the median voter will vote L when the median voter does. Hence, it is a probability-zero event that only a weak majority votes L when the median voter does.

payoffs.

We assume that media outlets set their editorial positions before the realization of Δ and θ, as the ideological reputation of a news outlet is hard to change, but political preferences may vary significantly across elections. We also assume each media outlet's revenue is equal to the size of its readership (revenue comes only from advertising). In reality, most Internet news sites are free. Each outlet's readership size is a stochastic function of Δ. Define

$$F^*(x) \equiv \frac{1}{2\delta}\int_{-\delta}^{\delta} F(x-\Delta)\, d\Delta$$

as the expected number of voters with ideal cutoff less than x. Let f^* denote the density of F^*. It is straightforward to show that f^*, like f, is also symmetric and strictly increasing when $\theta < 0.5$.

Let $\Theta = (\theta_1, ..., \theta_n)$, denote the editorial positions of n outlets, with $0 < \theta_1 < ... < \theta_n < 1$. Write $\widetilde{\theta}_0$ for the perceived position of party L, and $\widetilde{\theta}_{n+1}$ for the perceived position of party R. The expected market size of outlet i is

$$S_i(\Theta) \equiv F^*(0.5(\widetilde{\theta}_i + \widetilde{\theta}_{i+1})) - F^*(0.5(\widetilde{\theta}_i + \widetilde{\theta}_{i-1})).$$

When multiple outlets have the same position, they split the position's market share equally.

A strategy for each potential media outlet is a series of functions that determines at each entry round (if it occurs and if the outlet has not entered yet), whether to enter and, if it enters, what position to take, given the entry decisions of the other firms up to that point. A strategy profile of all potential entrants is a subgame perfect Nash equilibrium (SPNE) if it induces a Nash equilibrium in every subgame.

3 General Welfare Analysis

We first analyze how social welfare is affected by changes in the number of media firms and their editorial positions, independent of whether the firms are in their equilibrium positions. This gives intuition both for how the model works, and the relation between media market changes and welfare that are general, and not reliant on any particular equilibrium concept. To simplify, we restrict attention here to a baseline case in which $\delta = 0.5$. This is the natural case to focus on because it allows voters with all preferences in the support of θ, $[0,1]$, to be potentially influential.

Since each voter i's utility is linear in β_i, whose distribution is symmetric across β_m, average voter utility is equal to the median voter's utility.[20] And as discussed above, the electoral outcome is indeed determined by the vote of the median voter. Consequently we only need to analyze the median voter's welfare to analyze social welfare.

Suppose there are n outlets with positions $\theta_1 < ... < \theta_n$. From (1), given β_m the expected welfare loss (WL) when the median voter follows the endorsement of outlet i is $(\beta_m - \theta_i)^2$.[21] When $\delta = 0.5$, β_m has distribution $U[0,1]$. Expected WL unconditional on β_m is then

$$\begin{aligned} WL(\theta_1, ..., \theta_n) &= \int_0^{0.5(\widetilde{\theta}_0+\widetilde{\theta}_1)} \beta_m^2 d\beta_m + \sum_{j=1}^{n} \int_{0.5\left(\widetilde{\theta}_{j-1}+\widetilde{\theta}_j\right)}^{0.5\left(\widetilde{\theta}_j+\widetilde{\theta}_{j+1}\right)} (\beta_m - \theta_j)^2 \, d\beta_m \\ &+ \int_{0.5(\widetilde{\theta}_n+\widetilde{\theta}_{n+1})}^{1} (\beta_m - 1)^2 \, d\beta_m. \qquad (3) \end{aligned}$$

To understand this, recall that the median voter optimally gets news from outlet i, for $i \in \{1, ..., n\}$, when β_m is closer to the perceived position of i than to that of any other outlet or party, i.e. when $\beta_m \in \left(0.5(\widetilde{\theta}_{i-1} + \widetilde{\theta}_i), 0.5(\widetilde{\theta}_i + \widetilde{\theta}_{i+1})\right)$. Since the support of β_m is $[0,1]$, the median voter may choose to get news from any of the n outlets. This explains the middle term on the right-hand side (RHS) of (3). The median voter may also choose to get propaganda or no news at all. This occurs when $\beta_m < 0.5(\widetilde{\theta}_0 + \widetilde{\theta}_1)$ or $\beta_m > 0.5(\widetilde{\theta}_n + \widetilde{\theta}_{n+1})$. But in those cases he either always votes L or always votes R, so his welfare loss is the same whether he gets propaganda or not (β_m^2 and $(\beta_m - 1)^2$, respectively). This explains the first and last terms on the RHS of (3).

The marginal effect of θ_i, $i \in \{1, ..., n\}$ on WL can be written:

$$\begin{aligned} \frac{\partial WL}{\partial \theta_i} &= \underbrace{\rho\left(\theta_{i+1} - \theta_{i-1}\right)\left(\theta_i - E\left(\beta_m | \beta_m \in \left[0.5\left(\widetilde{\theta}_{i-1} + \widetilde{\theta}_i\right), 0.5\left(\widetilde{\theta}_i + \widetilde{\theta}_{i+1}\right)\right]\right)\right)}_{\text{Direct Effect}} \\ &+ \underbrace{0.5\rho\left(1-\rho\right)\left(\theta_{i+1} - \theta_i\right)\left(1 - \left(\theta_{i+1} + \theta_i\right)\right)}_{\text{Readership Effect (Right)}} + \underbrace{0.5\rho\left(1-\rho\right)\left(\theta_i - \theta_{i-1}\right)\left(1 - \left(\theta_i + \theta_{i-1}\right)\right)}_{\text{Readership Effect (Left)}} \qquad (4) \end{aligned}$$

[20] We ignore news firm profits to focus on voter welfare. It would be difficult to compare these outcomes.

[21] Welfare loss is defined as the difference between voter utility with full information (i.e. when the voter observes θ himself or gets news from an outlet with editorial position equal to the voter's ideal cutoff) and actual voter utility.

The direct effect of an increase in θ_i is the effect that results from the change in i's position, holding the readership of i fixed. This only affects WL when the median voter is part of i's readership, i.e. when $\beta_m \in \left[0.5\left(\widetilde{\theta}_{i-1}+\widetilde{\theta}_i\right), 0.5\left(\widetilde{\theta}_i+\widetilde{\theta}_{i+1}\right)\right]$. The direct effect is the effect of i becoming marginally more conservative; after the change in i's position the median voter votes R instead of L when the state is θ_i.

Since the first part of the direct effect, $\rho\left(\theta_{i+1}-\theta_{i-1}\right)$, is always positive, the direct effect's sign is determined by the difference between θ_i and the expected ideal cutoff of the "potential median voters" (those with ideal cutoffs in $[0.5-\delta, 0.5+\delta]$) who consume news from outlet i. Since quasi-rational consumers tend to consume excessively partisan news, this sign tends to be negative for liberal outlets. Thus, when a liberal outlet becomes marginally more conservative, the direct effect is for WL to decrease, i.e. welfare improves. A liberal outlet becoming marginally more liberal causes welfare to worsen. The conservative side is symmetric.

A change in θ_i also affects the readership composition, or extensive margin, of outlet i and its neighboring outlets. As outlet i becomes more conservative, it gains the most liberal consumers from more conservative neighboring outlet while losing its own most liberal consumers to its liberal neighbor. These effects, which we refer to as the readership effects, are captured by the second and third terms on the RHS of (4).[22] Note that they are zero when $\rho = 1$. Since the readership effects only involve voters indifferent between two outlets, and a rational voter indifferent between two outlets must obtain the same utility from each, there is no welfare effect when a rational voter chooses to switch outlets.

But when a quasi-rational voter is indifferent between two outlets, she would be strictly better off choosing the more moderate one. Thus both readership effects can easily be signed as positive if $\rho \in (0,1)$ for liberal outlets, and both effects are negative for conservative outlets. This means when outlets move towards the center, the readership effects increase WL. As outlets "spread out" and become more partisan, the readership effects reduce WL by inducing voters to consume news from more moderate sources.

Since β_m is uniformly distributed,

$$E\left(\beta_m \middle| \beta_m \in \left[0.5\left(\widetilde{\theta}^*_{i-1}+\widetilde{\theta}^*_i\right), 0.5\left(\widetilde{\theta}^*_i+\widetilde{\theta}^*_{i+1}\right)\right]\right) = 0.25\left(\widetilde{\theta}^*_{i-1}+2\widetilde{\theta}^*_i+\widetilde{\theta}^*_{i+1}\right). \tag{5}$$

[22]See Durante and Knight (forthcoming) for empirical evidence of this type of behavior; they found that when the center-right took control of the Italian government from the center-left, causing the slant of public television to move right, this attracted some new right-leaning viewers to public television, while left-leaning viewers defected for other, more leftist media sources.

Substituting (5) into (4) and simplifying,

$$\frac{\partial WL}{\partial \theta_i} = 0.5\rho(2-\rho)(\theta_{i+1}-\theta_{i-1})(\theta_i - 0.5(\theta_{i+1}+\theta_{i-1})). \tag{6}$$

The sign of this expression is determined by the sign of $(\theta_i - 0.5(\theta_{i+1}+\theta_{i-1}))$. It follows that, in general, WL increases when an outlet moves closer to its nearer neighbor, and WL decreases when outlets move towards the more distant neighbor. Moreover, the outlets should be evenly spaced for $\frac{\partial WL}{\partial \theta_i} = 0$ for each i, the necessary condition to attain a welfare maximum, for a given number of outlets.

To elaborate further by example, suppose outlets $i-1, i$ and $i+1$ are all liberal ($\theta_{i-1} < \theta_i < \theta_{i+1} < 0.5$). Then the readership effects for i are both positive. If the direct effect is also positive, which occurs when i is more conservative than its average potential median voter reader, then clearly $\frac{\partial WL}{\partial \theta_i} > 0$, and welfare would improve if i became more liberal (θ_i decreased). If i is sufficiently liberal, then the direct effect will be negative. This makes the sign of $\frac{\partial WL}{\partial \theta_i}$ ambiguous. But once the direct effect is negative, its magnitude increases as i becomes more liberal. Intuitively, i's readers are getting news that is increasingly too partisan as i moves left. Also, it is clear from (4) that the left readership effect goes to zero as i moves left, while the right effect gets larger. The changes in these two effects roughly cancel. Consequently, when i is sufficiently far left, then the direct effect dominates and $\frac{\partial WL}{\partial \theta_i} < 0$.

We obtain a clean closed form expression for $\frac{\partial WL}{\partial \theta_i}$ in (6) due to the assumption of uniform Δ. But we can note some other interesting implications of (4) that do not rely on this assumption. Since the readership effects are zero when $\rho = 1$, outlet i should take a position so its direct effect is zero to achieve $\frac{\partial WL}{\partial \theta_i} = 0$ when voters are rational. That is, each outlet's position should equal the average preference of its potential median voter readers (θ_i should equal $E\left(\beta_m | \beta_m \in \left[0.5\left(\widetilde{\theta}_{i-1}+\widetilde{\theta}_i\right), 0.5\left(\widetilde{\theta}_i+\widetilde{\theta}_{i+1}\right)\right]\right)$); this is unsurprising since it is essentially a standard welfare result for horizontally differentiated products. However, since the readership effects are always non-zero when $\rho < 1$, this implies the direct effect needs to also be non-zero to cancel them out and make $\frac{\partial WL}{\partial \theta_i} = 0$ to minimize WL. This means that, in general, partisan outlets should take positions that are *more* partisan than their average potential median voter reader when voters are *quasi-rational*. This is due to the endogenous nature of readership; when $\rho < 1$ and readers choose too partisan outlets, each outlet should be more partisan to counter readership losses that would occur otherwise.

These results are summarized by the following proposition.

Proposition 3.1. *Suppose there are n outlets and $\delta = 0.5$. Then:*

1. *For any $i \in \{1, ..., n\}$, $\frac{\partial WL}{\partial \theta_i} > (=) < 0$ iff $\theta_i > (=)\,(<)\,0.5(\theta_{i+1} + \theta_{i-1})$.*

2. *Welfare is maximized only if for each outlet i such that $\theta_{i+1} < 0.5$ or $\theta_{i-1} > 0.5$: $\theta_i < (>)\, E\left(\beta_m | \beta_m \in \left[0.5\left(\widetilde{\theta}_{i-1} + \widetilde{\theta}_i\right), 0.5\left(\widetilde{\theta}_i + \widetilde{\theta}_{i+1}\right)\right]\right)$ if $\theta_i < (>)\, 0.5$.*

We discuss one additional preliminary general result. We can use (4) and (6) to sign the effect of market entry. Suppose outlet i was an entrant and took a position $\theta_i \in [\theta_{i-1}, \theta_{i+1}]$. Clearly welfare would be unaffected by entry if $\theta_i = \theta_{i-1}$ or $\theta_i = \theta_{i+1}$, and welfare is continuous in θ_i for all $\theta_i \in [\theta_{i-1}, \theta_{i+1}]$. Moreover, (6) implies the welfare effect of entry would be weakly increasing in θ_i for $\theta_i \in [\theta_{i-1}, 0.5(\theta_{i-1} + \theta_{i+1})]$, and otherwise weakly decreasing in θ_i, strictly if $\theta_i \neq 0.5(\theta_{i-1} + \theta_{i+1})$. Thus, welfare is always strictly improved by entry, when the entrant takes a distinct editorial position (to the left of the most liberal existing outlet, right of the most conservative outlet, or in the middle). While this result would be almost trivial if voters made rational choices, the result is striking given that it holds for all $\rho > 0$.

Proposition 3.2. *Suppose there are n outlets and $\delta = 0.5$. Then if a new outlet enters the market and takes position $\theta_e \in (0, 1) \setminus \{\theta_1, ..., \theta_n\}$, then welfare strictly improves.*

Both of these propositions suggest that media proliferation improves welfare despite quasi-rationality. Proposition 3.2 is unambiguous, while Proposition 3.1 would suggest this if proliferation is associated with outlets spreading out and becoming more partisan. However, the results do not describe the relation between declining S and welfare when outlets are in their equilibrium positions. The results also do not apply to values of δ other than 0.5. The following sections address these issues.

4 Equilibrium

This section formally characterizes the equilibrium editorial positions and briefly discusses the intuition for them. If S is too large the market cannot support even a monopoly outlet; henceforth, we assume $S < \overline{S} \equiv 1 - 2F^*\left(0.5\left(1 - 0.5\rho\right)\right)$ so that there is at least one active outlet. Let $\zeta_0 = 0$ and define ζ_i, for $i \geq 1$, recursively by the equation

$$F^*\left(\widetilde{\zeta}_i\right) - F^*\left(\frac{\widetilde{\zeta}_i + \widetilde{\zeta}_{i-1}}{2}\right) = S. \tag{7}$$

Let $q(S) \equiv \max\{i|\zeta_i < 0.5\}$.[23]

Proposition 4.1. *When $S \geq 0.5 - F^*(0.5(1-0.5\rho))$, there is a pure-strategy SPNE where one outlet enters immediately at 0.5 and other potential entrants are deterred. Otherwise, for all $i \leq q(S)$, a pair of outlets enters at positions ζ_i and $1-\zeta_i$, respectively. If, in addition, $S < 1 - 2F^*\left(0.5\left(0.5 + \widetilde{\zeta}_{q(S)}\right)\right)$, there is a centrist outlet at 0.5.*

A proof is provided in the appendix. We conjecture this equilibrium is unique, except for a measure-zero set of S where a firm may be exactly indifferent about entering at 0.5 (the entry process is explained below). Subsequent comparative statics and welfare analysis assume that, if there are multiple equilibria, then this is the equilibrium that is selected.[24] The issue of indifference regarding entry for some S does not affect any of the subsequent analysis.

The intuition for how entry-deterrence incentives leads to this equilibrium is explained as follows. Panel A of Figure 1 shows an example of an equilibrium. The four partisan outlets (outlets 1, 2, 4, and 5) are located as close to 0.5 as possible, due to f^* being single-peaked, while deterring entry on their flanks. Entry is deterred since the best an entrant could do is choose a position marginally more partisan than an existing outlet and obtain a market size of just under S. If an active outlet deviated toward 0.5, then an entrant could enter in the next round and obtain a market size greater than S by taking the outlet's equilibrium position. This would cause the deviating outlet to end up with a market size smaller than S. This is shown in Panel B, for the case of outlet 2 deviating.[25]

[23]Given ζ_{i-1}, ζ_i is uniquely defined since $f(\zeta)$ is increasing when ζ is less than 0.5.

[24]Even if there are multiple equilibria, this one is highly plausible, as firm behavior in it is consistent with the empirical patterns in media discussed above (how media were more centrist when costs were higher, and have become more partisan as technology has evolved and the number of outlets has increased). Moreover, while it is important to understand equilibrium media behavior, we again note that many of our welfare analysis results do not depend on media outlets behaving as they do in any particular equilibrium.

[25]It is shown in the formal proof that it is subgame perfect for the entrant to take the original position of the deviating outlet.

Let

$$S^* \equiv \left\{S \in \left(0, \overline{S}\right) | S = 1 - 2F^* \left(0.5 \left(0.5 + \widetilde{\zeta}_{q(S)}\right)\right)\right\}; \tag{8}$$

$$S^{**} \equiv \left\{S \in \left(0, \overline{S}\right) | \zeta_{q(S)} = 0.5\right\}. \tag{9}$$

S^* and S^{**} are the set of S where entry occurs after a marginal decline in S. If $S \in S^*$ the new outlet enters at 0.5, and if $S \in S^{**}$, the entrant locates marginally close to 0.5. This is due to the other outlets deterring entry on their more partisan flanks. The position 0.5 is unoccupied before the entry for $S \in S^*$, but there is an existing centrist outlet before entry for $S \in S^{**}$. In this latter case, entry occurs when the existing centrist's market size would have just exceeded $2S$, and after entry the existing centrist takes a marginally non-centrist position symmetric to the entrant's. As S declines, the two near-centrists spread out (like other outlets, just enough to deter entry on their flanks). Eventually the market size of an outlet that took position 0.5 would equal S. When this occurs, entry again occurs at 0.5. As S continues to decline, all partisan outlets continue to spread out to deter entry, while the centrist outlet stays put. Eventually the centrist outlet's market size is $2S$ again and entry again occurs at 0.5, and the process repeats itself. The number of outlets goes to infinity as S goes to zero.[26]

The following corollary summarizes the comparative statics of equilibrium positions with respect to S. Let $\theta_1^* \leq .... \leq \theta_n^*$ denote the equilibrium positions of the active outlets, which are each a function of S (we suppress the argument), and let $\theta_0^* = 0$ and $\theta_{n+1}^* = 1$.

Corollary 4.2. *As S declines, existing outlets adopt more partisan positions. For $i = 1, ..., n$,*

$$\frac{d\theta_i^*}{dS} < (>)\, 0 \text{ if } \theta_i^* > (<)\, 0.5.$$

If $\theta_i^* = 0.5$ and $S \not\in S^{**}$, then $\frac{d\theta_i^*}{dS} = 0$. For any $S' \in S^*$, the number of active outlets is $2q\left(S'\right)$ and there exists $S'' < S'$ such that for all $S \in \left(S'', S'\right)$, the number increases to $2q\left(S'\right) + 1$ with the new outlet entering at 0.5. For any $S' \in S^{**}$ and $\epsilon > 0$, the number of active outlets is $2q\left(S'\right) + 1$ and there exists $S'' < S'$ such that for all $S \in \left(S'', S'\right)$, the number increases to

[26]We would like to stress that our discussion relates to comparative statics. The results should not be interpreted as implying that as S declines over time existing media outlets will change their editorial positions or that entries always occur at the center during this process. A dynamic analysis of the entry process is beyond the scope of this paper.

$2q(S') + 2$ *with the new outlet entering at a position in* $(0.5 - \epsilon, 0.5)$.

Figure 2 illustrates how the number of outlets and their positions change as S declines for different values of ρ. $\Theta^*(S) \equiv (\theta_1^*(S), ..., \theta_n^*(S))$ denotes the equilibrium positions of the active outlets. Since the density of voters is higher near the center, outlets nearer the center must be closer together to prevent entry. Thus, for any given S each non-centrist outlet is closer to its moderate neighbor than its partisan neighbor. This result is formalized as follows.

Corollary 4.3. *For all* $i = 1, ..., n$, $\theta_i^* > (<)(=)(\theta_{i+1}^* + \theta_{i-1}^*)/2$ *if* $\theta_i^* < (>)(=)0.5$.[27]

The proof is in the appendix. We present one additional result. The gap between adjacent outlets narrows as S becomes small, and voters have a more diverse set of choices when S is low; the proof is in the appendix. For any $\varepsilon > 0$, there exists S' such that for all $S < S'$, $\theta_1^* < 2\varepsilon$. By Corollary 4.3, the distance between any two adjacent outlets must then be less than 2ε. Hence, any position must be within ε of some outlet when $S < S'$.

Corollary 4.4. *For all* $\epsilon > 0$ *and* $x \in [0, 1]$, $\exists S' > 0$ *such that* $\forall S < S'$, *there exists an outlet* i *with an equilibrium editorial position in the* ε *neighborhood of* x.

5 Equilibrium Welfare

We now analyze welfare when outlets are in their equilibrium positions. The last section showed a declining S creates two possible effects. First, existing outlets spread out to protect their flanks. Second a new outlet enters the market at the center whenever $S \in S^* \cup S^{**}$. If there is an incumbent outlet at 0.5, then entry has only a marginal effect on welfare. This effect is equivalent to that which would occur if there were two outlets at 0.5 that became symmetrically marginally partisan. The effect of this type of change in market structure is analyzed further below. But if there is no outlet at 0.5, then entry strictly improves welfare. This is implied by the analysis in Section 3, but is especially clear for equilibrium entry as it always occurs at the perfectly centrist position. Since voters in our model overestimate the information value of non-centrist outlets, a voter must be better off if he switches to the centrist outlet after it enters.

[27] Strictly speaking, the corollary only holds for almost all S as there is a measure-zero set of S where if $\theta_i^* = 0.5$, then either θ_{i-1}^* or θ_{i+1}^* (but not both) also equals 0.5.

Lemma 5.1. *Suppose none of the existing outlets has adopted a position of* 0.5*. Then adding a new outlet at* 0.5*, holding the positions of the existing outlets fixed, increases welfare.*

The welfare consequence of the spreading out of the existing outlets is more complicated. Let $WL(\Theta^*(S))$ denote the expected welfare loss for the median voter when outlets are in their equilibrium positions, given S. We sometimes write $WL(\Theta^*(S))$ as just $WL^*(S)$ or WL^* for convenience. For $S \notin S^* \cup S^{**}$, the marginal effect of S on WL^* is

$$\frac{dWL^*}{dS} = \sum_{i=\underline{\alpha}}^{\overline{\alpha}} \frac{\partial WL}{\partial \theta_i}\bigg|_{\Theta=\Theta^*(S)} \frac{d\theta_i^*}{dS}, \tag{10}$$

with

$$\begin{aligned} \underline{\alpha} &\equiv \min\left\{ i \in \{1, ..., n\} \ \mid 0.5(\widetilde{\theta}_i + \widetilde{\theta}_{i+1}) \geq 0.5 - \delta \right\}; \\ \overline{\alpha} &\equiv \max\left\{ i \in \{1, ..., n\} \ \mid 0.5(\widetilde{\theta}_i + \widetilde{\theta}_{i-1}) \leq 0.5 + \delta \right\}. \end{aligned}$$

Outlets $\underline{\alpha}$ and $\overline{\alpha}$ are the most liberal and most conservative media outlets that the median voter may get news from, respectively. Outlets more partisan then outlets $\underline{\alpha}$ and $\overline{\alpha}$ have no effect on WL as their consumers never decide the election outcome. In the baseline case, $\underline{\alpha} = 1$ and $\overline{\alpha} = n$; when δ is less than 0.5 it is possible that $\underline{\alpha} > 1$ and $\overline{\alpha} < n$.

In Section 3, we derived an expression for $\frac{\partial WL}{\partial \theta_i}$ for the baseline case. It is easily shown this expression is the same for $i \in \{\underline{\alpha}+1, ..., \overline{\alpha}-1\}$, independent of δ. But the expression may be different for outlets $\underline{\alpha}$ and $\overline{\alpha}$. To see this, note that $\frac{\partial WL}{\partial \theta_i}$, $i \in \{1, ..., n\}$, for the baseline was composed of a direct effect and two readership effects, as shown in (4). The readership effects of i becoming marginally more conservative are that i loses potential median voter readers to the outlet to its left, and gains them from the outlet to its right. For $\delta < 0.5$, this is not necessarily true. Some outlets may only have one readership effect.

For example, suppose $\delta = 0.1$, so $\beta_m \in [0.4, 0.6]$. Suppose also $n = 2$, $\theta_1 = 1 - \theta_2 = 0.3$ and $\rho = 0.5$. Then $0.5(\widetilde{\theta}_0 + \widetilde{\theta}_1) < 0.4$ and $0.5(\widetilde{\theta}_2 + \widetilde{\theta}_3) > 0.6$, so potential median voters always get news from outlets 1 or 2, and never get propaganda. This means that when outlet 1 becomes more liberal, while it gains readers from the liberal party, it gains no readers who are potential median voters. Thus there is no left readership effect. Similarly, outlet 2 has no right readership effect.

Thus the marginal welfare effect of θ_i, $i \in \{\underline{\alpha}, ..., \overline{\alpha}\}$, may be written as

$$\begin{aligned}\frac{\partial WL}{\partial \theta_i} &= \frac{1}{2\delta}[\underbrace{\rho\left(\theta_{i+1}-\theta_{i-1}\right)\left(\theta_i - E\left(\beta_m | \beta_m \in \left[0.5\left(\widetilde{\theta}_{i-1}+\widetilde{\theta}_i\right), 0.5\left(\widetilde{\theta}_i+\widetilde{\theta}_{i+1}\right)\right]\right)\right)}_{\text{Direct Effect}} \\ &+ \underbrace{0.5\rho\left(1-\rho\right)\left(\theta_{i+1}-\theta_i\right)\left(1-\left(\theta_{i+1}+\theta_i\right)\right)I^R_{\theta_i}}_{\text{Readership Effect (Right)}} + \underbrace{0.5\rho\left(1-\rho\right)\left(\theta_i-\theta_{i-1}\right)\left(1-\left(\theta_i+\theta_{i-1}\right)\right)I^L_{\theta_i}}_{\text{Readership Effect (Left)}}], \quad (11)\end{aligned}$$

where $I^R_{\theta_i}$ is an indicator function that equals 1 when $\delta + 0.5 > 0.5\left(\widetilde{\theta}_i + \widetilde{\theta}_{i+1}\right)$, and $I^L_{\theta_i}$ equals 1 when $0.5 - \delta < 0.5\left(\widetilde{\theta}_{i-1} + \widetilde{\theta}_i\right)$.[28]

Let

$$Q\left(S\right) \equiv \left(\frac{\left(1-\rho\right)0.5 + \widetilde{\theta}^*_1}{2}, \frac{\left(1+\rho\right)0.5 + \widetilde{\theta}^*_n}{2}\right)$$

denote the set of ideal cutoffs of news-consuming voters. If $Q\left(S\right) \subset [0.5-\delta, 0.5+\delta]$, then $I^R_{\theta_i} = 1$ and $I^L_{\theta_i} = 1$ for all $i \in \{1, ..., n\}$. This means the probability the median voter consumes propaganda is strictly positive, as $\beta_m \in [0.5-\delta, 0.5+\delta]$. In this case, (6) holds for all $i \in \{1, ..., n\}$, and it follows that

$$\left.\frac{\partial WL}{\partial \theta_i}\right|_{\Theta=\Theta^*(S)} > (=) < 0 \text{ iff } \theta^*_i > (=)\,(<)\,0.5(\theta^*_{i+1} + \theta^*_{i-1}).$$

The baseline result regarding the marginal effect of a change in outlet position generalizes from $\delta = 0.5$ to the case of $Q\left(S\right) \subset [0.5-\delta, 0.5+\delta]$.

From Corollary 4.3 we know that in equilibrium, each outlet, with the exception of the one at the center, is strictly closer to its more moderate neighbor,[29] and from Corollary 4.2 we know the signs of the marginal effect of S on the equilibrium outlet positions. Hence, the marginal effect of S on WL can be unambiguously signed:

$$\frac{dWL^*}{dS} = \sum_{i=1}^{q(S)} \left.\underbrace{\frac{\partial WL}{\partial \theta_i}}_{+}\right|_{\Theta=\Theta^*(S)} \underbrace{\frac{d\theta^*_i}{dS}}_{+} + \sum_{i=n+1-q(S)}^{n} \left.\underbrace{\frac{\partial WL}{\partial \theta_i}}_{-}\right|_{\Theta=\Theta^*(S)} \underbrace{\frac{d\theta^*_i}{dS}}_{-} > 0. \quad (12)$$

Since $\widetilde{\theta}^*_1 \geq \left(1-\rho\right)0.5$ and $\widetilde{\theta}^*_n \leq \left(1+\rho\right)0.5$, $Q\left(S\right) \subset [0.5-\delta, 0.5+\delta]$ for all S when $\rho < 2\delta$. We have the following proposition.

[28]The right-hand side includes the term $\frac{1}{2\delta}$ as this is the density of Δ, but this does not affect the results.

[29]The centrist outlet (if there is one) is equi-distant from its two neighbors, or has the same position as the other centrist outlet.

Proposition 5.2. *When $\rho < 2\delta$, welfare strictly increases as S decreases.*

The proposition says when rationality is sufficiently *low*, welfare monotonically improves due to media proliferation. In Section 3, we showed that welfare increases as the outlets spread out if each outlet is located closer to its more moderate neighbor, when $\delta = 0.5$. In Section 4 we showed that due to single-peaked f, outlets will indeed locate closer to their moderate neighbors in equilibrium, and spread out as S declines. The proposition combines these results, and generalizes them to cases such that δ is sufficiently high relative to ρ. Intuitively, this is what is required for potential median voters to have extreme news preferences. If δ is large, then the median voter can be ideologically extreme. If that occurs (the realization of Δ is large) she will have extreme news preferences for all ρ. If δ is small, then the median voter is sure to be moderate. But she can still have extreme news preferences if ρ is small too.

The key intuition for why welfare improves is the same as that described in Section 3. The direct effect of an outlet becoming more partisan is likely harmful, while the readership effects are always beneficial. When an outlet is located closer to its more moderate neighbor, the direct effect is weak. If there are two readership effects, which $\rho < 2\delta$ guarantees, they dominate the direct effect, so the overall effect of an outlet becoming more partisan is beneficial. In the introduction, we said the intuition for welfare improving in this case (voters with extreme news preferences can be the median voter) is that proliferation increases the chance these voters get some news. This is equivalent to there being two readership effects for each outlet. While for most outlets the readership effects involve voters switching from one outlet to another, for each of the most partisan outlets, one of the readership effects is due to voters switching from propaganda to that outlet, i.e. from no news to news.

Figure 3 illustrates how the media outlets' positions and WL change with S for this case. As S goes to zero, WL declines from about 0.05 to 0.04 when $\rho = 1/3$, and from about 0.03 to 0.01 when $\rho = 2/3$. To get a sense of the scale of these effects, note that if the median voter's ideal cutoff is 0.5 and she gets news from outlet 1 with $\theta_1 = 1/3$, which is a fairly severe case of the median voter getting too partisan news, then WL $= (1/2 - 1/3)^2 = 0.028$. If $\beta_m = 0.25$ and the median voter gets no news, then WL$=0.25^2 = 0.0625$. Thus, the WL values represented in the figure correspond to losses that would occur for particular situations with far from optimal news sources. These numbers may seem small given the linear utility function, which implies potentially much larger losses from voting incorrectly. For example, if

$\beta_m = 0.5$ and $\theta < 0.5$ so the median voter should vote R, her expected utility from voting R is 0.25 and from voting L is -0.25, so the loss from voting incorrectly is 0.5. But the welfare loss from following the endorsement of sub-optimal media outlets is usually not nearly this large because these outlets tend to only endorse the "wrong" party when θ is close to β, and so the utility difference between the parties is small. Moreover, the wrong endorsement occurs infrequently in equilibrium, since partisan voters never choose outlets with editorial positions on the other side of the spectrum, and centrist voters are never forced to get news from outlets that are extremely partisan. This highlights a subtle result from our model, which is that due to the structure of voting mistakes and news reporting, it is very unlikely for the welfare costs of sub-optimal news consumption to be large relative to the scale of the utility function.[30]

Note that entry at 0.5 causes a discrete drop in WL only when the number of incumbent outlets is even. The fact that WL declines monotonically follows from single-peaked f, since this is what drives outlets locating closer to their more moderate neighbors. This is a standard assumption in this literature and for empirical evidence in support of it see Radcliff (1993). However, the assumption is not obviously true–for example, the recent literature on political polarization suggests the distribution of voter preferences may be bi-modal. If the assumption did not hold, Propositions 3.1 and 3.2 imply that the *net* welfare effects of media proliferation would still be positive, though not necessarily monotone.[31]

When $Q(S) \supseteq [0.5 - \delta, 0.5 + \delta]$, voters who are not consuming news have no influence over election outcomes, so a lower S that increases the fraction of these voters that do get news may not improve welfare. We illustrate the point with the duopoly case. Suppose S is such that there are two active outlets in equilibrium and $Q(S) \supseteq [0.5 - \delta, 0.5 + \delta]$. Since $I^L_{\theta_1^*} = I^R_{\theta_2^*} = 0$ in this case, we have can use (10), (11) and the symmetry of the model[32] to

[30] To be more concrete, consider the case of the median voter having ideal cutoff of 0.5 and getting news from an outlet with position 0.3. Then the voter only votes incorrectly when $\theta \in [0.3, 0.5]$ and her average utility then is -0.1. Her average utility from voting correctly would have been 0.1. Moreover, the probability of voting incorrectly is only $Pr(\theta \in [0.3, 0.5]) = 0.2$. So WL is only $0.2(0.1 - (-0.1)) = 0.04$. (Social) WL could be substantially higher than it is in the figure if ρ and δ were very small, or voters mistakenly chose news sources with politics on the other side of the spectrum from their own ideologies.

[31] Moreover, if voter preferences were bi-modal rather than single-peaked, then relatively extreme outlets would still have incentives to move toward the modes, so they would still locate closer to their moderate neighbors in equilibrium.

[32] The existing readership effects cancel when both outlets become marginally more partisan.

show

$$\begin{aligned}\frac{dWL^*}{dS} &= \left.\frac{\partial WL}{\partial \theta_1}\right|_{\Theta=\left(\theta_1^*,\theta_2^*\right)}\frac{d\theta_1^*}{dS}+\left.\frac{\partial WL}{\partial \theta_2}\right|_{\Theta=\left(\theta_1^*,\theta_2^*\right)}\frac{d\theta_2^*}{dS}\\ &= 2\rho\theta_2^*\left(\theta_1^*-E\left(\beta_m|\beta_m\in[0.5-\delta,0.5]\right)\right)\frac{d\theta_1^*}{dS}. \qquad (13)\end{aligned}$$

Corollary 4.2 continues to imply that $\frac{d\theta_1^*}{dS}>0$. The sign of a decline in S is thus determined by the relation between the outlet's position and expected ideal cutoff of the median voter, summarized as follows.

Proposition 5.3. *Suppose $Q(S)\supseteq[0.5-\delta,0.5+\delta]$ and there are two active firms in equilibrium. Then a marginal decline in S improves (worsens) welfare iff θ_1^* is strictly greater (less) than the average ideal cutoff of liberal potential median voters.*

In this case, which requires sufficiently *high* ρ ($\geq 2\delta$) to occur, a decline in S lowers welfare when each outlet is more partisan than the average median voter who consumes its news, i.e. the direct effect is the only effect. Welfare increases as S first declines after the entry of the second outlet, but eventually welfare decreases as the outlets spread out. The entry of the third outlet at 0.5 improves welfare. The effects of additional entry and spreading out are difficult to analyze precisely with generality. Broadly speaking, welfare goes through cycles as S declines and the identities of outlets $\underline{\alpha}$ and $\overline{\alpha}$ periodically change.[33] Figure 4 illustrates this relationship with numerical examples. Note that WL is more volatile when S is relatively high.

To examine the overall welfare effects of declining S for the case of $Q(S)\supseteq[0.5-\delta,0.5+\delta]$, we can compare the extreme cases–the limit as S goes to zero and monopoly. By Corollary 4.4, WL converges as S goes to zero to WL with voters choosing any outlet position in $(0,1)$. In this case, a median voter with ideal cutoff $\beta_m\in(0.5(1-\rho),0.5(1+\rho))$ will choose outlet i with $\widetilde{\theta}_i$ arbitrarily close to β_m, i.e. with θ_i arbitrarily close to $\frac{\beta_m-(1-\rho)/2}{\rho}$, while a median voter with β_m outside of this range does not consume news. In monopoly, we know $\theta_1^*=0.5$. To simplify the analysis here, we restrict attention to the case in which the median voter always consumes news from this outlet. This can be shown to be equivalent to $\rho>4\delta$. These

[33]In a previous version of the paper we analyzed a special case (where f is uniform and $\rho=4\delta$) in detail, showing that welfare goes through well-defined cycles, with increasing troughs and peaks that increased only if ρ is sufficiently high, as S goes to zero. Results are available on request.

parameter values thus favor monopoly in the welfare comparison, since they imply increasing n only causes potential median voters to switch outlets, and does not increase the fraction of these voters who read news, as this is always 100%.

In this case the monopoly WL is

$$\int_{0.5-\delta}^{0.5+\delta} (\beta_m - 0.5)^2 \, d\beta_m,$$

while the limiting WL is

$$\lim_{S \to 0} WL^* (S) = \int_{0.5-\delta}^{0.5+\delta} \left(\frac{(1-\rho)(\beta_m - 0.5)}{\rho} \right)^2 d\beta_m. \tag{14}$$

The following is immediate.

Proposition 5.4. *Suppose $\rho > 4\delta$. Then welfare in monopoly is strictly greater than (equal to) (less than) welfare in the limit as S goes to zero, and the number of media outlets becomes arbitrarily large, iff $0.5 > (=)(<)\rho$.*

This says if ρ is less than 0.5, but large relative to δ, then having only a single, centrist outlet prevents voters from consuming partisan news in a socially beneficial way.[34] Irrational voters make very poor choices. Market forces cause the monopoly choice to be a relatively good (centrist) one. So monopoly is better than large choice sets. We should interpret this result carefully, however. A monopoly outlet may be easily captured by special interests and pursue a partisan agenda for reasons other than direct market share maximization. Furthermore, similar results do not extend to duopoly. For any $\epsilon > 0$, define

$$\Phi \equiv \{F | \exists \theta_1 \text{ s.t. } 2(F^*(0.5) - F^*(0.5(0.5 + \widetilde{\theta}_1))) = F^*(\widetilde{\theta}_1) - F^*(0.5(\widetilde{\theta}_1 + (1-\rho)/2)), \widetilde{\theta}_1 - 1/3 < \epsilon\}. \tag{15}$$

Note that uniform F would be in Φ for all $\epsilon > 0$ (however, we still restrict F to be strictly single-peaked). Thus, the set Φ for small ϵ is the set of F's that are very similar to a uniform distribution, or with sufficiently high mass in the tails. In the appendix, we prove the following, which says when F is in this set, then the limiting welfare is always higher than the minimum duopoly welfare.

[34] The fact that welfare in the limit is greater than monopoly welfare when $\rho > 0.5$ actually holds for all δ, but we omit the details explaining this in the interest of brevity.

Proposition 5.5. *There exists $\epsilon > 0$ such that for all $F \in \Phi$, for all $\rho \in (0, 1)$ and $\delta \in (0, 0.5]$,*

$$\max_{S \in S(2)} WL^*(S) > \lim_{S \to 0} WL^*(S),$$

where $S(2)$ is the set of S such that there are two active firms in equilibrium.

The intuition for this result is two-fold. There are two cases of parameter values, $\rho < 2\delta$ and $\rho \geq 2\delta$. In the former, Proposition 5.2 holds and so limiting welfare is greater than any duopoly welfare. In the latter case, then Proposition 5.3 may hold and welfare may decline in duopoly. Moreover, as Proposition 5.4 implies monopoly welfare may be higher than limiting welfare, so duopoly welfare may also be higher, since duopoly welfare equals monopoly welfare when the duopolist first enters and both outlets are centrist. The intuition for why Proposition 5.5 still holds in this case is similar to the intuition for why welfare is most volatile when the number of outlets is small, but greater than one, shown in Figure 4 and mentioned above. As S declines, the duopolist outlets become very extreme in order to attract readers who are much more extreme than the median voter, who must be quite moderate as δ is small. The more extreme voters there are (the greater the mass is in tails of f), the more extreme the duopolists need to become to deter entry. The potential median voters have no recourse to the highly partisan duopolists, and the news the median voter reads is consequently highly partisan and uninformative, and welfare becomes very low when the duopolists maximally differentiate. This problem never occurs when S becomes very small and there is a rich set of (moderate and extreme) media choices.

6 Concluding Remarks

We develop a model that implies when voters with extreme news preferences are politically important, greater media choice is socially beneficial as it increases the chance these voters receive at least some news. Since partisan selective exposure is associated with news preferences being more extreme, selective exposure surprisingly makes this pro-proliferation result more likely to occur. Moreover, proliferation always insures against poor welfare outcomes that can occur in duopoly. In our model we measure the "importance" of a voter by her likelihood of being the median voter. In a richer model, a voter's importance may also depend on the characteristics of the political institutions. For example, extreme voters would be more influential when a super-majority is needed to pass certain legislation, or in party primary elections.

While we hope our analysis enhances understanding of the interaction of technology, media and politics, we fully acknowledge that our model relies on many simplifying assumptions. We view our work as an exploration of outcomes given these assumptions, but think their importance should be explored further in future work. One assumption of ours that is especially questionable is that all media observe the same facts. In reality, news gathering is costly and smaller outlets may not have the resources to conduct in-depth investigations and report high-quality news. Blogs, in particular, are considered likely to report unsubstantiated news and increase the propensity of false rumors to gain traction (Munger (2008)). However, having more outlets also means more news stories and angles on stories are reported. It is therefore unclear how increased media competition affects the overall quality of news.[35] Heterogeneous quality could explain why in reality people often get news from multiple sources, since one source may make a "mistake" (in our model it is an endogenous outcome that consumers get news from at most one outlet). Another reason outside our model why voters obtain news from multiple sources may be that news is multidimensional, and voters prefer different sources for news on different dimensions.

The fact that voters have heterogeneous political preferences in our model provides a clear force making media proliferation beneficial. But in other models, such as Mullainathan and Shleifer (2005), it is assumed that there is one type of unbiased news that is ideal for all consumers to receive. A robustness check we can do to examine this possibility is to substitute 0.5 for β_m in (3), and evaluate $\frac{\partial WL}{\partial \theta_i}$. This yields the welfare effect of a shift in outlet position when each voter's true ideal cutoff is 0.5, but voters choose outlets as they do in our model, so voters still have heterogeneous preferences for partisan news. The result is qualitatively unchanged from what we obtain for the regular model: $\frac{\partial WL}{\partial \theta_i} > (=) < 0$ iff $\theta_i > (=) (<) 0.5(\theta_{i+1} + \theta_{i-1})$, meaning welfare improves as the outlets spread out, and entry is always beneficial in the base-

[35]Bloggers have already contributed to breaking several major news stories, such as the firing of US attorneys by the Bush administration in 2007 and the use of forged documents relating to Bush's national guard service by the TV show *60 Minutes*. See Massing (2009) for a good discussion of these issues. Gentzkow and Shapiro (forthcoming) find evidence that vertical differentiation in online news is substantial, as most webpage visits go to large, centrist, presumably higher quality sites, which attract readers who also visit liberal and conservative partisan sites. This is also suggestive of proliferation being beneficial, or at least not harmful.

line and similar cases.[36] Proliferation still has the beneficial effect of bringing voters into the news market at the extensive margin. This result may not hold in other models, however.

Sunstein (cited above) is perhaps the most outspoken pessimist on the issue of Internet media; he might object to our assumption that it is optimal to match voter and media politics by arguing society benefits when citizens get unexpected news, which is more likely when voters cannot personalize their news source. This might imply even moderate voters should not simply get "moderate" news. In our model there is really no such thing as unexpected news for moderate voters, since they are approximately equally likely to get news endorsing either party. It is not clear how Sunstein's argument would relate to a voting model like ours; perhaps his claim relates to the possibility of multidimensional news discussed just above. If voters undervalued the importance of one dimension, then news in that dimension causing them to change their votes would be "unexpected."

Our model predicts extreme voters consume less media than moderates. But if the model was modified so voters obtained utility from having their prior political preferences confirmed and there were media outlets that produced pure propaganda (we rule this out for simplicity but could allow it), this would cause extremists to always consume media without changing our model's other predictions. This would make the model more consistent with empirics showing partisan voters have always been substantial media consumers (e.g., Prior (2007)).

It is likely difficult to estimate the key parameters, δ and ρ. Still, the model has empirical implications. It predicts there exist some relatively extreme voters–those with ideal cut-offs close to 0 or 1, who consume non-propaganda news only when there are many outlets–who will on average be more informed as a result of proliferation for all ρ and δ. These voters may or may not influence the election, but regardless this is a potentially important and testable claim. How an increase in the number of outlets affects how moderate voters vote is also an empirical issue that would indirectly shed light on the value of ρ. If voters whose political tastes are only marginally different frequently vote differently when there are many outlets, this would imply ρ is low.[37] Our model also predicts that the most extreme voters will be no better or worse informed regardless of the number of media outlets. This is non-trivial, since

[36] In this case $\frac{\partial WL}{\partial \theta_i}$ can be shown to equal $(\rho/2)(\theta_{i+1} - \theta_{i-1})(\theta_i - (\theta_{i+1} + \theta_{i-1})/2)$.

[37] For example, voters with ideal cut-offs of 0.49 and 0.51 should only vote differently 2% of the time. If they choose news from outlets with positions 0.4 and 0.6, due to low ρ, they will vote differently 20% of the time.

these voters may become better informed for a variety of reasons, or even worse informed due to misinformation. This issue, together with some of the others mentioned above, may cause media proliferation to have more harmful effects than those our model identifies.

References

Anand, B. and Di Tella, R. and Galetovic, A. (2007). "Information or Opinion? Media Bias as Product Differentiation," *Journal of Economics & Management Strategy*, vol. 16(3), 635-682.

Andina-Díaz, A. (2007). "Reinforcement vs. change: The political influence of the media" *Public Choice*, vol. 131(1), 65–81.

Baum, M.A. and Kernell, S. (1999). "Has cable ended the golden age of presidential television?" *The American Political Science Review*, vol. 93(1), 99–114.

Baum, M.A. and Groeling, T. (2008). "New media and the polarization of American political discourse," *Political Communication*, vol. 25(4), 345–365.

Bernhardt, D. and Krasa, S. and Polborn, M. (2008). "Political Polarization and the Electoral Effects of Media Bias," *Journal of Public Economics*, vol. 92(5-6), 1092–1104.

Besley, T. and Prat, A. (2006). "Handcuffs for the grabbing hand? Media capture and government accountability," *The American Economic Review*, vol. 96(3), 720–736.

Chan, J. and Suen, W. (2008). "A Spatial Theory of News Consumption and Electoral Competition," *Review of Economic Studies*, vol. 75(3), 699–728.

DellaVigna, S. and Kaplan, E. (2007). "The Fox News Effect: Media Bias and Voting," *The Quarterly Journal of Economics*, vol. 122(3), 699–728.

Downs, A. (1957). *An economic theory of democracy*, Addison-Wesley Publishing, Inc.

Drezner, D.W. and Farrell, H. (2008). "Introduction: Blogs, politics and power: a special issue of Public Choice," *Public Choice*, vol. 134(1), 1–13.

Duggan, J. and Martinelli, C. (2011). "A Spatial Theory of Media Slant and Voter Choice," *The Review of Economic Studies*, vol. 78(2).

Durante, R. and Knight, B. (forthcoming). "Partisan Control, Media Bias, and Viewer Responses: Evidence from Berlusconi's Italy," *Journal of the European Economics Association.*

Garrett, R.K. (2009). "Politically motivated reinforcement seeking: Reframing the selective exposure debate," *Journal of Communication*, vol. 59(4), 676–699.

Gasper, J.T. (2009). "Reporting for sale: the market for news coverage," *Public Choice*, vol. 141(3), 493–508.

Gentzkow, M. and Shapiro, J.M. (2006). "Media bias and reputation," *Journal of Political Economy*, vol. 114(2), 280–316.

Gentzkow, M. and Shapiro, J.M. (forthcoming). "Ideological Segregation Online and Offline," *Quarterly Journal of Economics.*

Iyengar, S. and Hahn, K.S. (2009). "Red media, blue media: Evidence of ideological selectivity in media use," *Journal of Communication*, vol. 59(1), 19–39.

Kahneman, D. and Slovic, P. and Tversky, A (1982). *Judgment under uncertainty: Heuristics and biases*, Cambridge University Press.

Kendall, T.D. (2010). "Strategic political commentary," *Public Choice*, vol. 142(1), 151–175.

Leeson, P.T. (2008). "Media freedom, political knowledge, and participation," *The Journal of Economic Perspectives*, vol. 22(2), 155–170.

Leeson, P.T. and Coyne, C.J. (2005). "Manipulating the media," *Institutions and Economic Development*, vol. 1(2), 67–92.

Coyne, C.J. and Leeson, P.T. (2004). "Read all about it! Understanding the role of media in economic development," *Kyklos*, vol. 57(4), 21–44.

Massing, M. (2009). "The News About the Internet." *The New York Review of Books*. August 13, 2009.

Mullainathan, S. and Shleifer, A. (2005). "The market for news," *American Economic Review*, vol. 95(4), 1031–1053.

Munger, M.C. (2008). “Blogging and political information: truth or truthiness?” *Public Choice*, vol. 134(1), 125–138.

Mutz, D.C. and Martin, P.S. (2001). “Facilitating Communication across Lines of Political Difference: The Role of Mass Media” *American Political Science Review*, vol. 95(1), 97–114.

Nagler, M.G. (2007). “Understanding the Internet’s Relevance to Media Ownership Policy: A Model of Too Many Choices?” *The B.E. Journal of Economic Analysis & Policy (Topics)*, vol. 7(1), art. 29.

Nie, N.H., Miller III, D.W., Golde, S., Butler, D.M. and Winneg, K. (2010). “The World Wide Web and the US Political News Market,” *American Journal of Political Science*, vol. 54(2), 428–439.

Obama, B.H. (2010). “Remarks by the President at University of Michigan Spring Commencement,” May 1, 2010. <<http://www.whitehouse.gov/the-press-office/remarks-president-university-michigan-spring-commencement>>

Pariser, E. (2011). *The filter bubble: What the Internet is hiding from you*, Penguin Press.

Pew Research Center (2008). “2008 Pew Research Center for the People and the Press News Consumption and Believability Study.”

Pew Research Center (2010). “ A Pro-Government, Socially Liberal Generation: Democrats’ Edge Among Millennials Slips.”

Prat, A. and Strömberg, D. (2011). “The political economy of mass media.” Working paper.

Prescott, E.C. and Visscher, M. (1977). “Sequential location among firms with foresight,” *The Bell Journal of Economics*, vol. 8(2), 378–393.

Prior, M. (2005). “News vs. entertainment: How increasing media choice widens gaps in political knowledge and turnout.” *American Journal of Political Science*, vol. 49(3), 577–592.

Prior, M. (2007). *Post-broadcast democracy: How media choice increases inequality in political involvement and polarizes elections*. Cambridge University Press.

Radcliff, B. (1993). "The Structure of Voter Preferences." *The Journal of Politics*, vol. 55(3), 714–719.

Simon, H.A. (1987). "Satisficing," *The new Palgrave: a dictionary of economics* , vol. 4, 243–245.

Strömberg, D. (2004). "Mass media competition, political competition, and public policy." *The Review of Economic Studies*, vol. 71(1).

Stroud, N.J. (2008). "Media use and political predispositions: Revisiting the concept of selective exposure." *Political Behavior*, vol. 30(3), 341–366.

Sunstein, C.R. (2001). *Republic.com*, Princeton University Press.

A Proofs

A.1 Proposition 4.1

A.1.1 Preliminary Lemmas

For any $x, y \in [0,1]$, $x < y$, let $G(x,y) \equiv F^*(y) - F^*(x)$. Define

$$\Psi \equiv \left\{ (x_1, x_2) \,|\, x_1 < 0.5 < x_2,\ \max\left(G\left(\frac{0.5 + \widetilde{x}_1}{2}, 0.5\right), G\left(0.5, \frac{0.5 + \widetilde{x}_2}{2}\right)\right) \leq S \right\},$$

as the set of (x_1, x_2) such that if x_1 is the position of the liberal outlet closest to 0.5 and x_2 the position of the conservative outlet closest to 0.5, then neither the liberal nor the conservative segment of a centrist outlet has a size strictly greater than S.

Lemma A.1. *For any $(x_1, x_2) \in \Psi$ and $y \in [x_1, x_2]$, the function*

$$H(y) \equiv G\left(\frac{\widetilde{y} + \widetilde{x}_1}{2}, \frac{\widetilde{y} + \widetilde{x}_2}{2}\right)$$

has a unique arg max y^* on $[x_1, x_2]$. Furthermore, $y^* < (=)\,(>)\,0.5$ if $|x_1 - 0.5| < (=)\,(>)\,|x_2 - 0.5|$, and $H'(y) < (>)\,0$ if $y < (>)\,y^*$.

Proof. For all $y \in [x_1, x_2]$

$$H'(y) = (\rho/2)\left(f^*\left(\frac{\widetilde{y}+\widetilde{x}_2}{2}\right) - f^*\left(\frac{\widetilde{y}+\widetilde{x}_1}{2}\right)\right).$$

Since $f^{*\prime}(x) > (<)\, 0$ when $x < (>)\, 0.5$, $f^*(\widetilde{x}_2) > f^*\left(\frac{\widetilde{x}_1+\widetilde{x}_2}{2}\right)$ only if x_2 is closer to 0.5 then is x_1. Thus, x_2 must be closer to 0.5 than is x_1 when x_2 is a solution to the maximization problem. Similarly, x_1 must be closer to 0.5 than is x_2 when x_1 is a solution to the maximization problem. Suppose $H'(y') = 0$ for some $y' \in (x_1, x_2)$. Since F^* is single-peaked at 0.5, it must be that

$$0.5 - \frac{\widetilde{y}'+\widetilde{x}_1}{2} = \frac{\widetilde{y}'+\widetilde{x}_2}{2} - 0.5.$$

Rearranging the terms, we have $\widetilde{y}' = 1 - 0.5(\widetilde{x}_1 + \widetilde{x}_2)$, and, hence, the second part of the lemma holds. Finally, since $f^*(x)$ is strictly increasing for $x < 0.5$ and strictly decreasing for $x > 0.5$, $H''(y') < 0$. This implies that there is at most one y' such that $H'(y') = 0$. □

Lemma A.2. *For any $(x_1, x_2) \in \Psi$, the maximization problem*

$$\begin{aligned}
L(x_1, x_2) \quad : \quad & \max_{y\in[x_1,x_2]} G\left(\frac{\widetilde{y}+\widetilde{x}_1}{2}, \frac{\widetilde{y}+\widetilde{x}_2}{2}\right), \\
s.t. \quad & \max_{z\in[y,x_2]} G\left(\frac{\widetilde{z}+\widetilde{y}}{2}, \frac{\widetilde{z}+\widetilde{x}_2}{2}\right) \leq S, \\
& \max_{z\in[x_1,y]} G\left(\frac{\widetilde{z}+\widetilde{x}_1}{2}, \frac{\widetilde{z}+\widetilde{y}}{2}\right) \leq S.
\end{aligned}$$

has a unique solution y^{**} such that

$$y^{**} \leq (\geq)\, 0.5 \text{ when } y^* < (>)\, 0.5.$$

Furthermore, $H(y^{**}) > S$ if $H(y^*) > S$.

Comment: This lemma shows that the optimal solution is less than 0.5 if and only if x_1 is closer to 0.5 than is x_2. In addition, if an outlet can enter between $(x_1, x_2) \in \Psi$ and obtain a market size strictly greater than S, then it can do so in a way that deters entry.

Proof. Since $(x_1, x_2) \in \Psi$, 0.5 is feasible. Since G is continuous, the constraint set is compact;

hence, $L(x_1, x_2)$ has a solution. Since

$$\max_{z\in[y,x_2]} G\left(\frac{\widetilde{z}+\widetilde{y}}{2}, \frac{\widetilde{z}+\widetilde{x}_2}{2}\right)$$

is decreasing in y and

$$\max_{z\in[x_1,y]} G\left(\frac{\widetilde{z}+\widetilde{x}_1}{2}, \frac{\widetilde{z}+\widetilde{y}}{2}\right)$$

is increasing in y, the feasible set is a closed interval containing 0.5. Let $\left[\underline{y}, \overline{y}\right]$ denote the feasible set. Let $y^* = \arg\max_{y\in[x_1,x_2]} H(y)$. It follows from Lemma A.1 that the unique solution to $L(x_1, x_2)$ is y^* if $y^* \in \left[\underline{y}, \overline{y}\right]$, $\underline{y}$ if $y^* < \underline{y}$, and $\overline{y}$ if $y^* > \overline{y}$. The second part of the lemma follows from the fact that $\underline{y} \leq 0.5$ and $\overline{y} \geq 0.5$.

Suppose $H(y^*) > S$. If the solution to $L(x_1, x_2)$ is y^*, then it is obviously strictly greater than S. Suppose, by way of contradiction, that $y^* < \underline{y}$ but that $H\left(\underline{y}\right) \leq S$. Since

$$\max_{z\in[x_1,y]} G\left(\frac{\widetilde{z}+\widetilde{x}_1}{2}, \frac{\widetilde{z}+\widetilde{y}}{2}\right)$$

is increasing in y,

$$\max_{z\in[x_1,y]} G\left(\frac{\widetilde{z}+\widetilde{x}_1}{2}, \frac{\widetilde{z}+\widetilde{y'}}{2}\right) \leq S$$

for any $y' \in \left(x_1, \underline{y}\right)$. That is, the second constraint is slack for $y' < \underline{y}$. Since, by Lemma A.1, H is strictly decreasing between y^* and x_2, $H(z) < S$ for all $z \in (\underline{y}, x_2]$. It follows that for any $z \in \left[\underline{y}, x_2\right]$,

$$G\left(0.5\left(\widetilde{z}+\underline{y}\right), 0.5\left(\widetilde{z}+\widetilde{x}_2\right)\right) < G\left(0.5\left(\widetilde{z}+\widetilde{x}_1\right), 0.5\left(\widetilde{z}+\widetilde{x}_2\right)\right) \equiv H(z) \leq S.$$

This implies that the first constraint is not binding at $\underline{y}$. By continuity, some $y' < \underline{y}$ must be feasible, a contradiction. Hence, $H\left(\underline{y}\right) > S$ when $\underline{y}$ is the solution to $L(x_1, x_2)$. Likewise, $H(\overline{y}) > S$ when $\overline{y}$ is the solution. □

A.1.2 Equilibrium Strategies

For any $x_1 < 0.5$, define

$$Y(x_1) \equiv \left\{y \in (0, 0.5) \,|\, \exists y' \in Y(x_1) \cup \{x_1\}, y' < y, \text{ s.t. } G\left(0.5\left(\widetilde{y}+\widetilde{y}'\right), \widetilde{y}\right) = S\right\}.$$

For any $x_2 > 0.5$, define

$$Z(x_2) \equiv \{z \in (0.5, 1) \,|\exists z' \in Z(x_2) \cup x_2, z' > z, \text{ s.t. } G(\widetilde{z}, 0.5(\widetilde{z} + \widetilde{z}')) = S\}.$$

For any $[x_1, x_2] \in [0, 1]$, $x_1 < x_2$, define a set $C(x_1, x_2)$ as follows.

Case 1: $x_1 < x_2 \leq 0.5$. Let $C(x_1, x_2) \equiv \{y \in Y(x_1) \,| y < x_2\}$.

Case 2: $0.5 \leq x_1 < x_2$. Let $C(x_1, x_2) \equiv \{z \in Z(x_2) \,| z > x_1\}$.

Case 3: $x_1 < 0.5 < x_2$. By construction, $(\max(\{x_1\} \cup Y(x_1)), \min(\{x_2\} \cup Z(x_2))) \in \Psi$. Let m and y^{**} denote the value and solution of the maximization problem

$$L(\max(\{x_1\} \cup Y(x_1)), \min(\{x_2\} \cup Z(x_2))).$$

By Lemma A.2, the solution is unique. Let

$$\tau = \begin{cases} \emptyset & \text{if } \; m \leq S, \\ \{y^{**}\} & \text{if } \; m > S. \end{cases}$$

Let

$$C(x_1, x_2) \equiv Y(x_1) \cup Z(x_2) \cup \tau.$$

Let Γ denote the set of all finite vector $\mathbf{x} \equiv (x_1, ..., x_k)$ with $x_1 = 0$, $x_k = 1$, and $x_i < x_{i+1}$ for all $i = 1, ..., k-1$. For any $\mathbf{x} \in \mathbf{\Gamma}$, define $D(\mathbf{x}) \equiv \cup_{i=1}^{k-1} C(x_i, x_{i+1})$. Let $n(\mathbf{x}) = \#D(\mathbf{x})$ denote the number of elements in $D(\mathbf{x})$. Let $\mathcal{I} \equiv \{1, 2, 3...\}$ denote the set of potential entrants. Note that $C(x_1, x_2)$ is defined such that any outlet with two liberal (conservative) neighbors has a liberal (conservative) segment of size S.

Consider the following strategy profile: During the first round of entry, the first $n((0,1))$ firms enter, with the i-th firm adopting i-th smallest element in $D((0,1))$ as its position. Other firms stay out. For any $t > 1$, let $\mathbf{x}^t \in \Gamma$ denote the set of editorial positions occupied during the previous $t-1$ rounds, and A^t denote the set of firms that have either entered or should have entered according to the equilibrium strategy in the previous $t-1$ rounds. In any entry round $t > 1$ with history $(\mathbf{x}^t, A^t)$, the first $n(\mathbf{x}^t)$ firms in the set $\mathcal{I}/A^t$ enters, with the

i-th firm in $\mathcal{I}/A^t$ adopting the i-th smallest element in $D(x^t)$ as its position. Other firms stay out. Note that $\mathbf{x}^t$ could be any vector in Γ; hence, the strategy is defined over all possible histories.

A.1.3 Proof of Proposition 4.1

Proof. Note that the positions in $D((0,1))$ are equilibrium positions of the active outlets described in the Proposition 4.1. Hence, to prove the the first part of Proposition 4.1, it is sufficient to show that the strategy profile is a subgame-perfect Nash equilibrium.

Consider any entry round t with history $(\mathbf{x}^t, A^t)$. For any two consecutive positions $x_1, x_2 \in \mathbf{x}^t$ and $x_1 < x_2$, if $C(x_1, x_2)$ is empty, then clearly no entrant can enter at position $x \in (x_1, x_2)$ and obtain a market size strictly greater than S. Suppose $C(x_1, x_2)$ is non-empty. There are three possible cases. First, $x_2 \leq 0.5$. In this case each outlet with position $x' \in C(x_1, x_2) \cup \{x_2\}$ has a liberal segment of size equal to S or less. Since f^* is strictly increasing between x_1 and x_2, the market size for an extra entrant entering between (x_1, x_2) could not be greater than S. Second, $x_1 \geq 0.5$. It can be shown by a similar argument that an extra entrant will not obtain a market size greater than S. Suppose $x_1 < 0.5 < x_2$. In this case, as in the first two cases, an extra entrant entering between x_1 and $\max Y(x_1)$ or between $\min Z(x_2)$ and x_2 will not yield a market size greater than S. Lemmas A.1 and A.2 guarantee that entering between $\max(\{x_1\} \cup Y(x_1))$ and $\min(\{x_2\} \cup Z(x_2))$ also would not yield a market size greater than S. Finally, note that the above argument implies for any position $x \in D(\mathbf{x}^t)$ no firm can obtain a market size greater than S by entering slightly to the left or slightly to the right of x. This implies that neither the liberal nor conservative segment of x is greater than S; therefore, an entrant cannot obtain a market share greater than S by entering exactly at x. Hence, it is optimal for the firms not among the first $n(\mathbf{x}^t)$ firms in $\mathcal{I}/A^t$ to stay out of the market.

It is straightforward to check that any of the first $n(\mathbf{x}^t)$ firms in the set $\mathcal{I}/A^t$ would obtain a market size strictly greater than S. If it deviates and stays out of the market in round t, then its continuation equilibrium strategy is to stay out forever. By the one-step-deviation-proof argument, it will be worse off if it stays out in round t. We have shown in the last paragraph that deviating to a position more liberal than its liberal neighbor or a position more conservative to its conservative neighbor will yield a market size not greater than S.

We still need to show that this outlet will not gain from deviating to a position between its two neighbors. There are three cases to consider. First, the equilibrium position of this outlet is strictly less than 0.5 and its equilibrium liberal segment is of size S. If this outlet deviates to a more liberal position, it market size will decline (regardless of whether another outlet will enter subsequently). If it deviates to a more moderate position, then, according to the equilibrium strategy, an entrant will enter and take this outlet equilibrium position in the next round. Since given incumbent outlets with positions $\{\mathbf{x}\} \cup D(\mathbf{x})$ no outlet could enter and obtain a market size greater than S, the deviating outlet must have a market size equal to S or less.

Second, the equilibrium position of this outlet is strictly greater than 0.5 and its equilibrium conservative segment is of size S. It can be shown by a similar argument that a deviating outlet will not obtain a market size greater than its equilibrium market size.

Finally, suppose this outlet has one liberal neighbor and one conservative neighbor, and both its liberal and conservative segments are smaller than S. (This is the case covered by Lemma A.2.) If the outlet's equilibrium position is the unconstrained optimum between the neighbors' position, then the outlet clearly could not gain from deviating. Suppose the outlet's equilibrium position is lower bound of the feasible set in Lemma A.2. If the outlet deviates to a more centrist position, its market size will go down. If it deviates to a more liberal position (i.e., towards the unconstrained optimal), then, by Lemma A.2, an entrant will enter in the next round taking a position between this outlet and 0.5. The deviating outlet, therefore, will end up between its original liberal neighbor and a new liberal entrant. Note the position of the liberal neighbor is defined such that the deviating firm would obtain a market size equal to S or less if the new entrant's position is 0.5. Since the new entrant's position is not greater than 0.5 by Lemma A.2, the deviating firm's market size could not be greater than S. □

A.2 Corollary 4.3

Proof. Proposition 4.1 implies that for each strictly liberal outlet i (i.e., for $i = 1, ..., q(S)$)

$$F^*\left(\widetilde{\theta^*}_i\right) - F^*\left(\frac{\widetilde{\theta^*}_i + \widetilde{\theta^*}_{i-1}}{2}\right) = S.$$

Since $f^*(x)$ is strictly increasing for $x < 0.5$, this implies $\theta_i^* > (\theta_{i+1}^* + \theta_{i-1}^*)/2$ for $i = 1, ..., q(S) - 1$.

For the most conservative liberal outlet, $i = q(S)$, it is sufficient to show $\theta_i^* > (\theta_{i+1}^* + \theta_{i-1}^*)/2$ when the outlets are most spread out with no perfectly centrist outlet. Let j denote a potential entrant. For all $\theta_j \in (\theta_i^*, \theta_{i+1}^*)$, $F^*\left(\widetilde{\theta}_j\right) - F^*\left(\frac{\widetilde{\theta^*}_i + \widetilde{\theta}_j}{2}\right) < S$. By continuity, this implies $F^*\left(\widetilde{\theta^*}_{i+1}\right) - F^*\left(\frac{\widetilde{\theta^*}_i + \widetilde{\theta^*}_{i+1}}{2}\right) \leq S$. Since $F^*\left(\widetilde{\theta^*}_i\right) - F^*\left(\frac{\widetilde{\theta^*}_i + \widetilde{\theta^*}_{i-1}}{2}\right) = S$, and the density of $F^*(x)$ is greater for $x \in (\theta_i^*, \theta_{i+1}^*)$ than $x \leq \theta_i^*$, this implies outlet i is strictly closer to $i+1$ than $i-1$, i.e., $\theta_i^* > (\theta_{i+1}^* + \theta_{i-1}^*)/2$. The other parts of the corollary follow from the symmetry of the model. □

A.3 Proposition 5.5

Proof. We need to prove that if F is sufficiently close to uniform ($F \in \Phi$, for some ϵ),[38] there exists $S' \in S(2)$ such that $WL(S') > \lim_{S \to 0} WL^*(S)$. Proposition 5.3 implies $\sup\{WL^*(S)|S \in S(2)\}$ is either $\lim_{S \to \inf\{S(2)\}} WL^*(S)$ or $WL^*(S)|_{S=\sup\{S(2)\}}$. If the latter, then $\sup\{WL^*(S)|S \in S(2)\}$ is monopoly welfare loss, which we denote WL_1. If the former, and welfare loss with two active outlets is greatest when the outlets are most spread out, then the expression for $\max_{S \in S(2)} WL^*(S)$ depends on F and may be complicated. However, since $F \in \Phi$, θ_1^* is ensured to be arbitrarily close to 1/3 when the outlets are most spread out. Thus, welfare loss with two outlets and single-peaked F can be arbitrarily close to welfare loss with two outlets located at 1/3 and 2/3. Let WL_2 denote welfare loss with outlets located at 1/3 and 2/3. It is then sufficient to show there exists $\epsilon > 0$ such that $\max\{WL_1, WL_2\} > \lim_{S \to 0} WL^*(S) + \epsilon$. (We need to show there is an ϵ difference because $\max\{WL_1, WL_2\}$ is the least upper bound of, and may not be exactly equal to, $\max_{S \in S(2)} WL^*(S)$.)

First note if $\rho < 2\delta$, then the result is straightforward since by Proposition 5.2 welfare always monotonically increases as S declines. If $\rho \geq 2\delta$, then all consumers get news from their perceived optimal outlets in the limit as S goes to zero, and (14) implies

$$\lim_{S \to 0} WL^*(S) \quad = \quad (2/3)\left(\frac{1-\rho}{\rho}\right)^2 \delta^3. \tag{16}$$

If $\rho \leq 4\delta$, then not all potential median voters get news in monopoly, and (3) implies

$$WL_1 = (2/3)(\delta^3 - (3/2)\delta^2 + (3/4)\delta + (3/32)\rho^2 - (3/16)\rho).$$

[38] Note that uniform F would always be an element of Φ because if F was uniform, then F^* would also be uniform.

Write $\rho = a\delta$. Then $WL_1 > \lim_{S\to 0} WL^*(S)$ iff

$$((3/32)a^4 - (3/2)a^2 + 2a)\delta > (3/16)a^3 - (3/4)a^2 + 1. \tag{17}$$

The right-hand side is negative if $a \in [2, 3.585)$, and the left-hand side is weakly positive if $a \geq 2.96$. Thus, (17) holds for all δ if $3.585 > a > 2.96$. If $a \leq 2.96$, then (17) will hold for all δ if it holds with δ equal to its upper bound, 0.5. Plugging $\delta = 0.5$ into (17) and rearranging yields $(3/64)a^4 + a > 1 + (3/16)a^3$. This inequality holds for all $a \geq 2$.

Thus, if $a < 3.584$, $WL_1 > \lim_{S\to 0} WL^*(S) + \epsilon$ for some $\epsilon > 0$.[39] If $a \geq 3.584$, then the right-hand side of (17) may be positive, so for sufficiently small δ, (17) may not hold. So we need to show that if $a \geq 3.584$, then $WL_2 > \lim_{S\to 0} WL^*(S) + \epsilon$. (3) can be used to show

$$WL_2 = (2/3)(\delta^3 - \delta^2/2 + \delta/12)$$

given that $\theta_1^* = 1/3 = 1 - \theta_2^*$ and that all potential median voters get news, which is easily shown to be true given the range of a. This expression is greater than $\lim_{S\to 0} WL^*(S)$ iff

$$a^2/12 - 1 > a\delta(a/2 - 2). \tag{18}$$

If $a \leq 4$, the right-hand side is weakly negative, so a sufficient condition for (18) is $4 \geq a > 12^{0.5} = 3.46$. Thus, if $4 \geq a > 3.584$, then $WL_2 > \lim_{S\to 0} WL^*(S) + \epsilon$ for small ϵ by continuity. If $a > 4$ and the RHS of (18) is positive, then it is sufficient to confirm that (18) holds when δ equals its upper bound, $1/a$, which is easily shown. $\square$

[39] We use 3.584 instead of 3.585 to ensure there is at least an ϵ difference between WL_1 and $\lim_{S\to 0} WL^*(S)$.

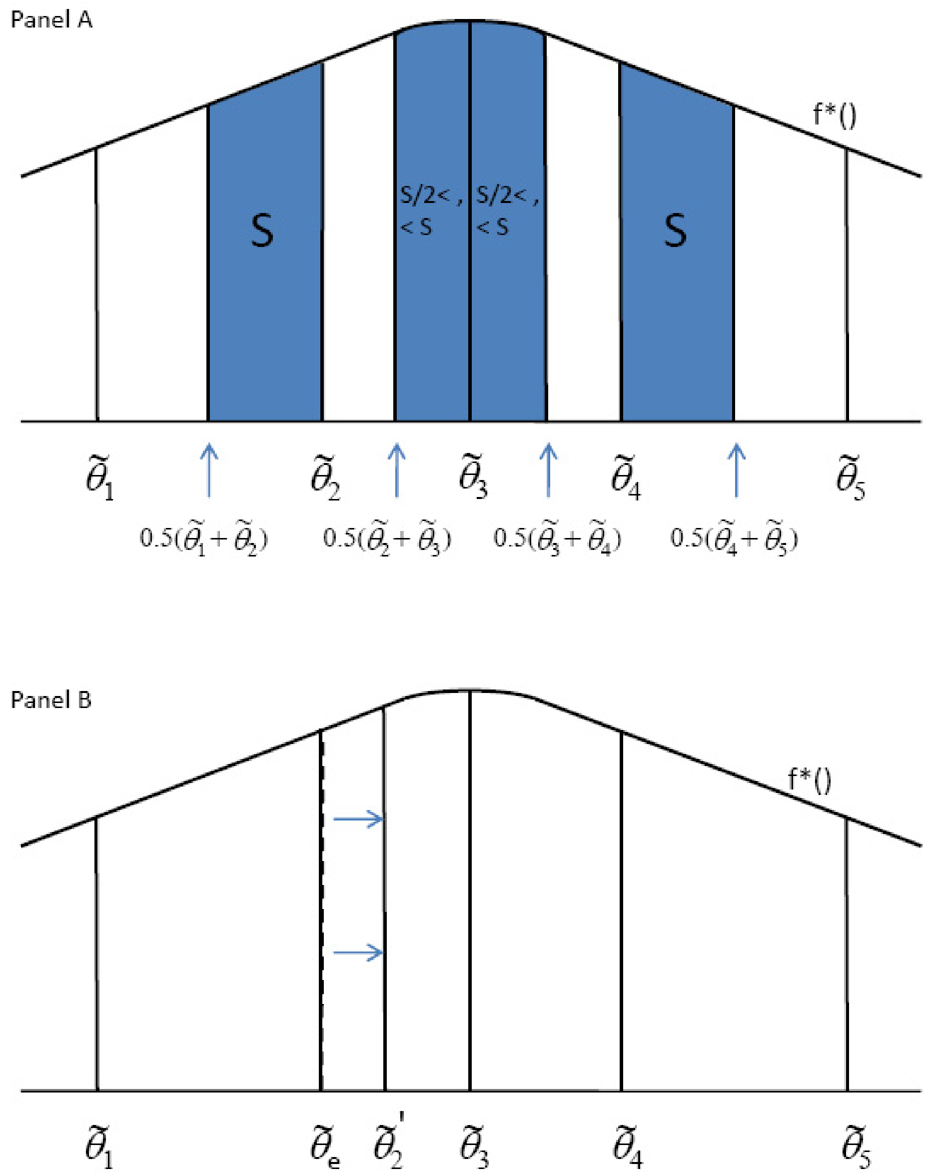

Figure 1: Panel A shows an example of equilibrium with five active outlets. The shaded regions labeled S are the liberal and conservative "flanks" of outlets 2 and 4. The shaded regions to the left and right of $\tilde{\theta}_3$ are the liberal and conservative markets of outlet 3, which is perfectly centrist. Panel B shows the effect of a deviation by outlet 2 to the right, entry to outlet 2's left at $\tilde{\theta}_e$ in the subsequent stage.

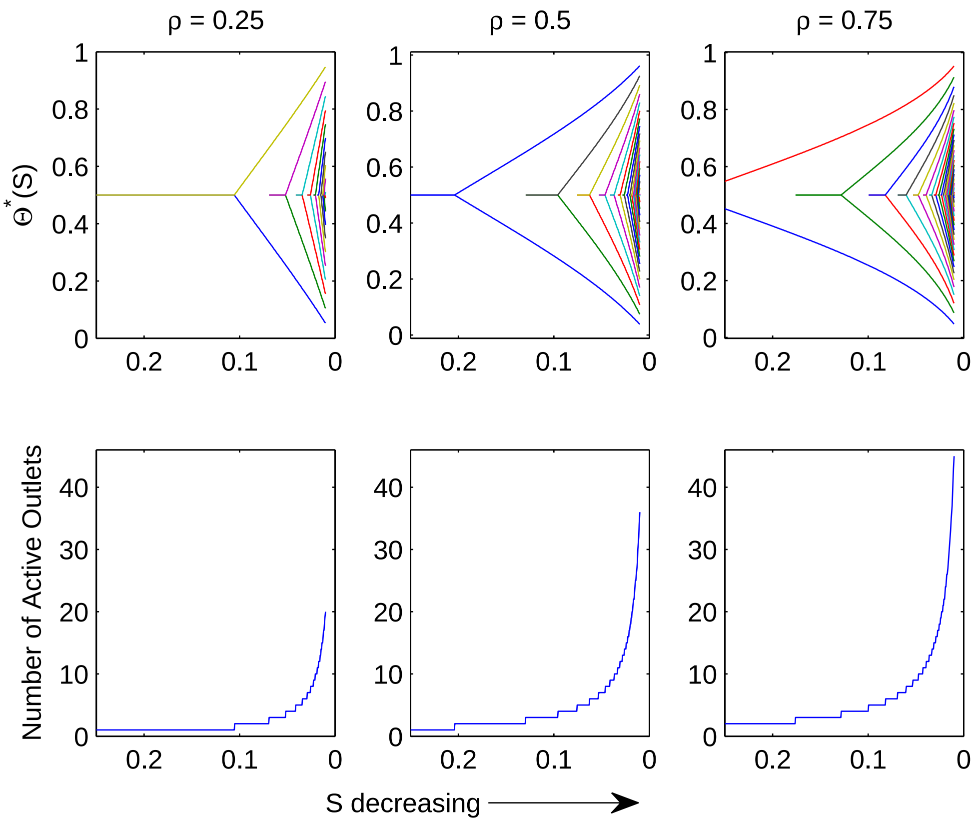

Figure 2: Illustration of equilibrium outlet positions and number of active outlets as functions of S, ρ; f is truncated normal distribution with $\sigma = 0.2$, $\delta = 0.2$.

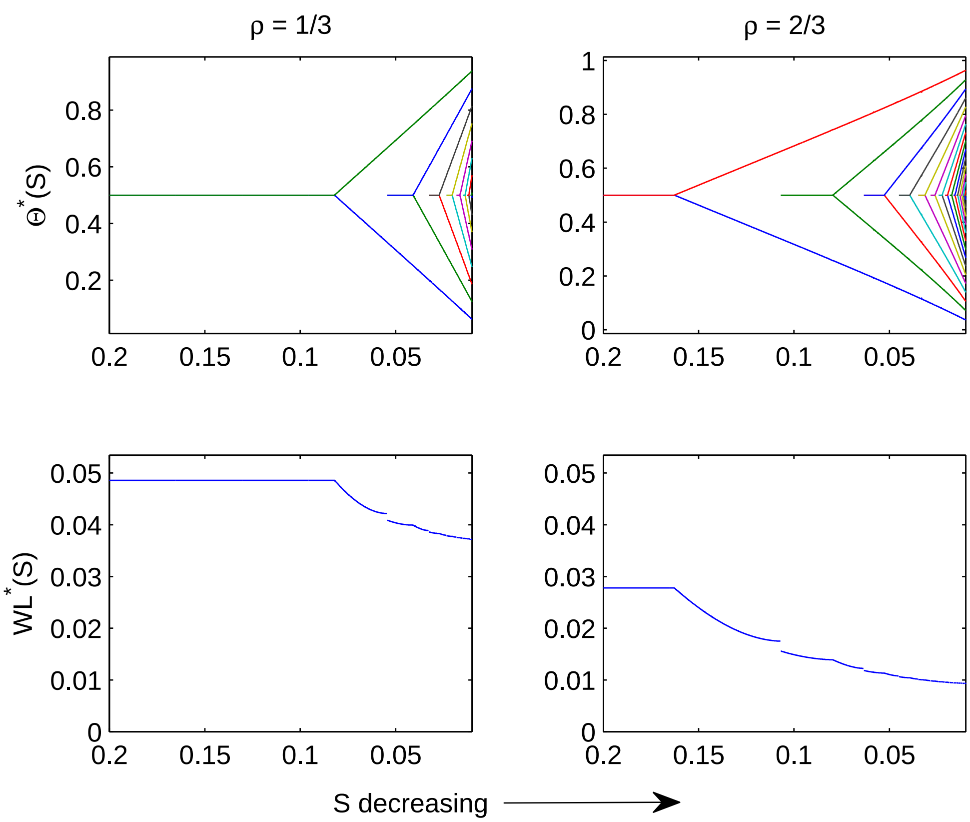

Figure 3: Examples of outlet positions ($\Theta^*(S)$) and welfare loss ($WL^*(S)$); f is truncated normal distribution with $\sigma = 0.2$, $\delta = 0.5$; $\rho < 2\delta$.

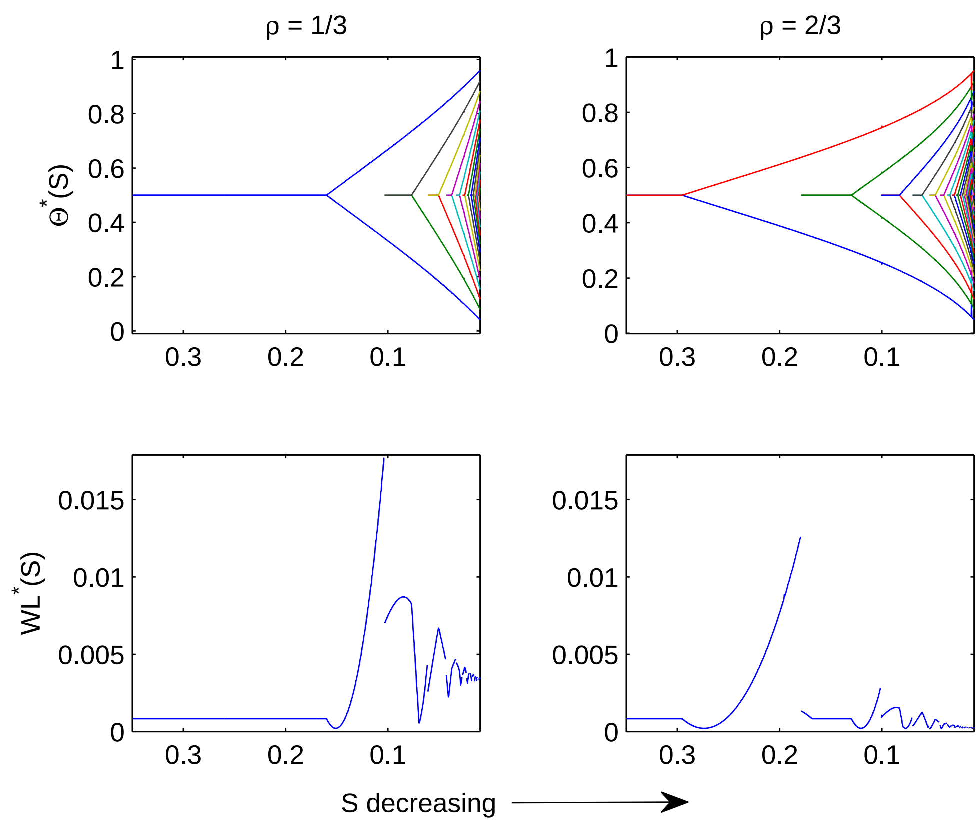

Figure 4: Examples of outlet positions ($\Theta^*(S)$) and welfare loss ($WL^*(S)$); f is truncated normal distribution with $\sigma = 0.2$, $\delta = 0.05$; $\rho > 2\delta$.