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News Market and Polarization

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Abstract

The thesis analyzes the news market under two structures: online media and offline media. It differentiates these structures on the basis that online firms can tailor news content to individual readers. This customization capability has implications for the level of price discrimination permissible under these structures.

Our analysis reveals that under the online equilibrium, *more* news stories are supplied at *lower* prices and to a *larger* audience. We find that factors that impede firm entry, such as high fixed entry costs, government restrictions, and network effects, make consumers worse off by either reducing the quantity of news in the market, or increasing the prices paid by consumers, or both.

We also find the affective polarization to be more pronounced in the online equilibrium when consumers exhibit a preference for sensational news. This suggests that the customization feature of online platforms influences the degree to which a society is affectively polarization. Policymakers should explore strategies to mitigate the effects of affective polarization caused by this channel that is unique to the online media.

Declaration of Authorship

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Summary

Chapter 1

News Media Structures

1.1. Introduction

We examine the news market under two different structures, online media and offline media. We pool media forms such as news and social media websites under the online umbrella, while pooling mediums such as print, television and radio under the offline umbrella. We explore how the quantity, readership and prices of news differ under the equilibrium of these structures. Our interest is primarily motivated by the notion that online media, and in particular, social media websites such as Twitter and Facebook, are *uniquely* to blame for the increased polarization across western societies. Various reputable news outlets have opined in favour of this notion.[1] It has gained further notoriety due to social media's involvement in disseminating disinformation during recent election cycles and pivotal events such as Brexit.

However, the academic discourse surrounding the impact of social media on polarization within western societies remains inconclusive. The existing literature fails to provide definitive evidence of a distinct mechanism inherent to online platforms that singularly influences societal polarization. Thus, in order to ascertain the credibility of this notion, we first need to identify a specific channel that is unique to the online structure. We then need to show that this channel can influence societal polarization whilst controlling for all other channels that can also influence polarization, but are common to all media forms. This is where our thesis differs from the existing literature on media and polarization. The existing literature focuses on channels that are prevalent across all media structures, which fails to address the proposition that social media uniquely contributes to the heightened polarization observed across the western societies.

[1] For e.g., see these articles in The Washington Post (2017), The Hill (2021) and The NY Times (2021).

For instance, let's consider the literature that examines the signal precision and media competition channels. Nimark and Sundaresan (2019) present a model where costly signal precision leads to people permanently disagreeing about the true state of the world, and Perego and Yuksel (2022) present a model where increased competition in the media sector causes informational specialization, which drives up social disagreement. These channels are common to all media forms, which implies that the findings of these studies are applicable to the broader media landscape. In other words, reducing signal precision or increasing competition will not only increase polarization in the online structure, but also in any other media structure.

Likewise, studies that specifically explore the influence of social media on polarization face the same limitation. For example, Edmond and Lu (2021), interpret the social media revolution as a simultaneous shock that reduces a politician's cost of information manipulation, and increases a voter's information precision. They show that when manipulation cost fall below a critical threshold, the social media revolution reduces voter welfare. However, the cost of information manipulation can also be modelled under the print media structure. In Baron's (2006) framework, this cost can stem from journalists' career incentives where increased competition amongst journalists will reduce this cost, leading to heightened polarization. Consequently, the same channel, namely the reduction in manipulation costs, can increase polarization under both online and offline structures. Hence, studies of this nature also fail to provide an answer to the aforementioned proposition.

This thesis fills in this gap in the literature by differentiating online media from offline media on the basis that online outlets can tailor news content to individual readers whilst offline outlets cannot. In other words, the offline structure allows firms to sell only one product, whilst the online structure allows firms to sell different products to different readers. Algorithms employed by the social media firms can quickly adjust to the interests and biases of different readers. After learning about these preferences these algorithms then cater different news feeds to different readers to match their preferences. In comparison, firms under the offline structure cannot perfectly cater to every reader's taste when demand over news is abundantly heterogeneous. Consequently, they focus on serving a group within the population whose demand over news is sufficiently homogeneous.

For example, in the U.S. television media, Fox news serves part of the population that chiefly affiliates with the Republican Party, whilst MSNBC serves the part that primarily affiliates with the Democratic party. Similarly, in the print media landscape, *Us Weekly* serves part of the population that is chiefly interested in the celebrity gossip whilst the *Financial Times* serves the part that is primarily interested in the financial world.[2] On the other hand, all of the aforementioned groups can be found on any social media site such as Facebook and Twitter. Baumann et al. (2020) show how some echo chambers of opposing views on issues such as Obamacare, gun control and abortion exist on Twitter.

Differentiating these structures only along this dimension allows us to shut down all other channels that can influence societal polarization but are common to all media structures. To the best of our knowledge, this is the first study to make such an attempt. A consequence of this differentiation is that the offline firms become incapable to any degree of price discrimination whilst online firms can price discriminate.

In this chapter, we present a general form model of the news market and use this distinction to study how the quantity, readership and prices of news differ under the equilibrium of our two news market structures. In the next chapter, we use these equilibrium outcomes to study how societal polarization differs under these structures. As almost all of the literature that studies the news market focuses on examining how societal polarization emerges from news reporting, we reserve any extensive discussion on the state of the literature for the second chapter of the thesis. Here, we solely focus on describing the demand and supply sides of the news market, and the interaction between the two.

Our model consists of utility maximising consumers with heterogeneous news consumption preferences, and profit maximising firms with identical costs structures within and across both market structures. We show that, under the online equilibrium, the aggregated quantity and readership of news, as well as consumer surplus, are at least equal to, if not greater than, those observed under the offline equilibrium. Importantly, these inequalities are strict under reasonable assumptions.

[2] Nielsen et al. (2020) provide a survey of readers' news preferences.

Moreover, we examine the impact of reducing the number of firms in the market to a level below the equilibrium. This restriction has a detrimental effect on at least one of the consumer outcomes. Under the offline structure, it leads to a decrease in the aggregated quantity and readership of news, accompanied by a decline in consumer surplus as prices rise. In contrast, under the online structure, the aggregated quantity and readership of news remain unchanged, but the consumer surplus diminishes completely to zero. This outcome arises because, in the absence of any threat of competition, firms in the online structure engage in first-degree price discrimination. Hence, factors that hinder the markets from reaching the equilibrium, such as restrictions on participation in a country's spectrum auctions or even network effects, result in outcomes where consumers lose on one or more dimensions.

1.2. An Example

Before we proceed to a formal model of the economy, let us elucidate our results in a simple setup. Consider a set $\boldsymbol{\omega} = \{\omega_1,\ \omega_2,\ \omega_3\}$ where each element represents valuable information known as *stories*, that is accessible exclusively to firms in the economy.

The Demand Side: Let there be only three consumers, c_1, c_2 and c_3 with heterogeneous demand over stories . c_1 is solely interested in hearing about ω_1, c_2 about ω_2, and c_3 about ω_2 and ω_3. We assume that gaining knowledge about a preferred story yields a utility of +1, whilst being exposed to an uninteresting story leads to a utility of -0.5.

The Supply Side: There are many potential entrants and they all have identical cost structures. These firms face a fixed entry cost of 1 util and a variable cost of .4 utils per story. The variable cost is assumed to be additive across stories.

To simplify matters, we also assume that both consumer preferences and firm cost structures are common knowledge. This assumption eliminates the influence of cost and asymmetric information channels on our results. Furthermore, we have endogenized the determination of the number of firms in equilibrium in the same vein, i.e., to remove the potential impact of competition channel on our findings. Thus, we only allow firm differentiation along a single dimension across these structures, i.e., their ability (or inability) to tailor news content to individual readers, and subsequently price discriminate.

Results: Under the *offline equilibrium*, only c_3 will read stories. This is because any firm providing stories to c_1 or c_2 will not be able to break even. If a firm decides to report $\{\omega_2\}$, it would only attract the readership of c_2, as a firm printing $\{\omega_2,\ \omega_3\}$ would have the patronage of c_3. Thus, the firm would calculate its revenue to be 1 util and its cost to be 1.4 utils (1+.4), and decide not to enter the market in the equilibrium. Similarly, a firm that decides to report only $\{\omega_1\}$ would not enter the market in the equilibrium.

Furthermore, if a firm printing $\{\omega_2,\ \omega_3\}$ decides to target the patronage of c_2, it would have to adjust its price accordingly. As c_2 and c_3 would receive a utility of .5 and 2, respectively, if they read this news set, the firm would have to set its price at most at .5 utils to attract both consumers. Consequently, it would calculate that at a price of .5 utils, its revenue of 1 util (.5 $\times$ 2) falls short of its total cost of 1.8 utils (1+.4+.4). Conversely, at a price of 2 utils, which the firm can charge if it decides to target only the patronage of c_3, its revenue of 2 utils would exceed its cost of 1.8 utils. Therefore, it would print $\{\omega_2,\ \omega_3\}$, but only demand the patronage of c_3. Since there are many potential entrants with identical cost structures, the threat of competition would lead the firm to set its price equal to the cost of providing stories to c_3 in the equilibrium, i.e., 1.8 utils. Notably, the story that c_2 wants to read, ω_2, is supplied under the equilibrium of the offline structure, but at a price that makes it optimal for c_2 to forego any purchase in the market.

On the other hand, under the *online equilibrium*, as firms are able to sell different stories to different readers, one firm can provide news to all three consumers in the equilibrium. It would sell $\{\omega_1\}$ to c_1, $\{\omega_2\}$ to c_2, and $\{\omega_2,\ \omega_3\}$ to c_3. Again, under the threat of competition, it would keep its prices equal to the average cost. Since firms can price discriminate under this structure, this cost would be different for different consumers and would depend on their news preferences. The firm determines the prices for c_1, c_2, and c_3 using the following approach. Initially, it recognizes that ω_1 and ω_3 appeal to only one consumer each, while ω_2 is of interest to two consumers. Consequently, the variable costs of ω_1 and ω_3 are assigned to c_1 and c_3 respectively, while the variable cost of ω_2 is equally divided between c_2 and c_3. Next, the firm proportionally divides the fixed cost amongst consumers. Consumer 1 assumes 1/3 of the firm's fixed cost since her interest lies solely in ω_1, which represents one-third of the firm's reported stories. Consumer 2 and 3 each bear half of the fixed cost associated with reporting ω_2, as both share an interest in this story. Specifically, each of their share of the fixed cost amounts to (1/2)(1/3) = 1/6. Finally, consumer 3 not only bears half of the fixed cost related to ω_2, but also assumes the fixed cost share of ω_3. Consequently, her share of the fixed cost totals to (1/6) + (1/3) = 1/2. The sum of these individual cost shares corresponds to the total fixed cost of the firm, which is 1/3 + 1/6 + 1/2 = 1. Therefore, the social media firm would charge (1/3)+.4 = .74 utils to c_1, (1/6)+.2 = .367 utils to c_2, and (1/2)+.2+.4 = 1.1 utils to c_3. A comparison of these equilibrium outcomes tells us that:

1. The online equilibrium supplies a greater number of stories, namely $\{\omega_1,\ \omega_2,\ \omega_3\}$, compared to $\{\omega_2,\ \omega_3\}$ under the offline equilibrium.
2. The readership is greater under the online equilibrium, three readers compared to one under the offline equilibrium.
3. Consumers face better prices under the online equilibrium; c_3 pays 1.1 utils, compared to 1.8 utils under the the offline equilibrium.

Thus, what we have shown in this simple setting is that, holding all other factors constant, the online structure's ability to tailor news content to individual readers, leads to better readership, news quantity, and consumer price outcomes in the equilibrium.

Now let us see how these outcomes change when we exogenously fix the number of firms allowed in the market. Let us assume that only one firm is allowed to operate under both market structures. Under the offline structure, the readership and supply of news will remain unchanged, i.e., the firm will still supply the set $\{\omega_2,\ \omega_3\}$ to c_3. However, as there is no longer a threat of competition, the firm will charge c_3 a price of 2 utils. Similarly, under the online structure, the firm will now charge c_1 and c_2 1 util each, and c_3, 2 utils. Thus, any factors that impede firm entry to the market are detrimental to consumer welfare. Let us now demonstrate that these results hold in a more general environment.

1.3. The Setup

The model consists of profit maximising news firms (outlets) and utility maximising readers (consumers). Let there be a set $\boldsymbol{\omega} = \{\omega_1,\ \omega_2, \dots, \omega_N\}$ that is accessible exclusively to firms in the economy. Let ω_n be an arbitrary element of this set. Each element ω_n represents some information that is valuable to at least one consumer in the economy. We call ω_n a *news*, *story* or *news story*.[3] Throughout this paper, $|\mathbf{s}|$ and $2^{\mathbf{s}}$ respectively denote the cardinality and the power set of any set $\mathbf{s}$. The following three subsections discuss the demand and supply side optimization problems, and the interaction between both.

1.3.1. The Demand Side

Let there be $K \geq 1$ readers. Let $\mathbf{K}$ denote the set of readers and k be an arbitrary reader. A reader k prefers to hear about certain stories. Let $\boldsymbol{\omega_k} \in 2^{\boldsymbol{\omega}}$ be the set of these stories. A news story $\omega_n \in \boldsymbol{\omega_k}$ is a story that k prefers to hear over other stories in $\boldsymbol{\omega} \setminus \boldsymbol{\omega_k}$. Also, let $\boldsymbol{\omega_j}$ denote the set of news stories that firm j reports.

We denote reader k's utility function as $u(|\boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}|,\ |\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|,\ p_{j_k})$, where $|\boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}|$ denotes the number of stories that k prefers to hear and are published by firm j, $|\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|$ denotes the number of stories that are published by j but k prefers *not* to hear, and p_{j_k} is the price charged by firm j to reader k if a purchase is made.

Assumption 1. *Reader's utility is increasing in* $|\boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}|$*, and decreasing in* $|\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|$ *and* p_{j_k}.

Put simply, reader k's utility is increasing in the amount of relevant information in firm j's reporting, and decreasing in the amount of irrelevant information in firm j's reporting, as we interpret $|\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|$ as cost incurred by k for processing any irrelevant information to her. For example, if k is only interested in sports stories, this cost would be the time wasted by k as she

[3]For the sake of simplicity, we shy away from a 'state of the world' setting, as in Nimark and Pitschner (2019); Chahrour et al. (2021), where $\boldsymbol{\omega}$ is the realized value of some high dimensional vector $\boldsymbol{\Omega}$.

peruses through a newspaper in search of sports stories. As such, a reader maximises her utility given by the following equation.

$$u\Big(|\boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}|,\ |\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|,\ p_{j_k}\Big) \tag{1.1}$$

We use u_{k_j} as a short hand to denote reader *k*'s utility from purchasing news from firm *j*.

1.3.2. The Supply Side

Let there be $\mathcal{J} \geq 1$ potential entrants. Let *j* denote an arbitrary potential entrant in the set $\boldsymbol{\mathcal{J}}$. Let $\boldsymbol{\omega_j} \in 2^{\boldsymbol{\omega}}$ be the set of stories firm *j* reports if it enters the market. A news story $\omega_n \in \boldsymbol{\omega_j}$ is a story that *j* reports over stories in $\boldsymbol{\omega} \setminus \boldsymbol{\omega_j}$. Further, let $|\mathbf{J}|$ be the number of firms operating in the market in equilibrium where $\mathbf{J} \subseteq \boldsymbol{\mathcal{J}}$ denote the set of those firms. We assume that:

Assumption 2. *The number of firms that enter the market,* $|\mathbf{J}|$*, is endogenous to the model.*

We make this assumption to ensure that the technology channel, i.e., online firms' ability to tailor news content to different readers is the sole driver of our results. If we let $|\mathbf{J}|$ to be determined exogenously, a small $|\mathbf{J}|$ only serves to amplify the inequalities that we show to exist in the equilibriums of our two news market structures. We discuss this in more detail in the results section when we look at the implication of relaxing this assumption. Further, we use the following assumption to construct the profit function of these firms. The motivation behind this assumption has been discussed in detail in section 1.1.

Assumption 3. *Under the online (offline) structure, firms are (not) allowed to tailor news content to individual readers.*

Let $\mathbf{r_j}$ denote the readership *set* of firm *j* if it enters the market. We can write $\boldsymbol{\omega_j}$ as $\bigcup_{k\in\mathbf{r_j}} \boldsymbol{\omega_{j_k}}$ where $\boldsymbol{\omega_{j_k}}$ is the set of stories catered to reader *k* by firm *j* if *k* makes a purchase from *j*. Assumption 3 says that for a firm *j* under the offline structure, $\boldsymbol{\omega_{j_k}} = \boldsymbol{\omega_{j_{k'}}}\ \forall k, k' \in \mathbf{r_j}$, whereas, this equality need not hold under the online structure.

A firm's revenue comes from the prices it charges to its readership. Let $(p_{j_k})_{k\in\mathbf{r_j}}$ be the sequence of prices that *j* charges to its different readers. This price sequence is a function of the set of stories a firm reports. If it provides relevant stories to readers who derive high utility from reading those stories, it can charge them a higher price relative to a firm whose readers derive very little utility from reading stories published by that firm.[4] Thus, firm *j*'s revenue is denoted by $\sum_{k \in \mathbf{r_j}} p_{j_k}(\boldsymbol{\omega_j})$. A consequence of assumption 3 is that under the offline structure, $p_{j_k} = p_{j_{k'}}\ \forall\ k, k' \in \mathbf{r_j}$, whereas, the equality need not hold under the online structure. In words, it means that the offline structure allows no price discrimination whilst the online structure allows price discrimination.

In practice, consumers typically do not directly pay a monetary fee to access news on social media platforms. However, they do pay in other ways, such as sharing their data and encountering advertisements while scrolling through these websites. All websites, including social media platforms, collect user data using cookies, which is then sold to various third parties for a plethora of purposes, including some nefarious ones.[5] Additionally, websites display advertisements to readers, which consume their time. Some argue that these ads might be relevant to consumers' interests and therefore add to their utility. However, the widespread use of ad-blocking tools such as *uBlock Origin* and privacy-focused browsers such as *DuckDuckGo* challenges this argument. Hence, when we discuss the 'price' paid by consumers to social media websites, we mean a non-monetary cost. Moreover, by measuring costs in terms of reader utilities under both structures, we can effectively compare prices and consumer surplus between them.

A firm's readership and its ability to charge specific prices to that readership are also influenced by the actions of other firms. When demand over news is heterogeneous, if two firms report the same set of stories, they would engage in price competition, resulting in zero profits for both. Consequently, both firms would have an incentive to deviate from this strategy and report a different set of stories. Therefore, when a firm determines which stories to report and what prices to charge, it does so by considering the expected actions of other firms. In other words, we have a game unfolding on the supply side. In the following subsection, where we delve into market interactions, we precisely define this game.

[4] As of May 2023, the yearly subscription of *The Economist* and *Us Weekly* costs \$519/year and \$130/year respectively (converted to Australian dollars).

[5] A well-known example of this is the Facebook-Cambridge Analytica data scandal.

Firm *j* also incurs fixed and variable costs. Let F_j denote its fixed costs. In practice, this could be salaries to the permanent staff, equipment and infrastructure maintenance costs, or in the case of a new entrant, startup costs. Its variable cost, v_j, is a function of the news stories it reports. If it reports stories that are cheaper to cover, its average variable cost would be lower relative to when it focuses on covering expensive stories. Again, to ensure that the technology channel is the sole driver of our results, we rule out the cost channel by making the following assumption.

Assumption 4. *$F_j = F_{j'} = F$ and $v_j(\boldsymbol{\omega_j}) = v_{j'}(\boldsymbol{\omega_j}) = v(\boldsymbol{\omega_j})\ \forall\ j, j' \in \boldsymbol{\mathcal{J}}$, within and across structures. Also, $v(\{\omega_n, \omega_{n'}\}) = v(\{\omega_n\}) + v(\{\omega_{n'}\})\ \forall\ \omega_n,\ \omega_{n'} \in \boldsymbol{\omega}$.*

In words, it means that all firms have the same fixed and variable costs for any given a set of stories within and across structures. To simplify further, we let the variable cost to be additive in stories. The additive assumption is a conservative one as any convexity will only serve to amplify the inequalities we show to exist in our results. Similarly, endowing all firms with same costs across structures is a conservative assumption as social media companies benefit from the economies of scale and allowing for this will, again, only amplify the inequalities that we show to exist in our two equilibriums.

From firm *j*'s prospective, we let *-j* denote the rest of firms in the market. Letting the cardinality of $\mathcal{J} \setminus \{j\}$ to be $\mathcal{J}'$ gives us $\boldsymbol{\omega_{-j}} = (\boldsymbol{\omega_{j'}})_{j'=1}^{\mathcal{J}'}$ and $\mathbf{p}_{-j} = \left((p^*_{j'_k})_{k \in \mathbf{r_{j'}}}\right)_{j'=1}^{\mathcal{J}'}$. A firm maximizes its profit given by the following equation:

$$\pi_j(\boldsymbol{\omega_j};\ \boldsymbol{\omega_{-j}},\ \mathbf{p}_{-j}) = \sum_{k \in \mathbf{r_j}} p_{j_k}(\boldsymbol{\omega_j};\ \boldsymbol{\omega_{-j}},\ \mathbf{p}_{-j}) -\ F_j -\ v_j(\boldsymbol{\omega_j}) \tag{1.2}$$

1.3.3. The Market

In this section, we first describe the stages in which the firms and consumers make decisions. Second, we define the supply side game. Lastly, we will define the market equilibrium.

Before we outline the stages of interaction between firms and consumers, it is necessary to determine what information firms will disclose to entice consumers to make a purchase. Once a firm decides on the set of stories it will report and the prices it will charge, it cannot reveal all the information contained in those stories, as consumers would no longer be willing to pay for them. Consequently, firms will only disclose partial information to readers. Let $\mathbf{h}_{j_k}$ represent the set of *headlines* of news stories that a firm *j* will share with reader *k* if *k* decides to make a purchase from *j*. By revealing the headlines of the stories it will share with reader *k*, firm *j* induces a belief in *k* about the utility of purchasing from *j*. This information is sufficient for *k* to form a belief about the utility of the purchase, but not enough to dissuade her from making the purchase. For simplicity, we make the following assumption.

Assumption 5. *Belief induced in* k *about her utility from* j *by* $\mathbf{h}^*_{j_k}$ *is accurate.*

In words, it means that firms cannot fool readers by manipulating news headlines. In reality, it may be possible for firms to fool readers in the short run. However, in the long run, readers can learn these patterns in reporting and will punish firms for headline manipulation by switching to other firms. The demise of *BuzzFeed* may support this argument. Thus, in the interest of simplicity we assume that firms cannot fool readers through headlines. We can now lay out the stages in which the firms and consumers make decisions.

Stage 1. Firms choose $\boldsymbol{\omega}_j$ and $(p_{j_k})_{k\in\mathbf{r_j}}$ simultaneously such that they maximise equation (1.2).

Stage 2. Firms announce $(\mathbf{h}_{j_k})_{k\in\mathbf{r_j}}$ and $(p_{j_k})_{k\in\mathbf{r_j}}$ simultaneously.

Stage 3. Readers make purchases such that they maximise equation (1.1).

Thus, first the supply side finds an equilibrium. Then, consumers take the news headlines supplied and prices quoted by each firm as given and maximise their utility. A firm operates and a consumer purchases *iff* doing so yields a non-negative profit or utility respectively. Before we move to describe the game on our supply side, to further simplify things, we make the following assumption.

Assumption 6. $(\boldsymbol{\omega}_k)_{k=1}^{K}$ *and* $(\pi_j)_{j=1}^{\mathcal{J}}$ *are common knowledge.*

In words, it means that before making a decision on which news stories to report, and what prices to charge, each firm *j* has knowledge of the readers' preferences and the potential profits of other firms based on their chosen set of stories. In practice, firms can acquire this information by studying the past reporting, prices, and profits of other firms. Modern technology further facilitates this process. For instance, television news channels are now able to track changes in their ratings minute by minute, indicating when consumers switch in or out. Similarly, in the case of social media, firms can utilize *cookies* to monitor the websites visited by consumers and the duration of their visits.

Now, let's define the game on the supply side. Firm *j* selects a set of stories to report and a set of prices to charge, taking into account the choices made by other firms. We can represent the strategy of firm *j* as $(\boldsymbol{\omega}_j,\ (p_{j_k})_{k\in\mathbf{r_j}})$, where $\boldsymbol{\omega}_j \in 2^{\boldsymbol{\omega}}$ represents the chosen set of stories and $p_{j_k} \in \mathbb{R}_+$ denotes the price the firm *j* will charge to reader *k* if *k* makes a purchase from *j*. A strategy profile of firm *j*, denoted as $\mathbf{S}_j$, comprises all such feasible strategies. Since all firms choose from the same set of stories and prices, their strategy profiles are identical, i.e., $\mathbf{S}_j = \mathbf{S}_{j'}$ for all $j, j' \in \boldsymbol{\mathcal{J}}$.

Definition 1 (The Game). *The supply side game* $\mathbf{G} = (\boldsymbol{\mathcal{J}},\ \mathbf{S},\ \mathbf{I},\ \pi)$ *consists of:*

1. *A finite ordered set of all potential entrants,* $\boldsymbol{\mathcal{J}} = (1, 2, ..., \mathcal{J})$*,*
2. *An ordered set,* $\mathbf{S} = (\mathbf{S}_1, \mathbf{S}_2, ..., \mathbf{S}_{\mathcal{J}})$*, of all possible strategies for all potential entrants,*
3. *An ordered set,* $\mathbf{I} = \Big((\boldsymbol{\omega}_k)_{k=1}^{K},\ (\pi_j)_{j=1}^{\mathcal{J}}\Big)$*, of information available to all players,*
4. *A payoff function,* $\pi_j : \mathbf{S} \times \boldsymbol{\mathcal{J}} \to \mathbb{R}$*.*

Recall that $\mathbf{r_j}$ denotes the readership set of firm *j* if it enters the market. Let $\mathbf{r}^f = \bigcup_{j=1}^{J} \mathbf{r_j}$ be the number of readers that the supply side demands after all firms choose their strategies. Also let $\mathbf{r}^c \subseteq \mathbf{K} : k \in \mathbf{r}^c \implies u_{k_j} \geq 0$ for at least one $j \in \mathbf{J}$. In words, it means that given the headlines and prices announced by firms in stage 2, $\mathbf{r}^c$ is the set of readers who believe that they will receive a non-negative utility from making a purchase in the market. The interaction setup allows us to define the following market equilibrium.

Definition 2 (The Market Equilibrium). *The equilibrium is a sequence of stories reported by firms,* $((\boldsymbol{\omega}^*_{j_k})_{k\in\mathbf{r_j}})_{j=1}^{J}$*, and a sequence of corresponding prices,* $((p^*_{j_k})_{k\in\mathbf{r_j}})_{j=1}^{J}$*, such that:*

1. *The game from definition 1 is in equilibrium,*
2. *No more firms can enter the market, i.e. all profits are 0,*
3. *Readers are maximising equation (1.1),*
4. *Market clears, i.e.,* $\mathbf{r}^f = \mathbf{r}^c = \mathbf{r}^*$*.*

Essentially, our focus initially lies on finding a Nash equilibrium on the supply side. Subsequently, according to definition 2, we can conclude that the readership desired by firms at the prices they set in the first stage of the interaction must be equal to the readership supplied by consumers at those prices in the market equilibrium. Before proceeding further, we need to make the following trivial assumption.

Assumption 7. *ε is the least monetary unit of value.*

This assumption is a mathematical necessity for Nash equilibrium to exist as infinite divisibility would mean that two firms with same cost structures, when in competition, can undercut each other infinitely many times.

1.3.4. The Heterogeneity in Demand

Let us rule out the uninteresting cases of perfect homogeneity and perfect heterogeneity in demand over news stories. We look at the case where the heterogeneity in news demand is somewhere *in-between*. To formalize this notion of *in-between*, let us divide the set of readers, $\{1, 2, \ldots, K\}$, into groups such that the demand over news is homogeneous within these groups. Let $\mathcal{G}$ be the set of these groups and let G denote an arbitrary group. Let $\mathbf{g}$ denote the set of readers in this group. As demand over news within any group is homogeneous, we can pick a $\boldsymbol{\omega}_G = \boldsymbol{\omega}_k : k \in \mathbf{g}$ to be the representative set of news stories that any reader k in $\mathbf{g}$ prefers to hear over other news stories. Importantly, what we mean by *in-between* is that we have at least one case of $\boldsymbol{\omega}_G \cap \boldsymbol{\omega}_{G'} \neq \phi$, such that there is another group $G'' \in \mathcal{G}$, whose demand over news is a subset of this set, $\boldsymbol{\omega}_{G''} \subseteq \boldsymbol{\omega}_G \cap \boldsymbol{\omega}_{G'}$.

Assumption 8. *There exists at least one* G″ *such that $\boldsymbol{\omega}_{G''} \subseteq \boldsymbol{\omega}_G \cap \boldsymbol{\omega}_{G'} \neq \phi$.*

Put simply, certain stories can have broad appeal across multiple groups, whilst others may only captivate specific groups. For instance, a story such as the outcome of a presidential election might captivate everyone. On the other hand, there are stories that pique the interest of specific groups exclusively. For example, one group may be engrossed in sports stories and celebrity gossip, but indifferent towards finance news. Another group might find sports and finance stories compelling, but have no interest in celebrity gossip. Additionally, there could be a third group that solely focuses on sports stories.

Our setup is important in this regard, as it allows us to study the market without restricting us to a certain class of distributions over news demand. For example, a Hotelling (1929) setting would restrict us to a scenario where demand over news stories is uniform, or a Salop (1979) setting would restrict us to the set of regular distributions (for e.g., see Perego and Yuksel (2022)). In the following section, we delve into the results, examining how the quantity, readership, and prices of news differ under the equilibrium of social and offline structures.

1.4. Results

From Nash (1950), we know that the equilibrium exists for the game described in definition 1. We are chiefly interested in how the quantity, readership and prices of news differ under our two market structures. Let us use superscripts *of* and *on* to denote variables under traditional and online structures respectively. We also use superscripts f and c to donate the firm and consumer side respectively. For example, we donate by $\boldsymbol{\omega}^{f,on}$, the set of stories supplied by the firms, and by $\boldsymbol{\omega}^{c,on}$, the set of stories demanded by the consumers, under the online structure. In the equilibrium, $\boldsymbol{\omega}^{f,on} = \boldsymbol{\omega}^{c,on} = \boldsymbol{\omega}^{on^*}$, i.e., all stories supplied by firms will be read. Further, let cs be the short-hand for consumer surplus and recall that $\mathbf{r}^*$ is the aggregated readership set in the equilibrium. This brings us to the following main theorem where we compare equilibrium consumer outcomes under these structures.

Theorem 1. *The equilibriums of online and offline structures lead to* $|\boldsymbol{\omega}^{on^*}| \geq |\boldsymbol{\omega}^{of^*}|$, $|\mathbf{r}^{on^*}| \geq |\mathbf{r}^{of^*}|$ *and* $cs^{on^*} \geq cs^{of^*}$.

Proof. We do this in 2 steps.

Step 1: In the first step, we work out the quantity of stories supplied, prices asked, and readership demanded, by firms under the two structures using the backward induction.

Step 2: In the second step, we show how these inequalities follow from our step 1 results.

Step 1: In this step, we solve for the subgame perfect equilibrium on our supply side using the backward induction. In the first stage, firms choose what stories to report, i.e., each j chooses an $\boldsymbol{\omega}_j$. In the second stage, they choose what readership to demand, $\mathbf{r}_j$, and prices to charge, $(p_{j_k})_{k \in \mathbf{r_j}}$. We first find the equilibrium of the second stage and then solve for the equilibrium in first stage.

The second stage: Taking $(\boldsymbol{\omega}_j)_{j=1}^J$ and $((p_{j_k})_{k\in\mathbf{r}_j})_{j=1}^J$ as given, a firm *j* demands its readership set, $\mathbf{r}_j$, to be all of the readers who would obtain a higher non-negative utility from making a purchase from it, than they would from any other firm in the market. Given that all $\mathcal{J}$ potential entrants have the same cost structure (assumption 5), and this is common knowledge (assumption 6), firms expect competition on prices. Further, as profits are 0 in equilibrium (second condition of the equilibrium), firms will charge price equivalent to the average cost of serving their readers. As this cost would be decreasing in the firm's readership, any firm reporting $\boldsymbol{\omega}_j$ and demanding any amount of readership less than $|\mathbf{r}_j|$, will be undercut by a firm that demands exactly $|\mathbf{r}_j|$ readers. Thus,

$$\mathbf{r}_j\Big((\boldsymbol{\omega}_j)_{j=1}^J, ((p_{j_k})_{k\in\mathbf{r}_j})_{j=1}^J\Big) = \{k : k \in \mathbf{r}_j \implies u_{k_j} \geq u_{k_{j'}} \;,\; u_{k_j} \geq 0 \;, \forall\, j, j' \in \boldsymbol{\mathcal{J}}\}. \tag{1.3}$$

In the aggregate, $\mathbf{r}^f = \cup_{j=1}^J \mathbf{r}_j$. Furthermore, competition anticipation leads firms to set prices equal to average cost in the equilibrium. As firms cannot price discriminate under the offline structure (a consequence of assumption 3), a firm *j* reporting $\boldsymbol{\omega}_j$ will price its product at:

$$p_j^{f,of^*} = p_{j_k}^{f,of^*} = \frac{F + v(\boldsymbol{\omega}_j)}{|\mathbf{r}_j|} \qquad \forall k \in \mathbf{r}_j. \tag{1.4}$$

In words, offline firms divide their total costs equally amongst their respective readerships in the equilibrium. On the other hand, online firms can price discriminate. Thus, they charge different prices to different readers depending on the set of stories those readers want to hear. Nevertheless, price charged to some consumer k will equal the average cost of servicing k as firms anticipate competition. These prices can be constructed in the following manner. First, the firms work out the fixed cost per story taking the set of stories it reports, $\boldsymbol{\omega}_j$, as given. This would be $F/|\boldsymbol{\omega}_j|$. Next, they work out for any story $\omega_n \in \boldsymbol{\omega}_j$ the number of consumers interested in that story. Let the set of these readers be denoted by $\mathbf{r}_{\omega_n}$. Firms can therefore workout the fixed cost per story per interested reader. Further, the variable cost of ω_n are also equally distributed amongst the readers who are interested in ω_n. Thus, a reader interested in some story ω_n would be asked to pay

$$\frac{1}{|\mathbf{r}_{\omega_n}|}\left[\frac{F}{|\boldsymbol{\omega}_j|}+v(\omega_n)\right] \tag{1.5}$$

by firm *j*, to read ω_n. A reader *k* who prefers to hear $\boldsymbol{\omega_k}$ would therefore be asked to pay the following amount by firm *j*.

$$p_{j_k}^{f,on^*}=\sum_{\forall \omega_n \in \boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}} \frac{F}{|\boldsymbol{\omega}_j||\mathbf{r}_{\omega_n}|}+\frac{v(\omega_n)}{|\mathbf{r}_{\omega_n}|} \tag{1.6a}$$

As variable costs are assumed to be additive in stories (assumption 4), we can write this equation as the following.

$$p_{j_k}^{f,on^*}=\left[\frac{F}{|\boldsymbol{\omega}_j|}+v(\boldsymbol{\omega_k}\cap\boldsymbol{\omega_j})\right]\sum_{\forall \omega_n \in \boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}} \frac{1}{|\mathbf{r}_{\omega_n}|} \tag{1.6}$$

The first stage: We can now work out the set of stories, $\boldsymbol{\omega}_j$, each firm would supply in the equilibrium. Under the *online* structure, working out $\boldsymbol{\omega}_j^*$ is easy. Let $\bar{u}(\omega_n)$ donate the utility that a reader interested in ω_n obtains from hearing ω_n at price 0. As the online structure allows firms to show different stories to different readers, a firm in this structure will always show ω_n to readers in $\mathbf{r}_{\omega_n}$ as long as the revenue from the story can cover the cost attached to reporting the story.

$$|\mathbf{r}_{\omega_n}|\bar{u}(\omega_n)-\frac{F}{|\boldsymbol{\omega}_j|}-v(\omega_n)\geq 0 \tag{1.7}$$

Firm *j* reports all such stories in the equilibrium. In other words, a story not in $\boldsymbol{\omega}_j$ in the equilibrium will imply that equation (1.7) does not hold for that news story. Thus, the set of all stories reported by some firm *j* in the online equilibrium is given by:

$$\boldsymbol{\omega}_j^{f,on^*}=\bigcup_{n=1}^{N}\omega_n : \omega_n \notin \boldsymbol{\omega}_j^{f,on^*} \implies equation\ (1.7)\ does\ not\ hold\ for\ \omega_n. \tag{1.8}$$

As all firms have identical cost structures (from assumption 4), we have:

$$\boldsymbol{\omega}^{f,on^*}=\boldsymbol{\omega}_j^{on^*}=\boldsymbol{\omega}_{j'}^{on^*}\ \ \forall j,j'\in J \tag{1.9}$$

As a single firm can serve all readers at the lowest possible cost, the number of firms in the market, J, in the equilibrium, is 1.[6] Threat of an entrant induces the firm to keep the price it charges to a reader k equal to the average cost of serving that reader. Further, we can rewrite equation (1.7) and equation (1.6) in the following way respectively.

$$|\mathbf{r}_{\omega_n}|\bar{u}(\omega_n) - \frac{F}{|\boldsymbol{\omega}^{f,on}|} - v(\omega_n) \geq 0 \tag{1.10}$$

$$p_{j_k}^{f,on*} = \left[\frac{F}{|\boldsymbol{\omega}^{f,on}|} + v(\boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on})\right] \sum_{\forall \omega_n \in \boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on}} \frac{1}{|\mathbf{r}_{\omega_n}|} \tag{1.11}$$

To solve for $\boldsymbol{\omega}_j$ under the offline structure, let $\boldsymbol{\omega}_{\mathcal{K}} = \bigcup_{k=1}^{K} \boldsymbol{\omega}_k$. All possible sets that can be reported by an arbitrary firm j for some non-negative profit are in $2^{\boldsymbol{\omega}_{\mathcal{K}}}$. Take an arbitrary set $\boldsymbol{\omega}_{arb} \in 2^{\boldsymbol{\omega}_{\mathcal{K}}}$ and let $\bar{u}^{min}(\boldsymbol{\omega_{arb}})$ be the least of the non-negative utilities for some reader k in set $\mathbf{r}_{arb}$ given by equation (1.3) at price given by equation (1.4). In equilibrium, the set $\boldsymbol{\omega}_{arb}$ will be reported by some firm j as long as the cost of doing so is less than or equal to the revenue a firm can earn from reporting it.

$$\boldsymbol{\omega}_j^{f,of*} = \boldsymbol{\omega}_{arb} : |\mathbf{r}_{arb}|\bar{u}^{min}(\boldsymbol{\omega}_{arb}) - F - v(\boldsymbol{\omega}_{arb}) \geq 0 \tag{1.12}$$

As J denotes the number of firms in the equilibrium, all of the stories reported in equilibrium are given by:

$$\boldsymbol{\omega}^{f,of*} = \bigcup_{j=1}^{J} \boldsymbol{\omega}_j^{f,of*} \quad \textit{for all } \boldsymbol{\omega}_j^{f,of*} \textit{ given by equation } (1.12) \tag{1.13}$$

This concludes our step 1 as we now know how to derive the equilibrium level of news quantity, readership and prices under our two market structures. We now show how our theorem inequalities follow from our step 1 results.

Step 2: Note that from definition 2, the demand equals supply in the equilibrium. Thus, we get:

[6] This number is a result of our choice to streamline the model by only allowing the two structures to be differentiated based on a firm's ability (or inability) to tailor news content to different consumers under these structures. However, in reality, it is common to observe multiple firms operating in a market, each distinguishing itself on multiple dimensions such as consumer interface, video duration, or limitations on content length, among others.

1. $p_{j_k}^{f,of^*} = p_{j_k}^{c,of^*} = p_{j_k}^{of^*}$ and $p_{j_k}^{f,on^*} = p_{j_k}^{c,on^*} = p_{j_k}^{on^*}$
2. $\boldsymbol{\omega}^{f,of^*} = \boldsymbol{\omega}^{c,of^*} = \boldsymbol{\omega}^{of^*}$ and $\boldsymbol{\omega}^{f,on^*} = \boldsymbol{\omega}^{c,on^*} = \boldsymbol{\omega}^{on^*}$
3. $\mathbf{r}^{f,of^*} = \mathbf{r}^{c,of^*} = \mathbf{r}^{of^*}$ and $\mathbf{r}^{f,on^*} = \mathbf{r}^{c,on^*} = \mathbf{r}^{on^*}$

First, we note that any set $\{\omega_n\}$ that satisfies equation (1.12) must also satisfy equation (1.10). Put differently, any story that is reported in the offline equilibrium will also be reported in the online equilibrium.

$$\boldsymbol{\omega}^{of^*} \subseteq \boldsymbol{\omega}^{on^*} \quad \Longrightarrow \quad |\boldsymbol{\omega}^{on^*}| \geq |\boldsymbol{\omega}^{of^*}| \tag{1.14}$$

Next, we will show that the consumer surplus for some reader k is at least as much in the online equilibrium as it is in the offline equilibrium. We observe that any story that is reported only under the online equilibrium must yield consumers a non-negative consumer surplus. Thus, to show that the weak inequality exists, we only need to show that for all the stories reported under both equilibriums, consumers pay equal or less price in the online equilibrium. For convenience, we list again the equilibrium prices paid by a reader k under the two market structures.

$$p_{j_k}^{of^*} = [F + v(\boldsymbol{\omega}_j^{tm})]\left[\frac{1}{|\mathbf{r}_j|}\right]$$

$$p_{j_k}^{on^*} = \left[\frac{F}{|\boldsymbol{\omega}^{f,on}|} + v(\boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on})\right]\left[\sum_{\forall \omega_n \in \boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on}} \frac{1}{|\mathbf{r}_{\omega_n}|}\right]$$

First, note that $F/|\boldsymbol{\omega}^{f,on}| \leq F$. Second, *as we are only comparing prices of those stories that are reported under both equilibriums*, we note that $v(\boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on} \cap \boldsymbol{\omega}_j^{tm}) \leq v(\boldsymbol{\omega}_j^{tm})$. This is because under the online structure, reader k only gets shown stories that are in her $\boldsymbol{\omega_k}$, which is not the case under the offline structure. Therefore, any stories not in $\boldsymbol{\omega_k}$ only add to the variable cost share of reader k.

Lastly, $\sum_{\forall \omega_n \in \boldsymbol{\omega_k} \cap \boldsymbol{\omega}^{f,on}} \frac{1}{|\mathbf{r}_{\omega_n}|} \leq \frac{1}{|\mathbf{r}_j|}$. In words, it means that for a set of stories, the readership of that set is always less than or equal to the individual readership of the stories in the set. For example, consider a set $\{\omega_n,\ \omega_{n'}\}$ where $|\mathbf{r}_n|$ people are interested in story ω_n, $|\mathbf{r}_{n'}|$ people are interested in story $\omega_{n'}$, and $|\mathbf{r}_{n,n'}|$ people are interested in both stories. The best case is that all of these readers interested in ω_n and also interested in $\omega_{n'}$, and vice versa. This will lead to all readers getting their news from a single firm reporting $\{\omega_n,\ \omega_{n'}\}$. In any other scenario, another firm reporting only $\{\omega_n\}$ or $\{\omega_{n'}\}$ will serve to reduce the readership of the first firm.

From these inequalities, we get that the price paid by any reader k under the online equilibrium, for stories that are reported under both structures, is always less than or equal to the price she pays under the offline equilibrium. Thus, reader k's consumer surplus under the online equilibrium is equivalent to, if not greater than, her surplus under the offline equilibrium.

$$cs_k^{on^*} \geq cs_k^{of^*}. \tag{1.15}$$

Further, all stories that are reported under the offline equilibrium can also be reported under the online equilibrium, and at a lower or equal prices, meaning that all readers who make a purchase under the offline equilibrium will also make a purchase under the online equilibrium.

$$\mathbf{r}^{of^*} \subseteq \mathbf{r}^{on^*} \quad \Longrightarrow \quad |\mathbf{r}^{on^*}| \geq |\mathbf{r}^{of^*}|. \tag{1.16}$$

If all readers who read the news under the offline equilibrium also read the news under the online equilibrium, and at lower prices, from equations (1.15) and (1.16), it follows that:

$$cs^{on^*} \geq cs^{of^*}. \tag{1.17}$$

This concludes the proof. □

Theorem 1 enables us to compare the impact of firms' ability (or inability) to customize news feeds across two structures on equilibrium consumer outcomes. Specifically, we have examined the number of consumers who read the news, the quantity of reported news stories, and the consumer surplus under the online and offline equilibriums. Results indicate that these outcomes are more favourable for consumers under the online equilibrium compared to the offline equilibrium. However, these inequalities are weak. To assert that the inequalities are strict, we require more structure on our *heterogeneity in demand* parameter.

Assumption 9. *Assume that there exists at least one $G'' \in \mathcal{G}$, such that:*

- *9.1: $\boldsymbol{\omega}_{G''} \not\subseteq \boldsymbol{\omega}_G \cap \boldsymbol{\omega}_{G'}\ \forall G, G' \in \mathcal{G}$,*
- *9.2: equation (1.10) holds for $\boldsymbol{\omega}_G, \boldsymbol{\omega}_{G'}, \boldsymbol{\omega}_{G''}$,*
- *9.3: equation (1.12) does not hold for $\boldsymbol{\omega}_{G''}$.*

Assumption 9 introduces a more specific framework for understanding the level of heterogeneity in consumers' demand for news stories. Essentially, it assumes the existence of a set of stories that are exclusively desired by a particular group and not by any other group (assumption 9.1). Moreover, it considers the cost of reporting these stories in a way that makes it feasible for outlets to cover them only under the online equilibrium (assumptions 9.2 and 9.3). This feasibility arises because, under the online equilibrium, the fixed cost is distributed amongst a larger number of stories (see equations (1.4) and (1.6)). This assumption is reasonable as it reflects the diverse range of consumer interests in reality, where some individuals are solely interested in niche topics. For example, consider a group of consumers who solely engage with the news media to hear stories biased against vaccinations. This brings us to the following corollary.

Corollary 1.1. *Weak inequalities in theorem 1 are strict under assumption 9.*

Given that the stories in $\boldsymbol{\omega}_{G''}$ are not a subset of the stories reported to readers other than g'' under the offline equilibrium (assumption 9.1), we can conclude that the quantity of reported stories is strictly greater under the online equilibrium, represented as $|\boldsymbol{\omega}^{on^*}| > |\boldsymbol{\omega}^{of^*}|$. Furthermore, since readers in g'' only receive news under the online structure, the readership is also strictly greater under this equilibrium, denoted as $\mathbf{r}^{on^*} > \mathbf{r}^{of^*}$. Lastly, the consumer surplus is higher under the online structure ($cs^{on^*} > cs^{of^*}$), as more stories are reported at better prices.

If we relax assumption 9.1, the weak inequality in the quantity of reported stories remains weak, but the inequalities in readership and consumer surplus become strict. This is because under the offline equilibrium, firms j and j' will report stories in $\boldsymbol{\omega}_{G''}$ to readers in g and g', but not to readers in g'' since doing so would require lowering the price further, which is not feasible for both firms. However, under the online structure, firms have the ability to tailor news content to different readers, and consequently price discriminate. Therefore, the firm j selling $\boldsymbol{\omega}_G$ and $\boldsymbol{\omega}_{G'}$ to readers in g and g' respectively, will also sell $\boldsymbol{\omega}_{G''}$ to readers in g''.

Let's now examine the impact of varying the fixed cost parameter on the results. As shown in the proof of theorem 1, the online equilibrium allows only one firm to operate. Therefore, modifying the fixed cost will affect the outcomes of the variables in theorem 1, but it will not alter the number of firms operating in the market. In contrast, under the offline structure, a decrease in fixed costs, in addition to affecting our key variables, will also increase the number of firms in the market. More precisely, let $\bar{u}(\boldsymbol{\omega}_{G''})$ be the utility of a reader k in g'' when she hears $\boldsymbol{\omega}_{G''}$ at price 0.

Corollary 1.2. *There exists a* $\mathrm{F}' < \mathrm{F}$ *such that as long as* $|\mathrm{g}''|\bar{u}(\boldsymbol{\omega}_{G''}) - v(\boldsymbol{\omega}_{G''}) \geq 0$ *holds, some new firm j will report* $\boldsymbol{\omega}_{G''}$ *from assumption 9 to readers in* g''*, under the offline equilibrium with fixed cost* F'*.*

When the fixed cost decreases, the number of firms in the offline equilibrium increase. Conversely, as the fixed cost increases, a single firm emerges, and beyond a certain point, the fixed cost becomes prohibitively high, resulting in no market for news. However, it is worth noting that if the economy satisfies the conditions outlined in assumption 9, lowering the fixed cost would also increase the quantity of news, readership, and consumer surplus under the offline structure. Similarly, under the online structure, reducing the cost enables the firm to report new stories that now satisfy equation (1.7). This improves the quantity of news, readership, and consumer surplus in the online equilibrium.

Lastly, let's consider a scenario where assumption 2 is no longer valid. This could occur if the government imposes restrictions on participation in the country's wavelength auction or artificially limits the number of radio or news channels in the economy. It could also arise if the network effects within the online structure become highly resistant to change. J represents the number of firms in equilibrium, and let J' represent the restricted number. We are specifically interested in the case where $J' < J + 1$. The reason for adding 1 to J is that the potential entry of this additional firm ensures that all profits remain at zero in the equilibrium.

Corollary 1.3. *When* $J' < J+1$*:*

- *Firms earn positive profits.*
- *The third inequality from theorem 1, switches to* $cs^{on^*} \leq cs^{of^*}$*.*

When the number of firms in the market is equal to or less than the optimal number, there is no threat of a new entrant with the same cost structure as existing firms. Consequently, firms can now freely set prices above the average cost and earn positive profits. In the online structure, firms can now engage in first-degree price discrimination to maximize their profits. This strategy maximizes producer surplus while reducing consumer surplus to zero. The quantity and readership of news remain unchanged.

Contrarily, under a offline structure, it is possible for two distinct groups, both obtaining news from the same firm, to exhibit varying levels of utility derived from news consumption. As firms cannot price discriminate, the group experiencing higher utility will accrue a positive consumer surplus. Consequently, the consumer surplus maybe reduced, although not always to zero. It is worth noting that this surplus is still smaller than the surplus observed when the number of firms is endogenized and the offline structure reaches equilibrium. Furthermore, this restriction also leads to fewer news stories being supplied to fewer readers in the offline structure.

Therefore, when the number of firms in the market is restricted below the equilibrium, consumer outcomes suffer on one or more dimensions. Under the offline structure, there is a decrease in the overall quantity and readership of news, accompanied by higher prices and a decline in consumer surplus. Under the online structure, the aggregated quantity and readership of news remain unchanged, but consumer surplus diminishes to zero. This outcome arises due to the absence of competition or any threat thereof, allowing firms to engage in first-degree price discrimination. Thus, factors that prevent the market from reaching equilibrium, such as restrictions on participation in spectrum auctions or persistent network effects, result in unfavorable outcomes for consumers on one or more dimensions.

1.5. Concluding Remarks

In this chapter, we have examined the news market under the social and offline structures. We differentiated these structures on the basis that online firms can tailor news content to individual readers. We found that under reasonable assumptions, the online equilibrium yields better consumer outcomes. In particular, more news stories are supplied at better prices and to a larger audience under the former equilibrium. We also find that factors that impede firm entry, such as high fixed entry costs, government restrictions, and network effects, make consumers worse off on one or more dimensions.

In the next chapter, we will show how these outcomes can affect the degree to which a society is polarized. In doing so, we give a possible answer to the notion that motivated this exercise, i.e., is online media uniquely to blame for the increased polarization across western societies?

Chapter 2

Polarization and News Media

2.1. Introduction

This chapter explores how social media's differentiating characteristic, i.e., its ability to tailor news feed to different readers, influences the degree to which a society is polarized. First, let us precisely define what we mean by polarization. The political science literature divides polarization in two categories, policy polarization and affective polarization. Policy polarization is the extent to which people's stances on policies differ, and affective polarization is the extent to which people feel negatively towards other people. The latter is often associated with claims of media-induced polarization in public discourse.

Whilst policy polarization has been extensively documented in western countries, data on affective polarization is scarce. Recent studies by Iyengar et al. (2019) and Boxell et al. (2022) attempt to measure affective polarization using survey data, particularly employing the 'feeling thermometer' type question that asks about people's sentiments towards their fellow citizens. These studies reveal a significant increase in affective polarization in the U.S. in recent years.

Additionally, surveys conducted by Pew Research Center (2019, 2020, 2021) indicate that opinions on issues like abortion, gay rights, and immigration have either remained consistent or become more homogeneous over time in the U.S. These findings suggest against any policy polarization. Consequently, there exists a notable divergence between affective and policy polarization trends in the U.S., which is intriguing as one would expect them to move in tandem.

This divergence between affective and policy polarization trends in the U.S. prompts further investigation. Building upon the insights from theorem 1, this chapter not only examines the impact of our proposed mechanism on the level of affective polarization within a society, but it also investigates its potential as an explanatory factor for the observed divergence in policy and affective polarization in the United States. We do so by decomposing a news stories ω_n into two components: the first component represents an *event* or a *policy*, while the second component represents a *bias*. In chapter 1, where we allow for heterogeneity in demand over news stories, this decomposition implies that demand can also vary across different events and biases. Furthermore, consumers have a dual motivation when seeking news stories. Firstly, they seek news stories that confirm their prior beliefs about events or policies that are of interest to them. Secondly, they desire information about others' biases on those events or policies to effectively coordinate their actions in the economy.

The existing literature well documents readers engaging in biased information search and being driven by coordination motives. Notably, studies such as Mullainathan and Shleifer (2005) and Nimark and Sundaresan (2019) investigate confirmation bias, while Hellwig and Veldkamp (2009) and Nimark and Pitschner (2019) explore the role of coordination motives in information acquisition. However, to the best of our knowledge, no previous study has examined these two types of demand in conjunction. Therefore, this thesis stands as the first endeavor to explore this aspect in some detail.

Exposure to others' biases, when they differ from reader's own biases, also creates cognitive dissonance and lowers the overall utility. This gives firms an incentive to misrepresent others' biases when doing so increases the utility of their own consumers. On one hand, a firm considers its readership's disutility from cognitive dissonance, and on the other hand, it takes into account their disutility arising from the misrepresentation of biases, which hinders their ability to effectively coordinate their actions with others. Consequently, their utility is contingent upon their ability to tolerate views that contradict their own beliefs. In other words, if the disutility caused by information that deviates from their biases is lower than the disutility they experience from the failure of coordinated actions, then, it becomes optimal for a firm to misrepresent others' biases to its consumers. This, in turn, enables firms to charge higher prices to their consumers, thereby maximizing their profits. Hence, in our model, the decision of firms to mischaracterize others' biases is primarily motivated by profit considerations.

However, it should be acknowledged that in reality, mischaracterization can also stem from ideological or political motivations. Research from DellaVigna and Kaplan (2007) and Gerber et al. (2011) demonstrates the significant persuasive effects of news media on their readership. However, it has been argued that the impact of persuasion is limited due to the fact that the demand for news is not independent of consumer biases. Evidence provided by Gentzkow and Shapiro (2004, 2010) indicates a strong demand for news slants that align with readers' biases.[1] These studies also suggest that news outlets respond to this demand, implying that consumer preferences shape the slanting strategies employed by news outlets in the market. Moreover, recent revelations from the Dominion Inc. v. Fox News case in the U.S. offer prima facie evidence supporting the claim that reader biases influence the slanting strategies of news firms (see The Washington Post, 2023).

We consider reader biases to be exogenous to the model, meaning that the level of policy polarization is determined outside of the system. However, affective polarization is influenced by two key factors that are endogenous to the model: the quantity of news supplied by firms and the information provided by these firms on others' biases. One of the reasons why a group may develop negative sentiments towards another group is when they perceive a divergence in their policy positions. The larger the gap between these viewpoints, the stronger the negative emotions become, resulting in a higher level of affective polarization between the groups. Therefore, stories that educate readers about biases held by others in the society play a crucial role in shaping their feelings towards fellow readers. Thus, these stories have an impact on the overall level of affective polarization in the society.

When the conditions are optimal for firms to mischaracterize others' biases, we observe a more pronounced *divergence* between policy and affective polarization in the online equilibrium. This is because more stories that mischaracterize these biases are reported in this equilibrium. As we control for all other channels that could impact affective polarization, this higher divergence suggests that the customization feature of social media platforms can influence the degree to which in a society there is affective polarization. Crucially, when consumers demonstrate a preference for sensational news, we find the society to be *more* affectively polarized in the online equilibrium. We therefore, provide a theoretical framework that establishes social media

[1] For a detailed review of empirical literature on persuasion, see DellaVigna and Gentzkow (2010).

as a distinctive factor contributing to the amplification of affective polarization in countries such as the United States. But before we delve into our findings, let us discuss the existing body of literature on the emergence of bias in news reporting.

2.2. Literature Review

Economists have long studied the impact of mass media on our society, with early investigations tracing back to Lazarsfeld et al. (1944), Prat and Strömberg (2013). More recently, Mullainathan and Shleifer (2005) have modeled the news market under two assumptions: readers suffer from confirmation bias, and media outlets slant accordingly. Gentzkow and Shapiro (2006) link these assumptions by showing that media outlets start slanting towards readers' priors because of their desire to built a reputation of accuracy with these readers. Suen (2004) shows that under these assumptions, even fully rational Bayesian agents can become more polarized in the short run. Callander and Carbajal (2022) explain long-run trends in the U.S. polarization by positing that these trends can be closely mimicked when confirmation bias in the population is combined with strategic maneuvering of the party elites.

Other papers that study the role of confirmation bias in polarization include Fryer et al. (2019) and Nimark and Sundaresan (2019). The former shows that polarization occurs through confirmation bias when agents use Bayes rule in an iterative way on a set of ambiguous signals. The latter identifies two effects, confirmation and complacency, that polarize ex-ante identical Bayesian agents when channel precision becomes costly. They use Sims' (1998; 2003) rational inattention framework to identify these effects. Matějka and Tabellini (2021) also use rational inattention to show that a drop in information acquisition cost for voters with extreme views, increases political polarization.

Our contribution to this strand of literature lies in our examination of coordination motives amongst biased readers. While previous studies have separately explored the effects of biased information search and coordination motives, our study is the first to investigate their combined influence and the resulting tensions within the utility function of a utility-maximizing agent (Hellwig and Veldkamp (2009) and Nimark and Pitschner (2019) explore the role of coordination motives in information acquisition). By integrating these two factors, we enhance the understanding of the subject matter.

Another strand of literature uses the 'competition for attention' framework to study the mass media's effect on social welfare. Galperti and Trevino (2020) study competition for attention in the news markets through Dewan and Myatt (2008, 2012) and Myatt and Wallace (2012) framework. They find that competition leads to homogeneous information supply despite heterogeneous demand, causing supply inefficiencies. In contrast, we have shown that competition generally increases the information heterogeneity in the news market.

Chen and Suen (2022) also use a competition for attention framework to study the quantity-quality trade-off in the news market. They show that as market becomes competitive, the quantity of news on a topic increases, and the quality decreases. This is different from their prior results where they find competition to be welfare improving. Specifically, Chan and Suen (2008) find voter welfare to be typically higher under a duopoly than monopoly. However, it is not clear a priori if consumers will be less or more informed, implying an ambiguous effect of media competition on consumer welfare. Similar results can be found in Edmond and Lu (2021), who interpret the social media revolution as a simultaneous shock that reduces politicians' information manipulation cost, and increases voters' information precision. They find the shock to be welfare improving only up to a certain threshold.

These results differ from Perego and Yuksel's (2022), who study endogenous acquisition of political information in a competitive market. They show that competition forces media outlets to becomes less informative on issues of common interest and more informative on issues of disagreement. Consequently, competition has negative social welfare consequences. This result stands in contrast to the previous results from the endogenous provision of information literature (for e.g., see Baron (2006) and Anderson and McLaren (2012)). This paper aligns with their findings by confirming that increased competition in the offline media market can lead to increased affective polarization in a society. However, in contrast to their study, we demonstrate that changes in competition levels under the online structure are neither necessary nor sufficient to influence the affective polarization of a society. Moreover, our results are primarily driven by readers being misinformed about biases of other readers in the economy.

This thesis also distinguishes itself from previous literature as it is, to the best of our knowledge, the first study to examine how affective polarization changes when a society transitions from traditional forms of news delivery to an economy predominantly reliant on social media for news dissemination. Additionally, we illustrate how social media platforms can amplify affective polarization by simply increasing the quantity of news accessible to readers in the economy. Let us now delve into the details of our augmentation setup.

2.3. The Augmented Setup

In this section, we outline the specific nature of information that consumers seek and examine how this demand for different types of information may create incentives for firms to deceive their readerships in their reporting. By introducing this enhanced framework, based on practical assumptions, we aim to address the central question raised at the beginning of the thesis: whether social media is uniquely to blame for the surge in affective polarization observed across some western societies.

2.3.1. The Augmented Demand Side

In the first chapter, we posited that readers are driven to acquire knowledge about the elements in set $\boldsymbol{\omega}$ due to the intrinsic value of the information contained in those elements (see assumption 1). In this chapter, we introduce an explicit assumption regarding the specific types of information that consumers desire to obtain.

Assumption 10. *Readers suffer from confirmation bias and they have coordination motives.*

Consequently, a reader k exhibits demand for two types of news stories. Firstly, she seeks stories that confirm her existing biases. Secondly, she desires stories that provide insights into others' biases. While in reality, a single news story may encompass both types of information, in an abstract sense, one can always separate such a story into two components: one confirming the consumer's bias and the other facilitating coordination of their actions.

Now, we can decompose a news story ω_n into two distinct components, e_x and b_z. Let $\mathbf{e}$

= $\{e_1,\ e_2,\ \ldots\ , e_X\}$, with e_x representing an arbitrary element of set **e**. We can interpret e_x as comprising factual information pertaining to a particular *event*. For example, it could involve details about the weather forecast in the capital city or information regarding a proposed government bill intended to become law.

Also let **b** = $\{b_1,\ b_2,\ \ldots\ , b_Z\}$ be the set of of all feasible biases that any reader can have on any event. This set can be as big and detailed as one wants it to be, or it could be kept simple. For instance, it could have a cardinality of $X \times K$ where every element of the set describes a bias of some reader k on some event e_x. Alternatively, it could have a cardinality of 3, indicating whether a reader is biased in favor of, against, or impartial towards an event e_x.

Now, an ω_n in set $\boldsymbol{\omega}_k$ serves two purposes. Firstly, it provides information to reader k about an event e_x. Secondly, it either reinforces k's bias or it informs her of others' biases with regard to this event. While the model in section 1.3 adequately captures the scenario when biases are homogeneous, it falls short in reality where biases vary across populations. Hence, the necessity for this augmentation arises. We assume that all groups demand two types of stories.

Assumption 11. *For every group* $\mathbf{G} \in \mathcal{G}$*, there is at least one subset* $\{(e_x,\ b_z),\ (e_x,\ b_{z'})\} \subseteq \boldsymbol{\omega}_G$*, where* b_z *confirms the biases of readers in* **g** *regarding* e_x*, and* $b_{z'}$ *provides information about the biases of another group on* e_x*.*

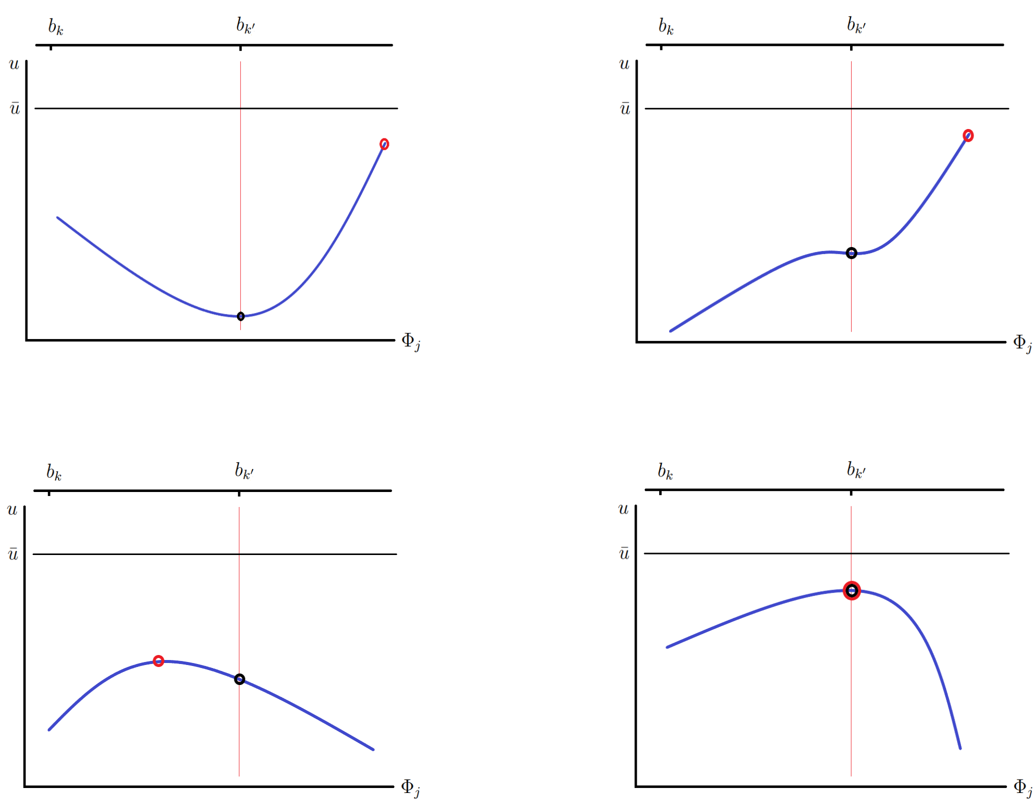
We can view assumption 11 as a more stringent variation of assumption 10, as it implies that all readers seek two specific types of stories on at least one event. These types include stories that confirm their own biases and stories that provide information about the biases held by others.

The second component of the tuple $(e_x,\ b_{z'})$, which informs readers about biases that differ from their own, leads to readers experiencing disutility due to cognitive dissonance. As a firm aims to maximize reader k's utility so that it can charge her a higher price, this disutility from cognitive dissonance provides it an incentive to misrepresent others' biases to reader k. On one hand, the firm considers reader k's disutility from cognitive dissonance, and on the other hand, it takes into account k's disutility arising from the misrepresentation of biases, which hinders her ability to effectively coordinate her actions. Consequently, reader k's utility is contingent upon her ability to tolerate views that contradict her own. In other words, if the disutility caused by information that deviates from her biases is lower than the disutility she experiences from the failure to coordinate her actions with others, then, it becomes optimal for the firm to misrepresent others' biases to $\boldsymbol{k}$.

Let Λ_j denote the amount of information provided by some firm *j* that *accurately* reports others' biases to its readership and let Θ_j be the amount of mischaracterization in *j*'s reporting. For ease, let $\Phi_j = Z(\Lambda_j, \Theta_j)$, where Φ_j represents the combined effect of Λ_j and Θ_j on reader's utility. We augment the utility function from equation (1.1) to the following.

$$u\Big(|\boldsymbol{\omega_k} \cap \boldsymbol{\omega_j}|,\ |\boldsymbol{\omega_j} \setminus \boldsymbol{\omega_k}|,\ \Phi_j,\ p_{j_k}\Big) \tag{2.1}$$

Whilst we do not make any claims about the functional form of Φ_j here, we do, however, give some examples to show the consequences of its different functional forms. Let b_k and $b_{k'}$ be $\boldsymbol{k}$ and k''s biases on some event respectively. Black circles on the graphs below indicate the utility derived by $\boldsymbol{k}$ when *j* reports $b_{k'}$ truthfully. Red circles denotes utility when *j* mischaracterizes $b_{k'}$. The top two graphs characterize readers who prefer sensational and less nuanced news over the truth. The bottom left graph characterizes readers who prefer less confrontational news over the truth. The bottom right graph characterizes readers who prefer the truth.



2.3.2. The Augmented Supply Side

News outlets respond to this demand by serving up stories that may either contain information that reinforces its readership's biases, or informs its readership about others' biases on events that are of interest to its readership, or both. The following two stories from the *Washington Examiner* (2019; 2022) provide an example of the different types of stories that news outlets serve to their readerships.

1. *Pence urges Republicans not to back down from abortion on campaign trail*
2. *Hell hath no fury like Democrats blocked from killing babies*

Consider yourself, for a moment, an anti-abortion voter in the United States who is biased towards voting for the Republican Party. The first news story only reinforces your existing bias without providing any additional information. However, the second story not only confirms your bias but also sheds light on the bias of another group in the economy, namely the members of the Democratic Party. Since readers have no means to independently verify this information, firms have the freedom to misrepresent the biases of others if it serves their best interests. In this particular case, several fact-checkers have debunked the claims presented in the second headline story (see Robertson (2019)).

Thus, we define an element ω_n from $\boldsymbol{\omega}_j$ as $(e_x,\ s_z)$, where $s_z \in \mathbf{b}$ is the *slant*. The slant can either confirm a bias held by the readership of firm *j* or inform them about a bias held by another group in the economy. Firms have the freedom to misrepresent the biases of others. This implies that they can choose a bias not held by a particular group and inform their readership that the bias belongs to that group. Since firms are simply catering to the demands of their readers, the supply side engages in the same optimization problem as in equation (1.2).

2.4. Results

We are now ready to answer how online media's differentiating characteristic, i.e., its ability to cater different news stories to different readers, influences the degree to which a society is affectively polarized. We know that the direction of slant of a profit maximising firm would be that which maximises the utility of its readership.[2] Therefore, three cases exist:

1. Λ_j *dominates* Θ_j *in the utility function*: In this case, readers would prefer truth over any mischaracterization. Thus, firms will truthfully report biases of others to their readerships.
2. Θ_j *dominates* Λ_j *in the utility function*: In this case, readers can either prefer:
   - 2.1: *Less confrontational news*. Firms will then report biases of others to be closer to the biases held by its readership than they actually are; or,
   - 2.2: *Sensational news*. Firms will then report biases of others to be farther to the biases held by its readership than they actually are.

Common observations suggest the last case to be the more plausible one. For example, news channels often use sensational tactics, such as excessive and repetitive usage of "Breaking News" banners, to grab viewers' attention and create a sense of urgency. This suggests that the sensationalization of news is an effective strategy to attract audiences. Certain tabloid newspapers, particularly those in countries like Britain and Australia, are known for their sensational headlines and stories. These tabloids focus on scandals, gossip, and shocking revelations about celebrities. The continued popularity and readership of such publications indicate a demand for sensational content amongst a significant portion of the population. Additionally, reality television shows such as *Big Brother Australia* and *Married at First Sight* thrive on creating drama, conflict, and exaggerated situations to entertain viewers. These shows attract large audiences and generate significant buzz, further emphasizing the appeal of sensational content. Furthermore, the rise of conspiracy theories, which often involve sensational claims, also suggests in favour of the appeal of sensational content. All of these aforementioned observations strongly suggest a prevailing preference among people for sensational news. Moreover, research such as Davis and McLeod (2003) and Vettehen and Kleemans (2018), provide further evidence to support this claim. This leads us to the following corollary.

[2] We do not calculate what the optimal slant ought to be for some firm j as such a calculation would require further assumptions on the functional form of the utility function in equation (2.1). For readers interested in these calculations, we refer them to Mullainathan and Shleifer (2005) who calculate the optimal slant for newspapers using a functional form model kin to a Hotelling setting.

Corollary 1.4. *When consumers prefer sensational news, under assumptions 9 and 11, corollary 1.1 implies affective polarization to be more pronounced under the online equilibrium.*

Referring to assumption 9 and corollary 1.1, the online equilibrium allows for a larger number of stories to be reported, while assumption 11 allows for some of these additional stories to inform readers about the biases of others in the economy. When readers exhibit a preference for sensational news, these stories tend to report biases of others to be more extreme than they actually are in reality. As a result, readers consuming these stories perceive the biases of others to be further apart from their own biases on more *events* or *policies*. This amplifies affective polarization, as readers become more emotionally divided from those whose biases are misrepresented in the sensational news stories. Therefore, under the online equilibrium, the preference for sensational news contributes to a more pronounced affective polarization among readers.

Conversely, if we assume that readers have a preference for less confrontational news, it would lead us to conclude that the society would be less affectively polarized under the online equilibrium as more stories will be reported that mischaracterize others' biases to be colder to readers' own biases than they are in reality.

Under assumption 9 and assumption 11, as long as the effect of Θ_j dominates the effect of Λ_j in the utility function, the degree of divergence between affective and policy polarization will always be greater under the online structure because more news stories will be reported under this equilibrium that misinform readers about others' biases in the economy.

On the other hand, if the effect of Λ_j dominates the effect of Θ_j in the utility function, firms will have no incentive to misinform readers about the biases held by others in the economy. In this scenario, both policy polarization and affective polarization in the economy will move in tandem under the equilibriums of both market structures. Lastly, as the readership and quantity of news stories inequalities do not reverse under corollary 1.3, the results from corollary 1.4 continue to hold even when we endogenously fix the number of firms operating under these structures.

In this regard, corollary 1.4 also provides pertinent insights that address the question raised in section 2.1, i.e., can our mechanism provide a potential explanation for the divergence observed in the policy and affective polarization trends in the United States. By considering the impact of online media on affective polarization, we can understand why these divergent trends exist. The mechanisms at play within online media platforms, that is the dissemination of sensational news at cheap prices, can lead to heightened emotional divisions among individuals. This emotional polarization may occur independently of any changes in individuals' policy preferences, thereby explaining the observed increase in affective polarization alongside a decrease in policy polarization in the United States. Therefore, corollary 1.4 offers valuable insights into the complex relationship between social media, affective polarization, and policy polarization, shedding light on the empirical findings and reconciling the apparent discrepancy between the two.

2.5. Concluding Remarks

In this chapter, we provide a framework supporting the argument that when individuals simultaneously seek bias confirmation and exposure to others' biases, and favour sensational news over nuanced analysis, it leads to a greater level of affective polarization under the online equilibrium. This happens because our mechanism enables online outlets to disseminate more news stories, that mischaracterize other's biases and heighten emotional divisions, at a cheaper rate and to a wider audience, compared to the offline equilibrium.

More broadly, this thesis highlights the impact of shifting from offline media to online media as the primary source of news dissemination. It highlights the unique characteristic of online media, namely its ability to tailor content to different consumers, and demonstrates its influence on the level of affective polarization of a society. By showing that this distinct social media channel can impact the affective polarization of a society, we address the key questions posed at the start of the thesis. Based on reasonable assumptions, we argue that the transition to online media as the primary news source amplifies affective polarization in society in the equilibrium. Furthermore, our framework provides insights into the divergence between the policy and affective polarization trends observed in the United States. Specifically, we demonstrate that it is possible for a society to experience an increased level of affective polarization while policy polarization simultaneously decreases.

However, we have not addressed all of the open question raised by empirical observations.

Specifically, the distinction between policy and affective polarization prompts us to inquire whether all western societies, beyond just the United States, have experienced an increase in affective polarization since the introduction of online media. Boxell et al. (2022) findings indicate that while affective polarization has indeed risen in countries such as France, and the United States, it has decreased in other countries such as Australia, and Norway. This raises the question: If online media is responsible for affective polarization, why has it only increased in certain countries and decreased in others?

Let us consider the conjecture that the average reader in the United States, and France may prefer sensational news, while the average reader in Australia and Norway may prefer less confrontational news. Thus, the adoption of social media could potentially intensify affective polarization in the former countries while reducing it in the latter in our model. It is important to note that numerous economic and geopolitical factors influence the level of affective polarization within a society. Therefore, we do not claim that our mechanism can fully explain the cross-country variation in affective polarization levels. However, it is certainly worth considering as one of the factors that may contribute to understanding the variation and divergent trends observed across different countries. We leave this as an open question for future researchers to explore.

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