Sponsored Content Advertising in a Two-sided Market

Prabirendra Chatterjee*

Bo Zhou†

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Abstract

Sponsored content advertising, also known as native advertising, is a new ad format in which a brand's content takes the same form and qualities of the publisher's original content. While many advertisers have largely embraced this new advertising format, consumers seem to react negatively towards sponsored content ads. In this paper, we present an analytical model that studies the strategic role of sponsored content advertising in a two-sided media market. We identify conditions under which competing platforms would choose sponsored content advertising over traditional advertising. Despite consumers' negative sentiment towards sponsored content ads, they can be better off together with the advertisers when both platforms choose this ad format. In fact, we show that a certain degree of consumer disliking is necessary to make both advertisers and consumers better off with sponsored content ads. However, both competing platforms offering sponsored content ads may also result in a Prisoner's Dilemma equilibrium outcome generating sub-optimal profits. We further show that two symmetric media platforms can choose different advertising strategies, leading to an asymmetric equilibrium outcome. Lastly, we analyze how the presence of multi-homing advertisers as well as an incomplete ad market coverage would affect the sponsored content ad equilibrium.

*Cardiff Business School, Cardiff University, e-mail: chatterjeep@cardiff.ac.uk.

†University of Maryland, College Park, Robert H. Smith School of Business, e-mail: bozhou@umd.edu. The authors thank the department editor, the associate editor, and three anonymous reviewers for extremely constructive comments that significantly improved this paper. The authors have benefitted from participants of the 2016 Marketing Research Camp at the University of Maryland College Park, the 2017 (10th) Workshop on the Economics of Advertising and Marketing in Tbilisi, Georgia, the 2017 Marketing Science Conference and the 2017 Summer Institute in Competitive Strategy at UC Berkeley; and seminar participants at Shanghai University of Finance Economics and Sabanci University. The authors thank David Godes, Yogesh Joshi, Jeffrey Shulman, Chutian Wang, and especially for Xuelian Qin for helpful suggestions. The order of authorship merely reflects alphabetic sequence.

1 Introduction

According to the American Press Institute, sponsored content advertising (often also referred to as native advertising) is defined as a type of advertising where a brand's content takes "the same form and qualities of a publisher's original content." The definition here refers to an advertising platform like the New York Times or BuzzFeed as the "publisher."[1] The definition also suggests that this content can provide useful information to readers so that their perception about the sponsored brand tends to be more favorable. While some forms of sponsored content advertising (e.g., advertorial) have been there for more than a hundred years, recent innovations in digital media have expanded the scopes of sponsored content advertising. With more primitive forms of sponsored content advertising, consumers were always urged to take concrete actions. The contemporary version of sponsored content advertising, however, never asks a consumer to buy a product. Instead, it portrays a favorable picture of the corresponding brand. As a result, the content looks more convincing and authentic, as if the publishing platform itself has developed the material, instead of the brand.

Take for example the article "Women Inmates: Why the Male Model Doesn't Work" which was published in the *New York Times*.[2] The article discussed the incarceration experience of the female inmates in the U.S. prisons. The write-up offered an in-depth analysis of the challenges that the female inmates experienced, and also provided some insights on how to improve the quality of life of the women convicts. At a first glance, it may seem like an example of a typical first-class journalism that any reader of NYT would expect to see. However, upon careful examination of the article, a reader would find that the article was a paid post. The advertiser/sponsor of this article was Netflix. Even though in the entire article there was no reference of either the brand (Netflix) or any product (i.e., the Netflix TV shows), any reader interested in contemporary television culture would realize that the article was subtly used to raise interest and awareness of Netflix's original series "Orange Is the New Black." This particular web TV series produced by Netflix was based on a real life woman inmate's experiences in a minimum security federal prison.

From an advertiser's perspective, the development of the sponsored content advertising sounds quite promising, but at the same time it can have a negative impact. In particular, although sometimes readers may accept sponsored content as useful and relevant as any other editorial content, a recognition of sponsored content advertising as a mere promotional message could make

[1] https://www.americanpressinstitute.org/publications/reports/white-papers/the-definition-of-sponsored-content/
[2] https://www.nytimes.com/paidpost/netflix/women-inmates-separate-but-not-equal.html

the readers more upset (Wojdynski and Evans 2016). If for whatever reason readers identify an editorial-like product review as a brand's promotional message, they may feel that the brand has tried to mislead them. Of course, one simple way brands can alleviate this problem is to clearly label the content as the promotional material. In reality though, many brands do not take such actions fearing that a clear labeling would transform the sponsored content advertising back into traditional advertising (equivalent to banner advertising) and thus the whole purpose of developing sponsored content advertising will not be served.

A 2015 survey undertaken by a content marketing platform shows that across different platforms, about sixty percent of the readers on average fail to identify a sponsored content article as a promotional activity of a brand (they believe that the article was written by the staff reporters of the publishing platform). This survey also shows that about forty eight percent of these readers felt deceived once they were told that the article was an example of sponsored content advertising.[3] Since then, the Federal Trade Commission echoed consumers' concerns by imposing a set of regulations on sponsored content ads, particularly by taking stricter stands regarding the disclosure and labeling policy.[4] Given the current regulation, in this paper we consider sponsored content ads as another ad format which can be effective and annoying at the same time. We essentially look at the use of different advertising formats with differential effectiveness and differential nuisance. As a result, our model can be suitably used (with necessary modifications) to understand how other advertising formats such as click bait may end up as an equilibrium strategy of a media platform.

A publishing platform too may lose credibility once its readers realize that the editorial-like article is neither relevant nor well integrated with the actual editorial content. The Netflix sponsored content on women inmates for example had received a lot of positive attention because of the high quality of the ad content. Moreover, the sponsored content was well integrated with the New York Times' other editorial content and successfully replicated NYT's journalistic style.[5] If the content is not well developed or well integrated, consumers may decide to stop visiting the platform or visit it less frequently. In a two-sided market, this decision may affect a platform in two ways. The first one comes as a direct effect for the platform which charges a price to its readers for accessing news content - the lower the number of visitors is, the lower the gross revenue of the platform will be (from readers' side). Additionally, if only a handful of consumers visit the

[3] https://contently.com/strategist/2015/09/08/article-or-ad-when-it-comes-to-native-no-one-knows/
[4] https://www.ftc.gov/tips-advice/business-center/guidance/native-advertising-guide-businesses
[5] https://digiday.com/media/new-york-times-native-ad-thats-winning-skeptics/

platform, even the advertisers will not be happy. In that case, a platform may lose a substantial number of advertisers too, which will further reduce this platform's revenue. This potential threat, however, does not necessarily dampen the spirit of either advertisers or publishing platforms in developing sponsored content advertisements. According to eMarketer (2019), online advertisers spent \$35 billion on native ads in 2018 and \$44 billion in 2019, with a projected \$53 billion being spent in 2020.[6] Furthermore, data from the Native Advertising Institute, shows that revenue generation from native advertising is expected to increase by 46% by 2021.[7]

In a recent article, Forbes has identified competition, transparency, and content creation as three most crucial factors in the context of sponsored content advertising.[8] The article also mentions that the names of the sponsored content ad products (such as BrandSpeak, BrandConnect, BrandPost, etc.) are "maddeningly similar" and often leave the audience confused about the real intentions of the platforms. This article suggests that as competition for ad dollars has become rife, the platforms are still learning how to adopt effective advertising strategies.

To sum up, given the different views among consumers, advertisers and platforms surrounding sponsored content advertising, this paper investigates how directionally opposite key driving forces such as consumers' ad annoyance and advertisers' benefit from more convincing storytelling shape the advertising format strategies of media platforms. Specifically, we seek to answer the following research questions in this paper. First, when should a media platform adopt sponsored content advertising instead of traditional advertising? Second, is sponsored content advertising necessarily more profitable for a media platform than traditional advertising? Third, can sponsored content advertising offer a higher surplus to both consumers and advertisers in spite of a higher degree of consumer annoyance? To answer the first question, we characterize the complete equilibrium conditions for two competing platforms as well as a monopoly platform. For the second question, we provide conditions under which sponsored content advertising as an equilibrium strategy can lead to lower payoffs for the platform (i.e., we show the existence of the prisoner's dilemma outcome). Lastly, to address the third question, we present conditions under which, in contrast to conventional wisdom, both advertisers and consumers can be better off in the presence of sponsored content advertising.

We organize the remainder of the paper as follows: in the next section we present the literature

[6]https://www.emarketer.com/content/us-native-advertising-2019

[7]https://smartyads.com/blog/native-advertising-news-and-trends/

[8]https://www.forbes.com/sites/lewisdvorkin/2014/03/25/inside-forbes-10-battlegrounds-to-watch-as-native-advertising-marches-on/#428c227640d8

review. In Section 3, we explain our model. Following that, we discuss equilibrium results in Section 4. Section 5 offers two extensions of our main model. In Section 6 we discuss the managerial implications and draw our concluding remarks. All proofs can be found in the appendix.

2 Literature Review

Since sponsored content advertising is a recent phenomenon, the academic research on this topic is currently at a nascent stage. Early papers on sponsored content advertising such as Becker-Olsen (2003) have experimentally identified the benefits of sponsored content ads for the advertisers as well as the platform. Becker-Olsen (2003) also explains how the informational context in sponsored content ads forces the consumers to engage in higher levels of information processing, and in turn affects a consumer's attitude towards advertising in general. Campbell and Marks (2015) and Conill (2016) qualitatively discuss the pros and cons of this new ad format in digital advertising, while Bakshi (2015) explains why and how to regulate native advertising in online news publications. Furthermore, Carlson (2015) provides a balanced critique of sponsored content advertising and explains how this new form of ads may be eroding the boundaries between editorial and advertising, and changing the normative understandings of journalistic autonomy.

Recent experimental studies such as Wojdynski and Evans (2016) also suggest that while a higher transparency level helps consumers identify the message as an advertisement, most of the time this ad recognition leads to negative evaluations. Lee, Kim and Ham (2016) alternatively suggests that if consumers have strong information-seeking motivation (as opposed to socializing motivation), then they would positively evaluate sponsored content advertising. In accordance with Lee et al. (2006), we also find that when consumers obtain intrinsic value from the content of the ad, sponsored content ads would become a more appealing format for the platforms. Most recently, field experiments have been used to study the impact of native ads. For example, Sahni and Nair (2020) varies the format of the ads and randomly assigns consumers into two extreme conditions, one with no indication of the sponsored nature of the ads, and the other with a clear disclosure of its sponsored nature. Empirically, they find that native ads benefit advertisers and detect no evidence of deception under typical formats of disclosure used in the paid-search marketplace. Combining clickstream, eye-tracking and survey data, Aribarg and Schwartz (2020) uses online and field experiments to study consumers' response to native ads versus display ads under different native ad disclosures. They find that a native ad generates a higher click-through rate due to its resemblance of the editorial content, but a display ad can garner more attention. Unlike these empirical studies that focus on a monopoly platform with different disclosure strategies, we focus on the strategic impact of sponsored content ads and explicitly model competition between media platforms. As a result, we can characterize the optimal ad prices under competition and assess the impact of varying advertiser demand on the equilibrium outcomes.

We follow the basic tenets of the two-sided market model with network effects laid out in the seminal papers such as Rochet and Tirole (2003) and Armstrong (2006). Rochet and Tirole (2003) provides a general framework of a two-sided market by illustrating that any market with network externalities can be considered as a two-sided market as long as a platform can effectively cross-subsidize between different user groups. Armstrong (2006) on the other hand offers the primary structure of a two-sided market where at least one group of economic agents opt for single-homing (i.e., they only choose one platform). We assume that both readers and advertisers choose single-homing in the main model, and then relax the assumption of single-homing and examine a situation when advertisers can multi-home (i.e., they can purchase from both platforms).

Following Katz and Shapiro (1985) that analyzes the role of consumers' expectations and network externalities, we assume that rational consumers' and rational advertisers' expectations are both correct in equilibrium. More recent papers like Ellison and Ellison (2005) as well as Tucker and Zhang (2010) suggest that almost all online markets show strong evidence of network externalities. Tucker and Zhang (2010) specifically finds that online retail websites may get more seller listings if a large number of sellers are already listed on the websites because that implies a larger buyer base. In comparison, our paper has incorporated the opposite externalities across the two sides of the market (advertisers prefer consumers while consumers dislike ads), which is more consistent with the context of the media market. Furthermore, Chen and Xie (2007) finds that due to cross-market network effects, an important factor like customer loyalty in one market may actually reduce the profit in a secondary market when the two markets are interdependent. By contrast, we show that even when consumers' disutility towards sponsored content ads is higher than their disutility towards traditional ads, due to cross-side externalities, consumers may actually be better off under sponsored content advertising.

Our paper also contributes to the growing literature on media markets. Several recent papers on media markets have shown that mere competition among platforms may not necessarily make consumers better off. Dukes and Gal-Or (2003) finds that competing media stations can offer exclusivity rights to advertisers, thus yielding more poorly informed consumers and alleviating price competition in the product market. On a related note, Gal-Or and Dukes (2003) shows that competing platforms can offer minimally differentiated content which lowers the amount of ads and helps advertisers gain higher margins from product sales to consumers. Anderson and Coate (2005) shows that equilibrium advertising levels may be too low or too high depending on the nuisance cost to viewers, the substitutability of competing platforms' programs, and the benefits to advertisers from reaching the viewers. Godes, Ofek and Sarvary (2009) suggests that duopoly media firms can set higher prices for the media content than a monopolist firm. Zhu and Dukes (2015) also finds that in regard to consumption of the factual content, consumers may not benefit from the competition among media producers. Media platforms in our paper compete on the ad format strategy, however such competition can increase the welfare of consumers even when they face a more undesirable ad format. Amaldoss, Du and Shin (2016) finds that consumers' heterogeneity in their aversion towards ads can lead symmetric platforms to adopt asymmetric pricing strategies. In general, our paper differs from this stream of research by focusing on the comparison between two advertising formats and analyzing how the cross-side externalities influence the equilibrium ad choice and pricing.

3 Model

3.1 Platforms

Two competing platforms, 1 and 2, are horizontally differentiated and located on the two extremes of each of the two Hotelling lines (faced by the readers (henceforth consumers) and the advertisers, respectively). Each platform offers media content to the consumers and allow advertisers to post either traditional ads, denoted by T (traditional advertisements) or sponsored content ads, denoted by S (sponsored content/native advertisements). A traditional ad can be perceived as a banner ad as the consumers instantaneously recognize it as a direct promotional message. However, a sponsored content ad may provide high-quality content and may be well integrated with other media content by the platform, and thus can potentially provide informational or entertainment value to a consumer.

Platform i ($i \in \{1,2\}$) charges prices, $p_{iC}^{\upsilon\omega}$ and $p_{iA}^{\upsilon\omega}$, to the consumers and the advertisers, respectively. Subscripts C and A denote consumers and advertisers, whereas superscripts υ and ω represent the advertising strategies of platform 1 and platform 2, respectively. A platform has three decision variables – price for the consumers, price for the advertisers, and the ad type (i.e., whether to adopt traditional ads or sponsored content ads). To focus on platforms' advertising choice and the strategic interaction between the platforms and both sides of the market, we assume that each platform chooses only one advertising format. In addition, the marginal cost of producing the media content or creating the advertising messages is 0. Thus, the profits of platform i when platform 1 chooses ad format v and platform 2 chooses ad format w are given by

$$\Pi_i^{\upsilon\omega} = p_{iC}^{\upsilon\omega} x_{iC}^{\upsilon\omega} + p_{iA}^{\upsilon\omega} x_{iA}^{\upsilon\omega},\ i \in \{1, 2\}. \tag{1}$$

$x_{iC}^{\upsilon\omega}$ and $x_{iA}^{\upsilon\omega}$ are respectively consumers' demand and advertisers' demand for platform i. In the main model, we assume that both markets for the consumers and for the advertisers are fully covered.[9] This structure is appealing because it allows one platform's strategy on one side (say platform 1's price for consumers) to influence not only its own other side (platform 1's demand from advertisers), but also indirectly affect the demand of consumers and advertisers from platform 2. We later analyze the impact of an incompletely covered ad market in an extension in Section 5.2. The table below summarizes all available strategies and profits for the two platforms.

Table 1: Platforms' Strategies and Profits

Platform 1 / Platform 2	Traditional Ad	Sponsored Content Ad
Traditional Ad	Case TT (Π_1^{TT}, Π_2^{TT})	Case TS (Π_1^{TS}, Π_2^{TS})
Sponsored Content Ad	Case ST (Π_1^{ST}, Π_2^{ST})	Case SS (Π_1^{SS}, Π_2^{SS})

3.2 Consumers

Consumers are uniformly distributed along the Hotelling line. We assume that the consumers obtain an intrinsic utility u_0 from consuming either platform's media content. However, depending on her location on the Hotelling line, a consumer may incur a mismatch cost t_C per unit of distance traveled (for example, the presentation style of the media content differs from that of her most preferred style). Put differently, t_C captures the strength of consumers' brand preferences towards the two platforms. Consistent with prior research on advertising in the media market (e.g., Anderson and Gabszewicz 2006), we assume that advertisements are perceived as nuisance and thus create negative externalities for consumers. In particular, γ_T captures the extent of

[9] We analyze the situation in which both sides of the market are incompletely covered in Appendix A.5. In this case, a platform has monopoly power on both sides of the market.

negative externalities to consumers when they see the traditional ads. When γ_T increases, a consumer's dislike for a traditional ad also increases. In case of traditional ads, a consumer's expected total amount of disutility is given by $\gamma_T x_{iA}^{eT}$ (superscript e denotes the expected value, T denotes traditional ads), where x_{iA}^{eT} is consumers' expected total number of the ads on platform i. Therefore, when platform i (of location l_i, where $l_1 = 0$ and $l_2 = 1$) adopts the traditional ads, a consumer with the location x_{iC}^T obtains the following utility from this platform:

$$U_{iC}^T = u_0 - t_C|x_{iC}^T - l_i| - p_{iC}^T - \gamma_T x_{iA}^{eT}. \tag{2}$$

Despite being a newer format, the logic of advertisement being a general nuisance would still be applicable to sponsored content ads, and thus consumers would also experience a disutility. Specifically, we assume that a consumer's marginal disutility from seeing a sponsored content ad is given by γ_S. In other words, γ_S captures the extent of negative externalities to consumers from the sponsored content ads on a platform.

Unique to this newer advertising format is the additional impact of its "content." In other words, the actual content or even the format itself of sponsored content ads can have an additional effect on consumers. To capture this unique aspect of sponsored content ads, we assume that when a platform adopts this ad format, consumers receive an extra utility (or disutility) of u_S. On the one hand, u_S can be positive, since sponsored content ads are much more engaging in nature and often provide a compelling story and detailed information about the product. As a result, consumers can derive utilities from the informational content of these ad messages. Moreover, many consumers often share such sponsored content ads on social media because of their entertainment value. The parameter u_S can thus capture such additional entertainment values which traditional ads fail to deliver. On the other hand, u_S can also be negative as consumers may initially mistakenly identify a sponsored content ad as an authentic piece of editorial content and upon realization, this may cause significant annoyance to the consumers. To facilitate exposition, in the following analysis, we do not distinguish between different drivers of u_S, and simply refer to u_S as the impact of the content from sponsored content ads.[10]

To summarize, when platform i (of location l_i) adopts the sponsored content ads, a consumer

[10] We want to highlight that the impact of its content on consumers, u_S, is the total incremental value that is not correlated with the number of sponsored content ads. It only depends on the current editorial team's capabilities and the collaboration between the platforms and the advertisers (in other words, it is determined by the current technology). Anything that is correlated with each one of these sponsored content ads has already been factored into the group externality parameter γ_S.

with the location x_{iC}^S obtains the following expected utility (superscript e denotes the expected value):

$$U_{iC}^S = u_0 + u_S - t_C|x_{iC}^S - l_i| - p_{iC}^S - \gamma_S x_{iA}^{eS}. \tag{3}$$

To clearly delineate the impact of the cross-market externality parameters from the impact of the content from sponsored content ads, we assume $u_S = 0$ in the main model in Section 4.1. Later, we analyze the impact of a non-zero u_S in Section 4.2.

3.3 Advertisers

Similar to consumers, we assume that advertisers are also uniformly distributed on a Hotelling line as the media platforms are horizontally differentiated from advertisers' perspective. Advertisers' transportation cost of per unit of distance is given by t_A, which captures the strength of their brand preferences towards the two platforms. Given our focus on the choice of ad format, this paper considers t_A as a simple parameter which captures the aspects of a match between an advertiser and a platform that is independent of the viewer base. Specifically, we assume that $t_A = 1$. As in real life we see that a platform like the New York Times offers multimedia-based ads whereas a platform like BuzzFeed offers ads in forms of online quizzes and top ten lists. In this example, t_A captures advertisers' relative preferences between multimedia-based ads and quiz-based ads.

We also assume that an advertiser gets a marginal utility of α_T for each consumer's exposure to the traditional ad. In other words, an advertiser's gross utility from displaying a traditional ad on a platform with an expected number of x_{iC}^{eT} consumers is given by $\alpha_T x_{iC}^{eT}$. Therefore, when platform i adopts the traditional ads, an advertiser with the location x_{iA}^T obtains the following expected utility (the price this advertiser pays, p_{iA}^T, can be seen as the total payment for x_{iC}^{eT} number of impressions.)

$$U_{iA}^T = \alpha_T x_{iC}^{eT} - |x_{iA}^T - l_i| - p_{iA}^T. \tag{4}$$

In contrast, in case of a sponsored content ad, the advertiser obtains a marginal utility α_S per consumer exposure. As a result, an advertiser's expected gross utility from displaying a sponsored content ad on the platform with an expected number of x_{iC}^{eS} consumers is given by $\alpha_S x_{iC}^{eS}$. To summarize, when platform i adopts sponsored content ads, an advertiser with the location x_{iA}^S

obtains the following expected utility

$$U_{iA}^{S} = \alpha_S x_{iC}^{eS} - |x_{iA}^{S} - l_i| - p_{iA}^{S}. \tag{5}$$

3.4 Two-sided Market and Assumptions

The two-sidedness of the market has been defined in the early literature on two-sided platforms (i.e., Rochet and Tirole 2003, Armstrong 2006). The most important aspect of this two-sidedness is the existence of the inter-group externalities. In our context, γ_T and γ_S capture the negative externalities consumers experience with traditional ads and sponsored content ads, respectively. On the other hand, α_T and α_S represent the positive externalities advertisers enjoy from the presence of consumers, with traditional ads and sponsored content ads, respectively.

To focus on the impact of sponsored content ads on the competition between platforms, we assume that either a consumer or an advertiser can choose only one platform. In other words, we analyze the "single-homing" situation. Later we relax the assumption of single-homing advertisers and examine how the results change when advertisers have the option of multi-homing.

To focus on the more interesting analysis in the single-homing case, we make the following assumptions:

$$\begin{aligned} &36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)) > \max\{3t_C(6 + \alpha_S - \alpha_T) - (\alpha_S + \alpha_T - \gamma_T) \\ &\quad(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)) > 0,\, 18t_C - 3(\gamma_S - \gamma_T) - (\alpha_T - \gamma_S - \gamma_T)(2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T) > 0\}, \end{aligned} \tag{6}$$

$$\bar{\alpha}_S > \alpha_S > \gamma_S,^{11} \quad \text{and} \quad \alpha_T > \gamma_T, \tag{7}$$

$$\alpha_S > \alpha_T, \quad \text{and} \quad \gamma_S > \gamma_T. \tag{8}$$

The first assumption states that the two platforms are sufficiently horizontally differentiated from consumers' perspective, such that both platforms have a positive demand from both sides of the market in all cases. The second assumption ensures that advertisers' marginal utility from reaching consumers is bounded from above but is greater than consumers' marginal disutility of seeing an ad. Otherwise, a media platform is unlikely to survive as an intermediary between consumers and advertisers. Finally, based on the current industry knowledge discussed in Section 1, we assume that the marginal impact of sponsored content ads (as compared to that of traditional ads) is more beneficial for advertisers and more adverse for consumers, i.e., $\alpha_S > \alpha_T$ and $\gamma_S > \gamma_T$.

[11] The threshold $\bar{\alpha}_S$ ensures non-negative prices and is given in Appendix A.1.

The following table summarizes all the notations in our model.

Table 2: Parameter and Decision Variables

Symbol	Definition
u_0	Consumers' intrinsic utility from accessing a platform
u_S	Impact of the content from sponsored content ads on consumers
γ_T	Consumers' marginal disutility towards a traditional ad
γ_S	Consumers' marginal disutility towards a sponsored content ad
α_T	Advertiser's marginal utility from showing a traditional ad
α_S	Advertiser's marginal utility from showing a sponsored content ad
t_C	Consumers' transportation cost
t_A	Advertiser's transportation cost, normalized to 1
T	Traditional Advertising
S	Sponsored Content Advertising
$.^e$	Expected value
$p_{iC}^{\upsilon\omega}$	Consumer price by platform i (platform 1 adopts υ and platform 2 adopts ω), $\upsilon, \omega \in \{T, S\}$
$x_{iC}^{\upsilon\omega}$	Consumer demand for platform i
$p_{iA}^{\upsilon\omega}$	Advertiser price by platform i
$x_{iA}^{\upsilon\omega}$	Advertiser demand for platform i

Finally, the timeline of the game is as follows. In stage 1, both platforms announce ad format decisions simultaneously. In stage 2, the two platforms announce prices simultaneously after observing each other's ad format choices. Lastly in stage 3, both consumers and advertisers make participation decisions, and payoffs are realized.

4 Equilibrium Analysis

In this section, we analyze the competing platforms' advertising and pricing decisions.[12] To focus on the impact of cross-side externalities, we first discuss the case when the content of sponsored content ads does not have any additional impact on consumers, i.e., $u_S = 0$, in Section 4.1. In Section 4.2, we concentrate on the impact of sponsored content ads' content alone, i.e., $u_S \neq 0$, on platforms' choices of ad formats by assuming away the differential impact of the cross-side externalities across the two ad types. Finally, in Section 4.3, we present the full model with differing cross-side externalities and the presence of sponsored content ads' content impact.

[12]Please see Appendix B.1 for the analysis of a monopoly platform. In this case, the impact of cross-side externalities on the platform's profits is similar to that under the case of duopoly, but the impact of the content of sponsored content ads on profitability is different.

4.1 Impact of Cross-Side Externalities

When competing for consumers and advertisers, both platforms take into account the impact of all cross-side externalities. Each platform first decides the ad format, and then chooses the prices for its consumers and advertisers. As shown in Table 1, there are three possible outcomes: SS, TT, and TS (or ST). After solving the three subgames, we analyze whether and when each of them is the equilibrium.

4.1.1 Both Platforms Offer Sponsored Content Ads (SS)

When both platforms offer sponsored content ads, platform 1's demand from consumers and advertisers are given by (those of platform 2's are symmetrically defined)

$$x_{1C}^{SS} = \frac{p_{2C}^{SS} - p_{1C}^{SS} + t_C - \gamma_S x_{1A}^{eSS} + \gamma_S x_{2A}^{eSS}}{2t_C}, \tag{9}$$

$$x_{1A}^{SS} = \frac{p_{2A}^{SS} - p_{1A}^{SS} + 1 + \alpha_S x_{1C}^{eSS} - \alpha_S x_{2C}^{eSS}}{2}. \tag{10}$$

We see that platform 1's demand from consumers decreases in its price, p_{1C}^{SS}, and in consumers' expected number of ads, x_{1A}^{eSS}. However, the demand of platform 1 increases in platform 2's price, p_{2C}^{SS}, and in consumers' expected number of ads on platform 2, x_{2A}^{eSS}. In this case, each platform's profit is given by $\Pi_i^{SS} = p_{iC}^{SS} x_{iC}^{SS} + p_{iA}^{SS} x_{iA}^{SS},\ i \in \{1, 2\}$.

With the assumption of rational expectations, $x_{iC}^{SS} = x_{iC}^{eSS}$ and $x_{iA}^{SS} = x_{iA}^{eSS}$ in equilibrium, we obtain the following prices and profits when both platforms offer sponsored content ads after solving their optimization problem:

$$p_{iC}^{SS*} = t_C - \alpha_S, \text{[13]} \tag{11}$$

$$p_{iA}^{SS*} = 1 + \gamma_S, \tag{12}$$

$$\Pi_i^{SS*} = \frac{1 + t_C - \alpha_S + \gamma_S}{2}. \tag{13}$$

First, note that the price for consumers, p_{iC}^{SS*}, decreases in advertisers' marginal utility towards consumers, α_S. This occurs because when α_S increases, consumers become more valuable to advertisers in the presence of sponsored content ads. To capitalize on advertisers' stronger desire

[13]When α_S is larger than t_C, readers have free access to the media content. Please see Appendix B.2 for the analysis of the case of free content for consumers.

to access consumers, platforms will reduce the price to attract more consumers.

By contrast, the price for advertisers, p_{iA}^{SS*}, increases in consumers' marginal disutility towards sponsored content ads, γ_S. This result arises because as γ_S increases, consumers have less incentive to go to a platform with sponsored content ads. To compensate for consumers' lower willingness-to-pay, the platforms charges higher advertising prices.

Importantly, despite consumers' aversion towards ads, each platform's profit increases in their disutility from seeing the sponsored content ads, $\frac{\partial \Pi_i^{SS*}}{\partial \gamma_S} > 0$. By contrast, a platform's profit decreases in advertisers' utility from reaching consumers, $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} < 0$. This result occurs because of the opposite cross-side externality in this context: The former raises advertisers' prices to compensate for consumers and the latter pushes down consumers' prices to attract more advertisers. More specifically, the marginal consumer trades off between buying from platform 1 and buying from platform 2 (refer to Equation (9)). In other words, the negative impact on one platform's consumer demand from γ_S is alleviated by the number of advertisers on the other platform. When the two competing platforms are symmetric, γ_S's negative impact on consumers can be completely mitigated by raising the price for advertisers.

4.1.2 Both Platforms Offer Traditional Ads (TT)

Given the similarity between the two advertising formats, to avoid repetition, in this section we briefly summarize the platforms' demand, prices, and profits when both platforms choose traditional ads. In this case, platform 1's demand from consumers and advertisers are given by (those of platform 2's are symmetrically defined) $x_{1C}^{TT} = \frac{p_{2C}^{TT} - p_{1C}^{TT} + t_C - \gamma_T x_{1A}^{eTT} + \gamma_T x_{2A}^{eTT}}{2t_C}$, and $x_{1A}^{TT} = \frac{p_{2A}^{TT} - p_{1A}^{TT} + 1 + \alpha_T x_{1C}^{eTT} - \alpha_T x_{2C}^{eTT}}{2}$, respectively.

With the assumption of rational expectations, $x_{iC}^{TT} = x_{iC}^{eTT}$ and $x_{iA}^{TT} = x_{iA}^{eTT}$ in equilibrium, we obtain the following prices and profits when both platforms offer traditional ads after solving their optimization problem:

$$p_{iC}^{TT*} = t_C - \alpha_T, \tag{14}$$

$$p_{iA}^{TT*} = 1 + \gamma_T, \tag{15}$$

$$\Pi_i^{TT*} = \frac{1 + t_C - \alpha_T + \gamma_T}{2}. \tag{16}$$

Comparing the case where both platforms offer traditional ads (TT) to the case where they offer sponsored content ads (SS), we observe that consumers' price is lower under sponsored content advertising, i.e., $p_{iC}^{SS*} < p_{iC}^{TT*}$. However, advertisers' price for sponsored content ads is higher than that for traditional ads, i.e., $p_{iA}^{SS*} > p_{iC}^{TT*}$. The result that advertisers would pay higher prices for sponsored content ads is in accordance with the current industry practice.[14]

4.1.3 Asymmetric Advertising Strategies by the Platforms (TS)

When one platform (say platform 1) offers traditional ads and the other platform (platform 2) offers sponsored content ads, platform 1's demand from consumers and advertisers are given by $x_{1C}^{TS} = \frac{p_{2C}^{TS} - p_{1C}^{TS} + t_C - \gamma_T x_{1A}^{eTS} + \gamma_S x_{2A}^{eTS}}{2t_C}$, and $x_{1A}^{TS} = \frac{p_{2A}^{TS} - p_{1A}^{TS} + 1 + \alpha_T x_{1C}^{eTS} - \alpha_S x_{2C}^{eTS}}{2}$. We can see that platform 1's demand from consumers decreases in its price, p_{1C}^{TS}, and consumers' expected number of ads on it, x_{1A}^{eTS}. It increases in platform 2's price, p_{2C}^{TS}, and in consumers' expected number of ads on platform 2, x_{2A}^{eTS}. In this case, platform 1's profit is given by $\Pi_1^{TS} = p_{1C}^{TS} x_{1C}^{TS} + p_{1A}^{TS} x_{1A}^{TS}$. Platform 2's demand and profit are similarly defined. Similar to the analysis before, with the assumption of rational expectations, we obtain the equilibrium result in the case of TS (details are given in Appendix A.1).

As long as the two platforms are sufficiently differentiated, platform 2 with sponsored content ads certainly wants more participation from the advertisers' side because those advertisers show a more favorable attitude towards its ad format, $\alpha_S > \alpha_T$. To appeal to more lucrative advertisers, platform 2 offers a lower price than platform 1 in order to attract more consumers, $p_{2C}^{TS*} < p_{1C}^{TS*}$. By contrast, platform 1 focuses on extracting surplus from the consumers' side and hence it charges a lower price (compared to platform 2) for advertisers, $p_{1A}^{TS*} < p_{2A}^{TS*}$. To some extent, this result has the flavor of "tacit collusion" between the two competing platforms that allows each of them to focus on one side of the market. Overall, competition on multiple dimensions (price and advertising) eventually leads to the directionally opposite effects on the pricing strategies of the two platforms. Our first lemma states how the externality parameters affect the asymmetric pricing strategies.

Lemma 1. *When $t_C \geq \underline{t}_C$, as α_S increases, both platforms decrease consumers' prices. The platform offering sponsored content advertising increases the ad price and the platform offering traditional advertising decreases the ad price as α_S increases.*[15]

When α_S increases, sponsored content ads become more attractive for the advertisers. As a result, the platform offering sponsored content ads reduces its consumers' price to enhance

[14] See https://broadstreetads.com/price-sponsored-content/, and https://nativeadvertisinginstitute.com/blog/sponsored-content-renewal-rates

[15] The threshold $\underline{t}_C$ is given in Appendix A.1. Note that $t_C \geq \underline{t}_C$ is a sufficient condition (used for simplifying the analysis and enhancing the exposition), and even if it is not satisfied, this lemma can still hold.

consumer demand and in turn to attract the more lucrative advertisers. The competitive pressure for more consumers forces the platform with traditional ads to reduce its price too. On the other hand, with a rise in α_S, the platform with sponsored content ads would charge a higher ad price because of advertisers' stronger preference towards this ad format. By comparison, the relatively less appealing ad format of traditional ads would force the platform with it to decrease its ad price.

4.1.4 Equilibrium Outcome

After analyzing the three subgames, we next summarize the equilibrium outcomes.

Proposition 1. *When $\alpha_S > \alpha_1$, both platforms offering traditional ads (TT) is the unique equilibrium. When $\alpha_1 > \alpha_S > \alpha_2$, one platform offering traditional ads and the other platform offering sponsored content ads (TS/ST) is the unique equilibrium. Lastly, when $\alpha_2 > \alpha_S > 0$, both platforms offering sponsored content ads (SS) is the unique equilibrium.*[16]

Proposition 1 shows that when advertisers' marginal utility from showing a sponsored content ad is relatively high, both platforms offering traditional ads is the unique equilibrium outcome. This seemingly counter-intuitive result takes place due to the two-sidedness of the market. As advertisers obtain a higher marginal utility from sponsored content ads, they prefer the platform which adopts this ad format. As more advertisers show up, this platform charges a lower price to the consumers to offset the effect of negative externality of advertising. When α_S is sufficiently high, i.e., $\alpha_S > \alpha_1$, the price for consumers is so low that the platform with sponsored content ads cannot be adequately compensated with any gains from the advertiser's side. As a result, both platforms offer traditional ads (TT) in this case.

As α_S decreases, a platform (say platform 2) may contemplate offering sponsored content ads because after this deviation, it can charge a lower price to its consumers (compared to the case of TT): $p_{2C}^{TS*} < p_{2C}^{TT*}$. The reduced price conditionally leads to a great consumer demand, which in turn allows platform 2 to capitalize on advertisers' higher willingness to pay for sponsored content ads. In this scenario, the deviation from T to S makes platform 2 better off. At the same time, platform 1 is satisfied with traditional ads because it can now further raise its consumer price (based on Lemma 1) as α_S decreases to focus on revenues from the consumer side. In particular, when advertisers' marginal utility from sponsored content ads is moderate, i.e., $\alpha_1 > \alpha_S > \alpha_2$,

[16] The thresholds, α_1 and α_2, are defined in Appendix A.1. In Corollary 1 we analyze the case when $\alpha_2 > \alpha_1$. Note that due to the assumption in Equation (8), when $\alpha_T > \max\{\alpha_1, \alpha_2\}$, both platforms offering traditional ads is the unique equilibrium.

platform 2 that shifts to S will charge a lower consumer price and a higher advertiser price compared to platform 1 with T, resulting in a situation where each platform focuses on revenues from one side of the market. Thus within this parameter range, two symmetric platforms end up adopting asymmetric ad strategies in equilibrium. As α_S decreases further, the non-deviating platform 1 on the other hand experiences a sharp decline in its profit because its revenue from the consumer side cannot offset the potential loss from the ad side through not choosing advertisers' preferred ad format, and thus this platform eventually starts to offer the sponsored content ads when $\alpha_S < \alpha_2$, leading to the SS equilibrium.

As shown in the appendix, it is also possible to have $\alpha_2 > \alpha_1$. Our next corollary summarizes how the equilibrium outcome changes if the above condition holds.

Corollary 1. *When $\alpha_S > \alpha_2$, TT is the unique equilibrium. When $\alpha_2 > \alpha_S > \alpha_1$, there exist two equilibria: TT and SS. When $\alpha_1 > \alpha_S > 0$, SS is the unique equilibrium.*

Identical to Proposition 1, when α_S is sufficiently high (low), TT (SS) is the unique equilibrium outcome. When α_S is moderately high, the tradeoff between a lower consumer price and a higher advertiser price versus a higher consumer price and a lower advertiser price can also lead to the possibility of multiple symmetric strategy equilibria. Thus, in this range both TT and SS can occur as equilibrium outcomes. Notice that when $(\gamma_S - \gamma_T) > (\alpha_S - \alpha_T)$, SS equilibrium is the more profitable one. In this case, it is up to the platforms to coordinate in order to achieve a mutually beneficial outcome.

Lastly, we find that the equilibrium conditions in terms of γ_S are exactly opposite to the equilibrium conditions in terms of α_S (Details are given in Appendix A.1). In other words, for higher values of γ_S, SS becomes the equilibrium; whereas TT is the equilibrium when γ_S is relatively low. Intuitively, as γ_S increases, platforms charge higher prices to the advertisers. When γ_S is sufficiently high, the benefit from offering sponsored content ads (through a higher ad price) is significantly greater than the cost of offering sponsored content ads (through a lower consumer price), and thus SS becomes the equilibrium. On the other hand, when γ_S is sufficiently low, the marginal revenue from the advertiser side for sponsored content ads cannot negate the loss from the consumer side. Thus, TT becomes the equilibrium.

Focusing on the parameter range where SS is the unique equilibrium discussed in Proposition 1 and Corollary 1, we next discuss whether the sponsored content advertising necessarily makes both platforms better off compared to the traditional advertising.

Proposition 2. *When $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$, both platforms offering sponsored content advertising is a Prisoner's Dilemma outcome.*

Although the popularity of sponsored content advertising has grown in the past few years, this proposition shows that both platforms adopting this format can in fact be a Prisoner's Dilemma outcome. In particular, when consumers' additional disutility from sponsored content ads compared to traditional ads, $(\gamma_S - \gamma_T)$, is lower than advertisers' additional utility from sponsored content ads compared to traditional ads, $(\alpha_S - \alpha_T)$, the SS equilibrium in the competitive two-sided media market will boil down to a Prisoner's Dilemma.

Ironically, even if advertisers strongly prefer sponsored content ads to traditional ads (i.e., a higher advertiser utility under SS, $U_A^{SS*} > U_A^{TT*}$), the resulting condition $(\alpha_S - \alpha_T) > 2(\gamma_S - \gamma_T)$ shows that the two competing platforms still would have been better off if they had both chosen traditional ads since $\Pi_i^{SS*} < \Pi_i^{TT*}$. The intuition is explained in two steps as follows. First, note that the price for consumers is lower when both platforms offer sponsored content ads: $p_{iC}^{SS*} < p_{iC}^{TT*}$. However, this is not necessarily because consumers dislike sponsored content ads more than they dislike the traditional ads. Instead, price is lower for consumers because advertisers prefer sponsored content ads to traditional ads. Advertisers' stronger preference towards sponsored content ads gives platforms a stronger incentive to cut prices for consumers to better capitalize on advertisers. This is unique to the context of the two-sided media market. Given that the price for advertisers in SS, $p_{iA}^{SS*} = 1 + \gamma_S$, is not significantly higher than that in TT, $p_{iA}^{TT*} = 1 + \gamma_T$, i.e., $p_{iA}^{SS*} - p_{iA}^{TT*} < p_{iC}^{TT*} - p_{iC}^{SS*}$, the two platforms' profits are lower when they choose sponsored content ads compared to traditional ads: $\Pi_i^{SS*} < \Pi_i^{TT*}$.

Second, suppose both platforms are offering traditional ads now. By unilaterally deviating to sponsored content ads, one platform can lower its price for consumers and gain a bigger market share on this side of the market. As a result, this focal platform becomes more appealing to advertisers for two reasons: more consumers and a more attractive advertising format (recall sponsored content ads are strongly preferred by advertisers when $(\alpha_S - \alpha_T) > 2(\gamma_S - \gamma_T)$). Therefore, this platform can raise its price for advertisers and improve its total profits. By a similar logic, the other platform has incentives to follow suit by shifting to sponsored content ads and cut prices for consumers as well. This eventually leads to the Prisoner's Dilemma outcome in which both platforms offer sponsored content ads even if offering traditional ads is a more profitable outcome.

Managerially, the condition $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$ is more likely to hold when the sponsored content ads are better integrated with the context of their surrounding editorials/news coverage, and the platform's transparency is high such that sponsored content ads are clearly disclosed to avoid consumers' confusion. One prominent example would be "T Brand Studio" launched by the New York Times as its native ad shop, with the specific objective of working with advertisers to craft brand stories which would be impactful as well as engaging for the consumers.[17] The success of "T brand studio" suggests that the net impact of sponsored content advertising can be substantially higher than that of traditional advertising. However, Proposition 2 cautions platform managers to account for the competitive environment when investing in sponsored content ads to improve α_S and reduce γ_S.

After comparing platforms' profitabilities between the two advertising formats, the natural question is whether consumers and advertisers are better off with sponsored content ads compared to traditional ads. We answer this question and summarize the welfare implications in the next proposition.

Proposition 3. *When both platforms offer sponsored content advertising,*

1. *consumers are better off when* $\gamma_S \leq \gamma_1 = \gamma_T + 2(\alpha_S - \alpha_T)$*;*
2. *advertisers are better off when* $\gamma_S \leq \gamma_2 = \gamma_T + \frac{(\alpha_S - \alpha_T)}{2}$.

At first blush, it may seem that when consumers dislike sponsored content ads more than they dislike traditional ads ($\gamma_S > \gamma_T$), they should be worse off when platforms offer sponsored content ads in equilibrium. However, the first part of Proposition 3 states otherwise as long as consumers' marginal disutility towards sponsored content ads is not excessively high, i.e., when $\gamma_S \leq \gamma_1$. This seemingly counter-intuitive result arises because of the following reasons. First, recall from the earlier discussion, the price for consumers is lower when both platforms offer sponsored content ads: $p_{iC}^{SS*} < p_{iC}^{TT*}$, because now the platforms have stronger incentives to extract more surplus from the advertisers who prefer this ad format. Second, in the SS equilibrium, consumers are not exposed to more ads compared to the situation of the traditional ads. In fact, the number of ads appearing on each platform stays the same across the two advertising formats: $x_{iA}^{SS*} = x_{iA}^{TT*} = 1/2$. Third, consumers' disutility from the traditional ads γ_T can be relatively high (which perhaps explains why a substantial number of consumers these days use technologies such as "ad-blocker"). The combination of the three reasons leads to a welfare increase for consumers when $\gamma_S \leq \gamma_1$.

The second part of Proposition 3 states that advertisers are also better off in the presence of sponsored content ads, as long as consumers' disutility towards this ad format does not exceed

[17] See https://www.tbrandstudio.com/.

their disutility towards traditional ads by too much. This result can be better understood by comparing the utility of an advertiser located at x_A across the two advertising formats: $U_{iA}^{SS} = \alpha_S x_{iC}^{eSS} - |x_A - l_i| - p_{iA}^{SS}$ and $U_{iA}^{TT} = \alpha_T x_{iC}^{eTT} - |x_A - l_i| - p_{iA}^{TT}$. On the one hand, this advertiser enjoys a higher utility from accessing the same amount of consumers (recall in both equilibria consumers' demand is 1/2): $\alpha_S x_{iC}^{eSS*} > \alpha_T x_{iC}^{eTT*}$. On the other hand, because consumers dislike sponsored content ads more, the platforms have to adjust advertisers' price accordingly: $p_{iA}^{SS*} = 1 + \gamma_S$, which increases in γ_S. When consumers' disutility towards sponsored content ads is below a threshold, i.e., when $\gamma_S < \gamma_2 = \gamma_T + \frac{(\alpha_S - \alpha_T)}{2}$, advertisers' benefit of exposing consumers to sponsored content ads outweighs the price they have to pay. Therefore, advertisers are overall better off with sponsored content ads.

It is worth pointing out that consumers are more likely to be better off than advertisers in the presence of sponsored content ads (because $\gamma_1 > \gamma_2$). In other words, when platforms shift from traditional ads to sponsored content ads and $\gamma_2 < \gamma_S < \gamma_1$, consumers are better off but advertisers are worse off. Again this happens because advertisers have to pay to indirectly compensate for consumers' disutility towards sponsored content ads, $p_{iA}^{SS*} = 1 + \gamma_S$, whereas consumers enjoy a lower price with this ad format, $p_{iC}^{SS*} < p_{iC}^{TT*}$.

4.2 Impact of Content from Sponsored Content Ads

Recall that when platform i adopts the sponsored content ads, a consumer located at x_{iC}^S obtains the expected utility of

$$U_{iC}^S = u_0 + u_S - t_C|x_{iC}^S - l_i| - p_{iC}^S - \gamma_S x_{iA}^{eS}.$$

In particular, u_S captures the impact of the "content" from sponsored content ads that does not depend on ad volume (as long as there are ads on the platform, $x_{iA}^{eS} > 0$). When $u_S > 0$, sponsored content ads bring consumers some positive informational or entertainment value. By contrast, when $u_S < 0$, sponsored content ads bring consumers some additional disutility, possibly due to the poor integration with the surrounding editorial content of the platform. We assume that $|u_S| < u^*$, such that the absolute impact from the content of sponsored content ads is not excessively high and the cross-side externality parameters are still relevant.[18]

To focus on the strategic impact of the cross-market externality parameters, we assumed u_S

[18]The value of u^* is given in Appendix A.2.

to be zero in Section 4.1. In this subsection, we consider the case where u_S is non-zero. In order to assess the sole impact of u_S on the equilibrium advertising strategies, we keep the ad format specific externality parameters the same. In other words, we make the simplifying assumption that $\alpha_T = \alpha_S$ and $\gamma_T = \gamma_S$ to delineate the effect of u_S. Other aspects of the model remain the same as the previous model in Section 4.1. Since the two ad formats now do not differ in terms of the externality parameters, the resulting prices and profits under the symmetric equilibrium strategies SS and TT become identical, the same as those given in Equations (11), (12), and (13).

Interestingly, even if the content from sponsored content ads has a significant impact on consumers, i.e., when the magnitude of u_S is high, it does not affect the optimal pricing or profits in the case of SS due to the competitive pressure. However, u_S does influence the prices and profits of the two platforms when they adopt asymmetric ad strategies (platform 1 with T and platform 2 with S):

$$p_{1C}^{TS*} = t_C - \alpha_S - \frac{u_S(3t_S - \alpha_S(\alpha_S - 2\gamma_S))}{9t_C - 2\alpha_S^2 + 5\alpha_S\gamma_S - 2\gamma_S^2}, \tag{17}$$

$$p_{1A}^{TS*} = 1 + \gamma_S - \frac{u_S(\alpha_S + \gamma_S)}{9t_C - (\alpha_S - 2\gamma_S)(2\alpha_S - \gamma_S)}, \tag{18}$$

$$p_{2C}^{TS*} = t_C - \alpha_S + \frac{u_S(3t_S - \alpha_S(\alpha_S - 2\gamma_S))}{9t_C - 2\alpha_S^2 + 5\alpha_S\gamma_S - 2\gamma_S^2}, \tag{19}$$

$$p_{2A}^{TS*} = 1 + \gamma_T + \frac{u_S(\alpha_S + \gamma_S)}{9t_C - (\alpha_S - 2\gamma_S)(2\alpha_S - \gamma_S)}, \tag{20}$$

$$\Pi_1^{TS*} = \frac{1}{2}(1 + t_C - u_S - \alpha_S + \gamma_S + \frac{u_S(u_S + 3t_C + \alpha_S - \alpha_S^2 + \gamma_S + 2\alpha_S\gamma_S)}{9t_C - 2\alpha_S^2 + 5\alpha_S\gamma_S - 2\gamma_S^2}), \tag{21}$$

$$\Pi_2^{TS*} = \frac{1}{2}(1 + t_C + u_S - \alpha_S + \gamma_S + \frac{u_S(u_S - 3t_C - \alpha_S + \alpha_S^2 - \gamma_S - 2\alpha_S\gamma_S)}{9t_C - 2\alpha_S^2 + 5\alpha_S\gamma_S - 2\gamma_S^2}). \tag{22}$$

First, we observe that with a positive u_S, the profit of the platform with sponsored content ads when its rival adopts traditional ads increases in u_S, i.e., $\frac{\partial \Pi_2^{TS*}}{\partial u_S} > 0$. In fact, even the platform with traditional ads can be better off as u_S increases, i.e., $\frac{\partial \Pi_1^{TS*}}{\partial u_S} > 0$ under some conditions.[19] The intuition is that holding constant γ_S, a higher positive u_S decreases consumers' overall disutility towards sponsored content ads. As a result, the platform with sponsored content ads can increase its price for consumers, and still maintain a higher ad price than its rival.

After analyzing all three subgames, we find that when $u_S > 0$, adopting sponsored content ads is a strictly dominant strategy for both platforms. Intuitively, a positive u_S means that overall, sponsored content ads are less undesirable for consumers. As a result, both platforms

[19] The result $\frac{\partial \Pi_1^{TS*}}{\partial u_S} > 0$ holds when $2u_S > u^*$. Thus, when u_S is very small, the impact of u_S on Π_1^{TS*} is negative.

have incentives to switch to this ad format, due to advertisers' stronger preference towards it. Consequently, SS is the unique equilibrium. Managerially, this result highlights the importance of the high-quality content production and integration of the sponsored content ads. Through a similar logic, when $u_S < 0$, adopting traditional ads is a strictly dominant strategy for both platforms. No asymmetric equilibrium takes place in this scenario. Furthermore, there is no prisoner's dilemma outcome any more, since the platform's profits under the two different ad formats are identical. The last result is important, because it implies that the prisoner's dilemma outcome between the two competing platforms is completely driven by the differential cross-side externalities.

4.3 Total Impact of Sponsored Content Ads

After separately assessing the impact of cross-side externalities in Section 4.1 and the content impact from sponsored content ads in Section 4.2, we now analyze the combined impact of a non-zero u_S and different externality parameters for different ad formats.

Our analysis shows that qualitatively the equilibrium outcomes remain the same as those presented in Proposition 1. For higher values of α_S (i.e., when sponsored content ads are more appealing to advertisers), TT will be the equilibrium. For lower values of α_S (i.e., when sponsored content ads are less appealing to advertisers), SS will be the equilibrium. When α_S is in the intermediate range, either the asymmetric equilibrium or multiple equilibria take place.

Due to the complexity of the analysis, we cannot directly compare the cutoff values of α_S that determine the equilibrium outcomes with their counterparts in Proposition 1.[20] Numerically, we find that SS is more likely to occur when $u_S > 0$. Similarly, TT is more likely to occur when $u_S < 0$. The asymmetric equilibrium is more likely to arise when $|u_S|$ decreases, holding everything else constant. Furthermore, SS being the prisoner's dilemma equilibrium is more likely to occur when $u_S > 0$. Technically, the condition for the prisoner's dilemma remains the same, i.e., $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$. Therefore, when the equilibrium threshold α_2 increases with $u_S > 0$, SS is more likely to occur, implying that the prisoner's dilemma is a more likely outcome. Ironically, this result highlights the managerial nuances faced by the competing platforms: Even if advertisers strongly prefer sponsored content ads (a relatively high α_S) and the quality of these ads are high so that consumers enjoy their content (a positive u_S), both platforms may still be more likely to end up being worse off. To clearly assess the implications of sponsored content

[20]The cutoff values in this subsection are presented in Appendix A.3.

ads for the platforms, managers need to fully account for the characteristics of the different ad formats, consumers' ad aversion, and the competitive environment.

Notably, the results from Proposition 3 remain completely unchanged in this comprehensive model. In other words, despite consumers' greater aversion towards sponsored content ads compared to traditional ads, both consumers and advertisers can still be better off when two competing platforms adopt sponsored content ads. This happens as long as consumers' marginal disutility towards sponsored content ads is not excessively high.

5 Extensions

In Section 4, we analyzed the competing platforms' equilibrium advertising formats under the assumption of single-homing and complete market coverage on both the consumer side as well as the advertiser side. In this section, we consider two alternative assumptions and study their impact on the equilibrium outcomes.

5.1 Multi-homing Advertisers

In this section, we relax the assumption of advertisers single-homing on a media platform. Instead, we allow advertisers to purchase from both platforms while consumers continue to single-home. We will later see that in equilibrium, not every advertiser will endogenously choose to multi-home. Typically, the advertisers who are located (on the advertisers' Hotelling line) relatively close to one of the media platforms do not find multi-homing appealing since their relative preference for the other platform is very low. The utility function of an advertiser who chooses single-homing will remain the same as Equations (4) and (5). The utility function of a multi-homing advertiser is given below

$$U_A^{\upsilon\omega} = \alpha_\upsilon x_{iC}^{e\upsilon} + \alpha_\omega x_{jC}^{e\omega} - (1 + p_{iA}^{\upsilon} + p_{jA}^{\omega}), \quad i, j \in \{1, 2\},\ \upsilon, \omega \in \{S, T\}; \tag{23}$$

where $x_{iC}^{e\upsilon}$ and $x_{jC}^{e\omega}$ denote expected consumer demand for platforms i and j, respectively, and $x_{iC}^{e\upsilon} + x_{jC}^{e\omega} = 1$. On the other hand, consumers' utility functions change into the following

$$U_{iC}^{T} = u_0 - t_C|x_{iC}^{T} - l_i| - p_{iC}^{T} - \gamma_T(x_A^{eM} + x_{iA}^{eT}), \tag{24}$$

$$U_{iC}^{S} = u_0 - t_C|x_{iC}^{S} - l_i| - p_{iC}^{S} - \gamma_S(x_A^{eM} + x_{iA}^{eS}),\text{[21]} \tag{25}$$

where x_A^{eM} (x_{iA}^{ev} and $x_{jA}^{e\omega}$) denotes the expected number of advertisers who multi-home (single-home on i and j), and thus $x_{iA}^{ev} + x_{jA}^{e\omega} + x_A^{eM} = 1$.

Platform i's profit function is given below

$$\Pi_i^{\upsilon\omega} = p_{iC}^{\upsilon\omega} x_{iC}^{\upsilon\omega} + p_{iA}^{\upsilon\omega}(x_{iA}^{\upsilon\omega} + x_A^{\upsilon\omega M}),\ i \in \{1,2\}, \tag{26}$$

where platform 1 pursues ad format υ, and platform 2 opts for ad format ω. To facilitate exposition, below we present the prices for consumers and advertisers and the profits of the platforms in the case of SS (where superscript "M" denotes the case of multi-homing). The optimal prices and profits in other subgames are presented in Appendix A.4.

$$p_{iC}^{SS*,M} = \frac{4t_C - \alpha_S(\alpha_S - 3\gamma_S)}{4}, \tag{27}$$

$$p_{iA}^{SS*,M} = \frac{(\alpha_S + \gamma_S)}{4}, \tag{28}$$

$$\Pi_i^{SS*,M} = \frac{8t_C - \alpha_S^2 + 6\alpha_S\gamma_S - \gamma_S^2}{16}. \tag{29}$$

After analyzing all subgames, we characterize the equilibrium conditions as follows. When $\alpha_S > \max\{\alpha_{Sa}, \alpha_{Sb}\}$ and $\alpha_T < \min\{\alpha_{Ta}, \alpha_{Tb}\}$, TT is the unique equilibrium. When $\alpha_S < \min\{\alpha_{Sa}, \alpha_{Sb}\}$ and $\alpha_T > \max\{\alpha_{Ta}, \alpha_{Tb}\}$, SS is the unique equilibrium. When $\alpha_{Sb} < \alpha_S < \alpha_{Sa}$ and $\alpha_{Ta} < \alpha_T < \alpha_{Tb}$, asymmetric equilibrium TS/ST occurs. Finally, when $\alpha_{Sa} < \alpha_S < \alpha_{Sb}$ and $\alpha_{Tb} < \alpha_T < \alpha_{Ta}$, multiple equilibria arise where both SS and TT are equilibria.[22] Similar to the single-homing case in Section 4.1, when α_S is relatively high, TT is the unique equilibrium and when α_S is relatively low, SS becomes the unique equilibrium.

One important question is how different parties fare once advertisers multi-home compared to the benchmark case where advertisers single-home. Given our focus on sponsored content ads, we answer this question in the SS equilibrium in the following lemma.

Lemma 2. *When both platforms offer sponsored content ads, comparing the case of advertiser multi-homing to the case of advertiser single-homing,*

1. *consumers are worse off;*
2. *advertisers are better off;*
3. *platforms are better off.*

[21] For the sake of comparative discussion, we assume $u_S = 0$ as it is in the main model.
[22] Please see Appendix A.4 for more details.

Intuitively, once advertisers start to multi-home, consumers will see more ads in the SS equilibrium. Furthermore, consumers' price is also higher than that under single-homing, i.e., $p_{iC}^{SS*,M} > p_{iC}^{SS*}$, because now the two platforms no longer need to compete for consumers as aggressively in order to attract more advertisers. Therefore, consumers are worse off. Advertisers are better off under multi-homing because they have reached more consumers, while platforms are better off because their revenues from both sides of the market have increased.

When comparing each party's welfare between SS and TT under multi-homing, we find that consumers are better off in SS compared to that in TT when $\gamma_S \leq \gamma_3 = 2\alpha_S - \sqrt{3\alpha_S^2 + \alpha_T^2 + \gamma_T^2 - 4\alpha_T\gamma_T}$. On the other hand, advertisers are better off in SS compared to that in TT when $\gamma_S \leq \gamma_4 = \gamma_T + (\alpha_S - \alpha_T)$. Recall that from Proposition 3, under single-homing, consumers and advertisers can also be better off under sponsored content ads compared to that under traditional ads. Interestingly, a comparison between the new threshold values of γ_S and those in Proposition 3 under single-homing leads to the following proposition.

Proposition 4. *When advertisers multi-home, once both platforms shift from traditional ads (TT) to sponsored content ads (SS),*

1. *consumers are less likely to be better off compared to the case of advertiser single-homing, i.e.,* $\gamma_3 < \gamma_1$*;*
2. *advertisers are more likely to be better off compared to the case of advertiser single-homing, i.e.,* $\gamma_4 > \gamma_2$*.*

First, note that Proposition 4 is comparing consumer/advertiser surplus between SS and TT across two conditions: advertiser multi-homing and advertiser single-homing (i.e., this is a difference-in-difference comparison). The first part of Proposition 4 means that under multi-homing, consumers' surplus can still be higher in SS compared to that in TT, but it occurs in a narrower range of γ_S given $\gamma_3 < \gamma_1$. In other words, as consumers' marginal disutility from sponsored content ads increases and some advertisers choose to multi-home, consumers are less likely to be better off because platforms are compensating them less (Recall from Lemma 2, two platforms no longer need to compete for consumers as aggressively to attract more advertisers.). The second part of Proposition 4 states that advertisers are better off in a wider range of γ_S under multi-homing because $\gamma_4 > \gamma_2$. The intuition can be first seen from the comparison between the following ad price differences, $(p_{iA}^{SS*,M} - p_{iA}^{TT*,M}) - (p_{iA}^{SS*} - p_{iA}^{TT*})$, which implies that the ad price increase when platforms shift from TT to SS can be less significant under multi-homing. Furthermore, multi-homing helps advertisers reach more consumers, and the benefits from sponsored content ads over traditional ads are thus magnified.

5.2 Incompletely Covered Advertising Market

In the main text, we assumed that the markets for consumers and for advertisers are both fully covered by the two platforms. Clearly, both platforms compete head-to-head on the advertisers' side. In Section 5.1, we analyzed the situation where advertisers can choose to multi-home and the ad side is still fully covered. This effectively means that the two platforms have some monopolistic power on the advertising side because they no longer directly compete for advertisers. In this section, we analyze a situation with an incompletely covered ad market that allows both the direct competition for advertisers and some monopolistic power over them by the two platforms. In other words, we combine the two features on the ad side of the previous models, and analyze the equilibrium outcome.

Specifically, we assume that the two platforms are located at $l_1 = 1/3$ and $l_2 = 2/3$ on the Hotelling line, where advertisers are uniformly distributed.[23] In this context, two platforms actively compete for advertisers located centrally (i.e., advertisers located at $y \in [1/3, 2/3]$) while maintaining certain monopolistic power over advertisers located towards the left of l_1 or the right of l_2 (i.e., advertisers with location $z \in (0, 1/3) \cup (2/3, 1)$). The utilities for the two types of advertisers when the focal platform adopts the ad format v ($v \in \{S, T\}$) are given as

$$U_{iA}^{v}(y) = \alpha_v x_{iC}^{ev} - |y_{iA}^{v} - l_i| - p_{iA}^{v}, \tag{30}$$

$$U_{iA}^{v}(z) = \alpha_v x_{iC}^{ev} - |z_{iA}^{v} - l_i| - p_{iA}^{v}. \tag{31}$$

The assumptions on the consumers remain the same as those in the main text and are thus not repeated.

To enhance exposition, we only present the subgame where both platforms offer sponsored content ads in this subsection.[24] We focus on the parameter range where $\frac{7+12\gamma_S}{9} < \alpha_S < \frac{4(1+\gamma_S)}{3}$, which ensures that the advertising market is partially covered in equilibrium.[25] Solving the

[23]This assumption on the platforms' specific locations is to simplify our analysis. Our results remain qualitatively the same as long as the advertising market is incompletely covered by the two platforms.

[24]The analysis of all the subgames, TT, SS, TS/ST, as well as when each one is the equilibrium outcome, is presented in Appendix A.5.

[25]When the condition $\alpha_S \geq \frac{4(1+\gamma_S)}{3}$ holds, the advertising market will be fully covered. Similar conditions to ensure incomplete ad market coverage can be identified for other subgames.

platforms' profit maximization problems leads to the following optimal prices and demand:

$$p_{iC}^{SS*} = \frac{15t_C - 2\alpha_S(1+3\alpha_S-9\gamma_S)}{15}, x_{iC}^{SS*} = \frac{1}{2};$$
$$p_{iA}^{SS*} = \frac{1+3\alpha_S+6\gamma_S}{15}, x_{iA}^{SS*} = \frac{1+3\alpha_S-4\gamma_S}{10}.$$

Given the importance of the externality parameters, γ_S and α_S, we first discuss their impact on the optimal prices for both sides of the market below.

Lemma 3. *The price for consumers increases in γ_S and decreases in α_S, whereas the price for advertisers increases in both γ_S and α_S.*

In contrast with our main model, the prices for consumers and advertisers depend on both γ_S and α_S when the advertising market is partially covered. Similar to the main model, consumers' price decreases as α_S increases (i.e., $\frac{\partial p_{iC}^{SS*}}{\partial \alpha_S} < 0$ if $\gamma_S < \frac{17}{3}$). Intuitively, as α_S increases, there will be more advertisers on the platform which generate more disutility for consumers. Thus, the platform has incentives to decrease the consumer price. Interestingly, the consumer price increases as γ_S increases (i.e., $\frac{\partial p_{iC}^{SS*}}{\partial \gamma_S} = \frac{6\alpha_S}{5} > 0$), and the rate of increase further rises as α_S increases. A higher γ_S indicates that consumers are more averse to sponsored content ads. In this case, the platform has incentives to decrease its number of advertisers (i.e., $\frac{\partial x_{iA}^{SS*}}{\partial \gamma_S} < 0$). To compensate for the potential loss in the ad market, the platform will increase the consumer price with relative ease given its rival's similar incentive to raise price and that the consumer side is fully covered.

Consistent with the main model, the ad price increases as γ_S increases (i.e., $\frac{\partial p_{iA}^{SS*}}{\partial \gamma_S} > 0$). This happens because when consumers are more averse to ads, the platform has more incentives to decrease its number of advertisers. Thus, to compensate for the demand loss in the ad market, the platform will increase the advertiser price. In addition, the price for advertisers also increases as α_S increases (i.e., $\frac{\partial p_{iA}^{SS*}}{\partial \alpha_S} > 0$). This is because as α_S increases, sponsored content ads become more appealing to advertisers; as a result, the platform can charge a higher ad price.

After analyzing prices for both sides of the market, we next examine the impact of the externality parameters on platforms' profitability in the following proposition.

Proposition 5. *In the SS equilibrium, there is a non-monotonic relationship between α_S and profits. In particular, when $\gamma_S < \frac{11}{12}$ and $\frac{7+12\gamma_S}{9} < \alpha_S < \frac{4(1+\gamma_S)}{3}$, Π_i^{SS*} decreases in α_S; when $\gamma_S > \frac{3}{2}$, Π_i^{SS*} increases in α_S; otherwise, Π_i^{SS*} first increases and then decreases in α_S.*

Recall that the platforms' profits always decrease in α_S in our main model where advertisers are fully served, because a higher α_S leads to a lower price for consumers. However, once the market coverage for advertisers becomes incomplete, the impact of α_S on the platforms' profits can be positive when γ_S is relatively high. Based on Lemma 3, with a relatively large γ_S, the platforms can charge high prices for both sides of the market. As α_S increases, although consumers' price decreases, the increase in both the advertisers' price and their demand are large enough to outweigh the loss from the consumer side. As a result, the platforms' profits increase in α_S. Proposition 5 highlights the importance of market coverage (i.e., the extent of advertisers' demand elasticity) in shaping how the cross-side network effects influence the platforms' profits. Managerially, this result echoes practitioners' enthusiasm for the sponsored content ads, because its greater appeal to advertisers can translate to greater profits for the platforms under the right conditions.

6 Conclusion

Over the last few years, sponsored content advertising has become more popular with both media platforms and advertisers. The main advantage of this advertising format is that readers are likely to view these ads as editorial content by the media platform, and thus may be more engaged and form a more positive impression about the underlying brands (advertisers). This type of ads' appeal to advertisers can be further enhanced when the media platforms avoid any clickbait strategy and instead offer a judicious combination of information and promotion that make the ad placement purposeful. However, if consumers identify sponsored content ads as imposed promotional messages, they are likely to react more negatively to them. As a result, it becomes an important question to understand the impact of sponsored content advertising in the context of two-sided media markets.

Our analysis shows that whether or not a platform should adopt the sponsored content ads depends largely on the cross-group externalities between consumers and advertisers. In particular, both platforms should offer sponsored content ads when advertisers' marginal utility from sponsored content is low, or when consumers' extent of aversion towards this ad format is strong. This seemingly surprising result shows that the two-sidedness of the media market plays a pivotal role in understanding the equilibrium ad format strategies. Consistent with the industry practice, we show that the ad price for sponsored content ads is higher than that for traditional ads. We have also confirmed industry experts' intuition that both advertisers and consumers can be better off with sponsored content ads compared to the traditional ads, as long as consumers are not too unhappy with the sponsored content ad format. Our analysis also suggests that if advertisers have too strong affinity towards sponsored content advertising, a moderate amount of unhappiness from consumers' side would actually prevent the platforms from extracting more rents in aggregate. Interestingly, although consumers dislike sponsored content ads more than they dislike traditional ads, their surplus can increase when both platforms offer sponsored content ads, because now they can enjoy a lower price. Furthermore, we find that when consumers have a relatively high disutility from sponsored content ads, advertisers' surplus may further increase if advertisers can multi-home.

We demonstrate that it is possible for competing platforms to end up in a Prisoner's Dilemma outcome by both offering sponsored content ads. This happens because both platforms have incentives to undercut their rival's price for consumers in order to attract more advertisers. This result highlights that even if one side of the market strongly prefers a particular instrument, it might not be beneficial for the platform in the two-sided market to offer this instrument in a competitive environment. This result also contributes to the advertising literature – while existing wisdom suggests that the Prisoner's Dilemma outcome in advertising emerges because of competition over ad budget (Corfman and Lehmann 1994), we find that the same outcome can be seen even when firms compete over the advertising format.

It is important to note that the existence of asymmetric equilibrium confirms that mere imitation of the rival platform's advertising strategy may adversely affect the profitability of a media platform. By contrast, media platforms must pay close attention to advertisers' receptiveness and consumers' sensitivity towards different advertising formats, two key factors that affect the welfare and profits of all involved parties. Thus, an effective integration of sponsored content with regular editorial content can help the advertisers to strengthen their relationships with the consumers which in turn will make the consumers more accepting of sponsored content ads. The platform can also improve the interactivity of the sponsored content ads to enhance advertisers' benefit. For example, the media platform can offer more touch points on the sponsored content ads where consumers can directly interact with different parts of the message so that they can be more engaged and as a result, increases the appeal of such ads to advertisers.

This paper takes a first stab at understanding the strategic impact of sponsored content advertising on media platforms, advertisers, and consumers. To simplify the analysis, we assumed that platforms can either adopt the sponsored content or the traditional advertising. In reality, a media platform can choose a hybrid of two ad formats. Furthermore, we focus on the full information disclosure case where consumers can perfectly identify sponsored content ads. In practice, the transparency of a sponsored content ad can be a continuous strategic variable, and regulatory agencies like the Federal Trade Commission have varied guidelines across the world. As a result, consumers may react differently depending on the transparency, the presentation style and the content of the sponsored content ads. Future research can explore the implications of these characteristics of sponsored content ads. It will also be interesting to consider the role of dynamics in this context and analyze how consumers' response to these ads change over time. Finally, the collaboration between media platforms and advertisers to create high-quality sponsored content can be very costly, and may affect the eventual ad choices. Future research can also study the co-production of ads and organic content, and shed insights on when and how it is optimal to engage in the co-creation of advertising, with or without any intervention from the regulatory agencies.

References

Aribarg A, and Schwartz E. 2020. Native advertising in online news: trade-offs among clicks, brand recognition, and website trustworthiness. *Journal of Marketing Research*, 57(1) 20–34.

Amaldoss W, Du J and Shin W. 2016. Pricing in two-sided media markets. *Working Paper*.

Anderson SP, Coate S. 2005. Market provision of broadcasting: a welfare analysis. *The Review of Economic Studies*, 72(4) 947–972.

Anderson SP, Gabszewicz JJ. 2006. The media and advertising: a tale of two-sided markets. *In: Victor A. Ginsburg and David Throsby, Editor(s), Handbook of the Economics of Art and Culture, Elsevier*, 1:567–614.

Armstrong M. 2006. Competition in two-sided markets. *The RAND Journal of Economics*, 37(3) 668–691.

Becker–Olsen LK. 2003. And now, a word from our sponsor – a look at the effects of sponsored content and banner advertising. *Journal of Advertising*, 32(2) 17–32.

Campbell C, Marks LJ. 2015. Good native advertising isn't a secret. *Business Horizons*, 58(6) 599–606.

Carlson M. 2015. When news sites go native: Redefining the advertising – editorial divide in response to native advertising. *Journalism*, 16(7) 849–865.

Chen Y, Xie J. 2010. Cross-market network effect with asymmetric customer loyalty: implications for competitive advantage. *Marketing Science*, 26(1) 52–66.

Chu S. 2011. Viral advertising in social media – participation in facebook groups and responses among college–aged users. *Journal of Interactive Advertising*, 12(1) 30–43.

Conill RF. 2016. Camouflaging church as state – an exploratory study of journalism's native advertising. *Journalism Studies*, April 5, 1–11.

Corfman K, Lehmann D. 1994. The prisoner's dilemma and the role of information in setting advertising budgets. *Journal of Advertising*, 23(2) 35–48.

Dukes A, Gal-Or E. 2003. Negotiations and exclusivity contracts for advertising. *Marketing Science*, 22(2) 222–245.

Edelman, B, Ostrovsky, M, Schwarz, M. 2007. Internet advertising and the generalized second price auction: Selling billions of dollars worth of keywords. *American Economic Review*, 97(1) 242–259.

Edelman, B, Ostrovsky, M. 2007. Strategic Bidder Behavior in Sponsored Search Auctions. *Journal of Decision Support Systems*, 43(1) 192–198.

Ellison G, Ellison SF. 2005. Lessons about markets from the internet. *The Journal of Economic Perspectives*, 19(2) 139–158.

Gal-Or E, Dukes A. 2003. Minimum differentiation in commercial media markets. *Journal of Economics & Management Strategy*, 12(3) 291–325.

Godes D, Ofek E, Sarvary M. 2009. Content vs. advertising: the impact of competition on media firm strategy. *Marketing Science*, 28(1) 20–35.

Katz ML and Shapiro C. 1985. Network externalities, competition, and compatibility. *The American Economic Review*, 75(3) 424–440.

Lee J, Kim S, Ham DC. 2016. A double–edged sword? Predicting consumers' attitude toward and sharing intention of native advertising on social media. *American Behavioral Scientist*, July 21, 2016.

Lipsman, A, Mudd, G, Rich, M, Bruich, S. 2012. The power of "like" − how brands reach (and influence) fans through social media marketing. *Journal of Advertising Research*, 52(1) 40–52.

Rochet JC, Tirole J. 2003. Platform competition in two-sided markets. *Journal of the European Economic Association*, 1(4) 990–1029.

Sahni NS, Nair H. 2020. Sponsorship disclosure and consumer deception: experimental evidence from native advertising in mobile search. *Marketing Science*, 39(1) 5–32.

Tucker C, Zhang J. 2010. Growing two-sided networks by advertising the user base: a field experiment. *Marketing Science*, 29(5) 805–814.

Varian, H. 2007. Position Auctions. *International Journal of Industrial organization*, 25(6) 1163–1178.

Vries, De–L, Gensler, S, Leeflang, P. 2012. Popularity of brand posts on brand fan pages: an investigation of the effects of social media marketing. *Journal of Interactive Marketing*, 26(2) 83–91.

Wojdynski BW, Evans NJ. 2016. Going native: Effects of disclosure position and language on the recognition and evaluation of online native advertising. *Journal of Advertising*, 45(2) 157–168.

Zhu Y, Dukes A. 2015. The selective reporting of factual content by commercial media. *Journal of Marketing Research*, 52(1) 56–76.

A Appendix

A.1 Proofs of Propositions

Proof of Lemma 1

Proof. $p_{1C}^{TS*} = (6t_C(6t_C - 3\alpha_S - 3\alpha_T + \gamma_S - \gamma_T) + (\alpha_S + \alpha_T)(\alpha_S + \alpha_T - \gamma_S)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T) - t_C(\alpha_S^2 + 3\alpha_T^2 - 4\alpha_T(\gamma_S + \gamma_T) + \alpha_S(4\alpha_T - 6(\gamma_S + \gamma_T)) + 2(\gamma_S + \gamma_T)^2)))/(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))$,

$p_{2C}^{TS*} = (6t_C(6t_C - 3\alpha_S - 3\alpha_T - \gamma_S + \gamma_T) + (\alpha_S + \alpha_T)(\alpha_S + \alpha_T - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T) - t_C(3\alpha_S^2 + \alpha_T^2 + 4\alpha_S(\alpha_T - \gamma_S - \gamma_T) - 6\alpha_T(\gamma_S + \gamma_T) + 2(\gamma_S + \gamma_T)^2)))/(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))$,

$p_{1A}^{TS*} = (36t_C - (\alpha_S - \gamma_S - \gamma_T)(2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\gamma_S + \gamma_T) - (2\alpha_S^2 + 4\alpha_S\alpha_T + 2\alpha_T^2 - 6\alpha_S\gamma_S - 6\alpha_T\gamma_S + \gamma_S^2 - 4\gamma_T(\alpha_S + \alpha_T - \gamma_S)) - (3\gamma_T^2 - 6t_C(\alpha_S - \alpha_T - 3\gamma_S - 3\gamma_T)))/(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))$,

$p_{2A}^{TS*} = (36t_C - (\alpha_T - \gamma_S - \gamma_T)(2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\gamma_S + \gamma_T) - (2\alpha_S^2 + 4\alpha_S\alpha_T + 2\alpha_T^2 - 4\alpha_S\gamma_S - 4\alpha_T\gamma_S + 3\gamma_S^2 - 2\gamma_T(3\alpha_S + 3\alpha_T - 2\gamma_S)) - (\gamma_T^2 - 6t_C(\alpha_S - \alpha_T + 3\gamma_S + 3\gamma_T)))/(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))$.

Below we show that when $t_C > \underline{t}_C = \max\{t_{C1}, t_{C2}, t_{C3}, t_{C4}\}$ (which is a sufficient condition), $\frac{\partial p_{1C}^{TS*}}{\partial \alpha_S} < 0$, $\frac{\partial p_{2C}^{TS*}}{\partial \alpha_S} < 0$, $\frac{\partial p_{1A}^{TS*}}{\partial \alpha_S} < 0$ and $\frac{\partial p_{2A}^{TS*}}{\partial \alpha_S} > 0$.

First, $\frac{\partial p_{1C}^{TS*}}{\partial \alpha_S} = \{(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))((\alpha_S + \alpha_T)(\alpha_S + \alpha_T - \gamma_S) - 2t_C(9 + \alpha_S + 2\alpha_T - 3\gamma_S - 3\gamma_T) + ((\alpha_S + \alpha_T) - 2(\gamma_S + \gamma_T))(\alpha_S + \alpha_T - \gamma_S)(\alpha_S + \alpha_T - 2\gamma_S - 2\gamma - T)) - ((5(\gamma_S + \gamma_T) - 4(\alpha_S + \alpha_T))(36t_C^2 + (\alpha_S + \alpha_T)(\alpha_S + \alpha_T - _S)(\alpha_S + \alpha_T - 2\gamma_S - 2\gamma_T) - t_C(\alpha_S^2 + 3\alpha_T^2 + 4\alpha_S\alpha_T + 6(3\alpha_T + \gamma_S - \gamma_T) + 6\alpha_S(3 - \gamma_S - \gamma_T) - 4\alpha_T(\gamma_S + \gamma_T) + 2(\gamma_S + \gamma_T)^2)))\}/(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))^2$.

The sign of the above expression is the sign of its numerator, and it will be negative when $t_C > t_{C1}$ since the numerator is a quadratic, concave function of t_C, where t_{C1} is the larger root and is given below:

$t_{C1} = \{[(\alpha_S^2(4\alpha_T - 7\gamma_S - 7\gamma_T - 72) + 2\alpha_S(4\alpha_T^2 - 3\alpha_T(\gamma_S + \gamma_T 24) + 2(\gamma_S + \gamma_T)^2 + 96\gamma_S + 84\gamma_T) + \alpha_T^2(\gamma_S + \gamma_T - 72) + 4\alpha_T^3 - 2\alpha_T(2(5\gamma_S - 42)\gamma_T + \gamma_S(5\gamma_S - 96) + 5\gamma_T^2) + 2(\gamma_S + \gamma_T)((2\gamma_S - 33)\gamma_T + (\gamma_S - 39)\gamma_S + \gamma_T^2))^2 + 144(2\alpha_S + \gamma_S + \gamma_T - 18)(2\alpha_S^2 + 4\alpha_S\alpha_T - 2\alpha_S(\gamma_S + \gamma_T) + 2\alpha_T^2 - 2\alpha_T(\gamma_S + \gamma_T) + \gamma_S(\gamma_S + \gamma_T))(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T))^2]^{1/2} + [2\alpha_T(2\alpha_S^2 - 3\alpha_S(24 - \gamma_S - \gamma_T) - 5(\gamma_S + \gamma_T)^2 - 12(8\gamma_S + 7\gamma_T)) - 7\alpha_S^2\gamma_S - 7\alpha_S^2\gamma_T - 72\alpha_S^2 + \alpha_T^2(8\alpha_S + \gamma_S + \gamma_T - 72) + 4\alpha_S\gamma_S^2 + 8\alpha_S\gamma_S\gamma_T + 192\alpha_S\gamma_S + 4\alpha_S\gamma_T^2 + 168\alpha_S\gamma_T + 4\alpha_T^3 + 6\gamma_S^2\gamma_T + 2\gamma_S^3 - 78\gamma_S^2 + 6\gamma_S\gamma_T^2 - 144\gamma_S\gamma_T + 2\gamma_T^3 - 66\gamma_T^2]\}/(72(18 - 2\alpha_S - \gamma_S - \gamma_T))$.

Second, $\frac{\partial p_{2C}^{TS*}}{\partial \alpha_S} = \{[(36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T)))((\alpha_S + \alpha_T)(3\alpha_S + \alpha_T - 4\gamma_S) - 2t_C(9 + 3\alpha_S + 2\alpha_T - 2\gamma_S - 2\gamma_T) - 2(3(\alpha_S + \alpha_T) - \gamma_S) - 2\gamma_T^2)] + [(4(\alpha_S + \alpha_T) - 5(\gamma_S + \gamma_T))(36t_C^2 + (\alpha_S + \alpha_T)(\alpha_S + \alpha_T - _T)(\alpha_S + \alpha_T - 2\gamma_S - 2\gamma_T) - t_C(3\alpha_S^2 + \alpha_T^2 + 2\alpha_S(9 + 2\alpha_T - 2\gamma_S - 2\gamma_T) + 6(\gamma_S - \gamma_T) + 6\alpha_T(3 - \gamma_S - \gamma_T) + 2(\gamma_S + \gamma_T)^2))]\}/\{36t_C - (2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T))\}^2$.

The sign of the above expression is the sign of its numerator, and similar to the proof above, it will be negative when $t_C > t_{C2}$, where t_{C2} is given by

$t_{C2} = \{[((\alpha_S^2(4\alpha_T - 7\gamma_S - 7\gamma_T + 72) + 2\alpha_S(4\alpha_T^2 - 3\alpha_T(\gamma_S + \gamma_T - 24) + 2(\gamma_S + \gamma_T)^2 - 12(7\gamma_S + 8\gamma_T)) + \alpha_T^2\gamma_S + \gamma_T + 72) + 4\alpha_T^3 - 2\alpha_T(2(5\gamma_S + 48)\gamma_T + \gamma_S(5\gamma_S + 84) + 5\gamma_T^2) + 2(\gamma_S + \gamma_T)((2\gamma_S + 39)\gamma_T + \gamma_S(\gamma_S +$

$33) + \gamma_T^2))^2 - 144(2\alpha_S + \gamma_S + \gamma_T + 18)(\gamma_T(\gamma_S - 2(\alpha_S + \alpha_T)) + 2(\alpha_S + \alpha_T)(\alpha_S + \alpha_T - \gamma_S) + \gamma_T^2)(\alpha_S + \alpha_T - 2(\gamma_S + \gamma_T))^2]^{1/2} + [3\alpha_S(\gamma_S + \gamma_T - 24) - 2\alpha_T(-2\alpha_S^2 + 5(\gamma_S + \gamma_T)^2 + 84\gamma_S + 96\gamma_T) - 7\alpha_S^2\gamma_S - 7\alpha_S^2\gamma_T + 72\alpha_S^2 + \alpha_T^2(8\alpha_S + \gamma_S + \gamma_T + 72) + 4\alpha_S\gamma_S^2 + 8\alpha_S\gamma_S\gamma_T - 168\alpha_S\gamma_S + 4\alpha_S\gamma_T^2 - 192\alpha_S\gamma_T + 4\alpha_T^3 + 6\gamma_S^2\gamma_T + 2\gamma_S^3 + 66\gamma_S^2 + 6\gamma_S\gamma_T^2 + 144\gamma_S\gamma_T + 2\gamma_T^3 + 78\gamma_T^2]\}/(72(18 + 2\alpha_S + \gamma_S + \gamma_T))$.

Third, $\frac{\partial p_{1A}^{TS*}}{\partial \alpha_S} = \{[36t_C - (2(\alpha_S+\alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S+\gamma_T))][6\gamma_S - 6t_C + 4\gamma_T + 3(\gamma_S+\gamma_T)^2 - 2\alpha_T(2+\gamma_S+\gamma_T) + 4\alpha_S(1+\gamma_S+\gamma_T)] + (4(\alpha_S+\alpha_T) - 5(\gamma_S+\gamma_T))[-2\alpha_S^2(\gamma_S+\gamma_T+1) + \alpha_S(-2\alpha_T(\gamma_S+\gamma_T+2) + 3(\gamma_S+\gamma_T)^2 + 6\gamma_S + 4\gamma_T) - 2\alpha_T^2 + 2\alpha_T\gamma_S^2 + \gamma_T^2(2\alpha_T - 3(\gamma_S+1)) + \gamma_T(4\alpha_T(\gamma_S+1) - \gamma_S(3\gamma_S+4)) + 6\alpha_T\gamma_S - \gamma_S^3 - \gamma_S^2 - \gamma_T^3 + 6t_C(-\alpha_S + \alpha_T + 3(\gamma_S+\gamma_T+2))]\}/\{36t_C - (2(\alpha_S+\alpha_T) - \gamma_S - \gamma_T)(\alpha_S+\alpha_T - 2(\gamma_S+\gamma_T))\}^2$.

The sign of the above expression is the sign of its numerator, and it will be negative when $t_C > t_{C3}$, where t_{C3} is given by

$t_{C3} = \{[4\alpha_S^2(-2\alpha_T^2 + 10\alpha_T(\gamma_S+\gamma_T) + 7(\gamma_S+\gamma_T)^2 + 6(\gamma_S - \gamma_T)) - 16\alpha_S^3(\alpha_T - 3(\gamma_S+\gamma_T)) + 4\alpha_S^4 + 8\alpha_S(-4\alpha_T^2(\gamma_S+\gamma_T) + 6\alpha_T^3 - \alpha_T(2(\gamma_S+9)\gamma_T + (\gamma_S - 18)\gamma_S + \gamma_T^2) - 3(\gamma_S+\gamma_T)(2(\gamma_S-1)\gamma_T + \gamma_S(\gamma_S+2) + \gamma_T^2)) - 8\alpha_T^2((8\gamma_S+15)\gamma_T + \gamma_S(4\gamma_S - 15) + 4\gamma_T^2) - 24\alpha_T^3(\gamma_S+\gamma_T) + 36\alpha_T^4 + 4\alpha_T(\gamma_S+\gamma_T)(2(5\gamma_S+3)\gamma_T + \gamma_S(5\gamma_S - 6) + 5\gamma_T^2) + \gamma_S^2((\gamma_S - 108)\gamma_S + 36) + 4(\gamma_S+27)\gamma_T^3 + 6(\gamma_S(\gamma_S+18)+6)\gamma_T^2 + 4\gamma_S((\gamma_S-27)\gamma_S - 18)\gamma_T + \gamma_T^4]^{1/2} - 2\alpha_S^2 + 4\alpha_S(\alpha_T - 3(\gamma_S+\gamma_T)) + 6\alpha_T^2 - 10\alpha_T(\gamma_S+\gamma_T) + 5(\gamma_S+\gamma_T)^2 + 6\gamma_S - 6\gamma_T\}/72$.

Finally, $\frac{\partial p_{2A}^{TS*}}{\partial \alpha_S} = \{(36t_C - (2(\alpha_S+\alpha_T) - \gamma_S - \gamma_T)(\alpha_S+\alpha_T - 2(\gamma_S+\gamma_T)))2(3t_C - 2\alpha_S + 2\gamma_S + 3\gamma_T + (\gamma_S+\gamma_T)^2 - \alpha_T(2+\gamma_S+\gamma_T)) - [(5(\gamma_S+\gamma_T) - 4(\alpha_S+\alpha_T))(36t_C - (\alpha_T - \gamma_S - \gamma_T)(2(\alpha_S+\alpha_T) - \gamma_S - \gamma_T)(\gamma_S+\gamma_T) - (2\alpha_S^2 + 4\alpha_S\alpha_T + 2\alpha_T^2 - 4\alpha_S\gamma_S - 4\alpha_T\gamma_S + 3\gamma_S^2 - 2\gamma_T(3\alpha_S + 3\alpha_T - 2\gamma_S)) - (\gamma_T^2 - 6t_C(\alpha_S - \alpha_T + 3\gamma_S + 3\gamma_T)))]\}/\{36t_C - (2(\alpha_S+\alpha_T) - \gamma_S - \gamma_T)(\alpha_S+\alpha_T - 2(\gamma_S+\gamma_T))\}^2$.

The sign of the above expression is the sign of its numerator, and it will be positive when $t_C > t_{C4}$, where t_{C4} is given by

$t_{C4} = \{[(4\alpha_S^2(-2\alpha_T^2 + 10\alpha_T(\gamma_S+\gamma_T) + 7(\gamma_S+\gamma_T)^2 + 6(\gamma_S - \gamma_T)) - 16\alpha_S^3(\alpha_T - 3(\gamma_S+\gamma_T)) + 4\alpha_S^4 + 8\alpha_S(-4\alpha_T^2\gamma_S + \gamma_T) + 6\alpha_T^3 - \alpha_T(2(\gamma_S+9)\gamma_T + (\gamma_S - 18)\gamma_S + \gamma_T^2) - 3(\gamma_S+\gamma_T)(2(\gamma_S-1)\gamma_T + \gamma_S(\gamma_S+2) + \gamma_T^2)) - 8\alpha_T^2((8\gamma_S+15)\gamma_T + \gamma_S(4\gamma_S - 15) + 4\gamma_T^2) - 24\alpha_T^3(\gamma_S+\gamma_T) + 36\alpha_T^4 + 4\alpha_T(\gamma_S+\gamma_T)(2(5\gamma_S+3)\gamma_T + \gamma_S(5\gamma_S - 6) + 5\gamma_T^2) + \gamma_S^2((\gamma_S - 108)\gamma_S + 36) + 4(\gamma_S+27)\gamma_T^3 + 6(\gamma_S(\gamma_S+18)+6)\gamma_T^2 + 4\gamma_S((\gamma_S-27)\gamma_S - 18)\gamma_T + \gamma_T^4]^{1/2} - 2\alpha_S^2 + 4\alpha_S(\alpha_T - 3(\gamma_S+\gamma_T)) + 6\alpha_T^2 - 10\alpha_T(\gamma_S+\gamma_T) + 5(\gamma_S+\gamma_T)^2 + 6\gamma_S - 6\gamma_T\}/72$.

□

Proof of Proposition 1

Proof. $\Pi_1^{TT} - \Pi_1^{ST} = \frac{\gamma_T - \alpha_T}{2} + \frac{(2(\alpha_T+\alpha_S-\gamma_T-u_S)(\alpha_T-\gamma_T-\gamma_S)(\alpha_S+\alpha_T-\gamma_S-\gamma_T)+t_C(\alpha_S-\alpha_T)(2\alpha_S+\gamma_S+\gamma_T)}{2((2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))-36t_C)}$ $+\frac{((\alpha_S+\alpha_T+2\gamma_S)(\gamma_S-\gamma_T)-6t_C(\alpha_S+5\alpha_T-\gamma_S-5\gamma_T))}{2((2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))-36t_C)} > 0$ if and only if $\alpha^* > \alpha_S > \alpha_1$ where

$$\alpha^* = \frac{6t_C+2t_C\alpha_T-2\gamma_S^2+\gamma_T-t_C\gamma_T-\alpha_T\gamma_T+\gamma_T^2-\gamma_S(1+t_C-\alpha_T+\gamma_T)}{4(t_C-\gamma_S)} + \frac{\sqrt{((\alpha_T-2\gamma_S-1)\gamma_S+t_C(6+2\alpha_T-\gamma_S-\gamma_T)+\gamma_T-(\alpha_T+\gamma_S)\gamma_T+\gamma_T^2)^2+8(t_C-\gamma_S)(2\gamma_S\gamma_T-\gamma_S(\alpha_T+\alpha_T^2+2\gamma_S)+\alpha_T(1-\alpha_T+\gamma_S)\gamma_T+\alpha_T\gamma_T^2-t_C(6(\gamma_S-\gamma_T)-\alpha_T(6-\gamma_S-\gamma_T)))}}{4(t_C-\gamma_S)},$$

$$\alpha_1 = \frac{6t_C+2t_C\alpha_T-2\gamma_S^2+\gamma_T-t_C\gamma_T-\alpha_T\gamma_T+\gamma_T^2-\gamma_S(1+t_C-\alpha_T+\gamma_T)}{4(t_C-\gamma_S)} - \frac{\sqrt{((\alpha_T-2\gamma_S-1)\gamma_S+t_C(6+2\alpha_T-\gamma_S-\gamma_T)+\gamma_T-(\alpha_T+\gamma_S)\gamma_T+\gamma_T^2)^2+8(t_C-\gamma_S)(2\gamma_S\gamma_T-\gamma_S(\alpha_T+\alpha_T^2+2\gamma_S)+\alpha_T(1-\alpha_T+\gamma_S)\gamma_T+\alpha_T\gamma_T^2-t_C(6(\gamma_S-\gamma_T)-\alpha_T(6-\gamma_S-\gamma_T)))}}{4(t_C-\gamma_S)}.$$

Similarly, $\Pi_1^{SS} - \Pi_1^{TS} = \frac{\gamma_S - \alpha_S + t_C}{2} - \frac{(2(\alpha_S - \gamma_S - \gamma_T)((\alpha_S + \alpha_T - \gamma_S)(\alpha_S + \alpha_T - \gamma_S - \gamma_T) + t_C(\gamma_S + \gamma_T - \alpha_S - 3\alpha_T))}{2(-(2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S - \gamma_T)) + 36t_C)}$ $- \frac{(36t_C^2 - t_C(5\alpha_S + \alpha_T - 5\gamma_S - \gamma_T) - (\gamma_S - \gamma_T)(\alpha_S + \alpha_T + 2\gamma_T))}{2(-(2(\alpha_S + \alpha_T) - \gamma_S - \gamma_T)(\alpha_S + \alpha_T - 2(\gamma_S - \gamma_T)) + 36t_C)} > 0$ if and only if $\alpha_2 > \alpha_S > \alpha^{**}$ where

$$\alpha_2 = \frac{\gamma_S - \alpha_T\gamma_S + \gamma_S^2 - \gamma_T + \alpha_T\gamma_T + \gamma_S\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T)}{2(\gamma_S + \gamma_T)} + \frac{\sqrt{(\gamma_S(1 - \alpha_T + \gamma_S) - (1 - \alpha_T - \gamma_S)\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T))^2 + 4(\gamma_S + \gamma_T)(\alpha_T\gamma_S(1 + \gamma_S) + (2\alpha_T^2 + 2\gamma_S - \alpha_T(1 + \gamma_S))\gamma_T - 2(1 + \alpha_T)\gamma_T^2 + t_C(6(\gamma_S - \gamma_T) - \alpha_T(6 - 2\alpha_T - \gamma_S - \gamma_T)))}}{4(2(\gamma_S + \gamma_T)},$$

$$\alpha^{**} = \frac{\gamma_S - \alpha_T\gamma_S + \gamma_S^2 - \gamma_T + \alpha_T\gamma_T + \gamma_S\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T)}{2(\gamma_S + \gamma_T)} - \frac{\sqrt{(\gamma_S(1 - \alpha_T + \gamma_S) - (1 - \alpha_T - \gamma_S)\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T))^2 + 4(\gamma_S + \gamma_T)(\alpha_T\gamma_S(1 + \gamma_S) + (2\alpha_T^2 + 2\gamma_S - \alpha_T(1 + \gamma_S))\gamma_T - 2(1 + \alpha_T)\gamma_T^2 + t_C(6(\gamma_S - \gamma_T) - \alpha_T(6 - 2\alpha_T - \gamma_S - \gamma_T)))}}{4(2(\gamma_S + \gamma_T)}.$$

It can also be easily shown that the signs (which are equal to the numerators) of both profit differences are quadratic and concave functions of α_S. The upper bound on α_S in Equation (7) in Section 3.4, $\bar{\alpha}_S$, is given by $\bar{\alpha}_S = \min\{[6t_C + 2t_C\alpha_T - 2\gamma_S^2 + \gamma_T - t_C\gamma_T - \alpha_T\gamma_T + \gamma_T^2 - \gamma_S(1 + t_C - \alpha_T + \gamma_T) + \{((\alpha_T - 2\gamma_S - 1)\gamma_S + t_C(6 + 2\alpha_T - \gamma_S - \gamma_T) + \gamma_T - (\alpha_T + \gamma_S)\gamma_T + \gamma_T^2)^2 + 8(t_C - \gamma_S)(2\gamma_S\gamma_T - \gamma_S(\alpha_T + \alpha_T^2 + 2\gamma_S) + \alpha_T(1 - \alpha_T + \gamma_S)\gamma_T + \alpha_T\gamma_T^2 - t_C(6(\gamma_S - \gamma_T) - \alpha_T(6 - \gamma_S - \gamma_T)))\}^{1/2}]/(4(t_C - \gamma_S)), \quad (\gamma_T - \gamma_S(\gamma_S + \gamma_T + 1) - t_C(\gamma_S + \gamma_T - 6))/(\gamma_T + 2t_C - \gamma_S), \quad (18 - \gamma_S - \gamma_T)/2\}$.

From Equation (7), it can be derived that $\alpha^* > \alpha_S > 0 > \alpha^{**}$. Thus, for the equilibrium analysis, we only need to investigate the following two regions in terms of α_S: (i) $\alpha_1 > \alpha_2 > 0$ and (ii) $\alpha_2 > \alpha_1 > 0$.

Given the above profit differences, the equilibrium conditions in the first region ($\alpha_1 > \alpha_2 > 0$) are as follows:

When $\alpha_S > \alpha_1$, TT is the unique equilibrium. When $\alpha_1 > \alpha_S > \alpha_2$, TS/ST is the unique equilibrium. When $\alpha_2 > \alpha_S > 0$, SS is the unique equilibrium. This completes the proof of Proposition 1.

Given the above profit differences, the equilibrium conditions in the second region ($\alpha_2 > \alpha_1 > 0$) are as follows:

When $\alpha_S > \alpha_2$, TT is the unique equilibrium. When $\alpha_2 > \alpha_S > \alpha_1$, TT and SS are both equilibria. When $\alpha_1 > \alpha_S > 0$, SS is the unique equilibrium. This completes the proof of Corollary 1.

Also, $\Pi_1^{SS} - \Pi_1^{TS} > 0$ if $\gamma_S > \gamma_A$ or $\gamma_S < \gamma_B$ and $\Pi_1^{TT} - \Pi_1^{ST} > 0$ if $\gamma_C > \gamma_S > \gamma_D$ where,

$$\gamma_A = \frac{\alpha_S^2 + \alpha_T\gamma_T - \alpha_T - 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C}{2(\alpha_S + \alpha_T)} + \frac{\sqrt{4(\alpha_S + \alpha_T)(\gamma_T(\alpha_S + \alpha_T)(\alpha_S - 2\alpha_T + 1) + 2(\alpha_T + 1)\gamma_T^2 + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_T - 3)t_C(\alpha_S - \alpha_T)) + (\gamma_T(\alpha_S - \alpha_T + 2) - (\alpha_S - 1)(\alpha_S + \alpha_T) + t_C(\alpha_S - \alpha_T + 6))^2}}{2(\alpha_S + \alpha_T)},$$

$$\gamma_B = \frac{\alpha_S^2 + \alpha_T\gamma_T - \alpha_T - 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C}{2(\alpha_S + \alpha_T)} - \frac{\sqrt{4(\alpha_S + \alpha_T)(\gamma_T(\alpha_S + \alpha_T)(\alpha_S - 2\alpha_T + 1) + 2(\alpha_T + 1)\gamma_T^2 + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_T - 3)t_C(\alpha_S - \alpha_T)) + (\gamma_T(\alpha_S - \alpha_T + 2) - (\alpha_S - 1)(\alpha_S + \alpha_T) + t_C(\alpha_S - \alpha_T + 6))^2}}{2(\alpha_S + \alpha_T)},$$

$$\gamma_C = \frac{2\alpha_S^2 - \alpha_T^2 + \alpha_T\gamma_T - \alpha_T + 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C}{4(1 + \alpha_S)} + \frac{\sqrt{(-2\alpha_S^2 + \gamma_T(\alpha_S - \alpha_T - 2) - \alpha_S\alpha_T + \alpha_S + \alpha_T^2 + \alpha_T + t_C(\alpha_S - \alpha_T + 6))^2 + 8(\alpha_S + 1)(\gamma_T(\alpha_S + \alpha_T)(-\alpha_T + \gamma_T + 1) + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_S - 3)t_C(\alpha_S - \alpha_T))}}{4(1 + \alpha_S)},$$

$$\gamma_D = \frac{2\alpha_S^2 - \alpha_T^2 + \alpha_T\gamma_T - \alpha_T + 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C}{4(1 + \alpha_S)} - \frac{\sqrt{(-2\alpha_S^2 + \gamma_T(\alpha_S - \alpha_T - 2) - \alpha_S\alpha_T + \alpha_S + \alpha_T^2 + \alpha_T + t_C(\alpha_S - \alpha_T + 6))^2 + 8(\alpha_S + 1)(\gamma_T(\alpha_S + \alpha_T)(-\alpha_T + \gamma_T + 1) + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_S - 3)t_C(\alpha_S - \alpha_T))}}{4(1 + \alpha_S)}.$$

Finally, we characterize the equilibrium outcomes in terms of γ_S. It can be easily shown that the sign of $(\Pi_1^{SS} - \Pi_1^{TS})$ is a quadratic and convex function of γ_S, whereas the sign of $(\Pi_1^{TT} - \Pi_1^{ST})$ is a quadratic and concave function of γ_S. Similar to the assumption on the upper bound on α_S, we impose a lower bound on γ_S, $\underline{\gamma}_S$, which is given by

$\underline{\gamma}_S = \max\{(\alpha_S^2 + \alpha_T\gamma_T - \alpha_T - 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C - (4(\alpha_S + \alpha_T)(\gamma_T(\alpha_S + \alpha_T)(\alpha_S - 2\alpha_T + 1) + 2(\alpha_T + 1)\gamma_T^2 + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_T - 3)t_C(\alpha_S - \alpha_T)) + (\gamma_T(\alpha_S - \alpha_T + 2) - (\alpha_S - 1)(\alpha_S + \alpha_T) + t_C(\alpha_S - \alpha_T + 6))^2)^{1/2})/(2(\alpha_S + \alpha_T)), \quad (2\alpha_S^2 - \alpha_T^2 + \alpha_T\gamma_T - \alpha_T + 2\gamma_T - \alpha_S(-\alpha_T + \gamma_T + t_C + 1) + \alpha_T t_C - 6t_C - ((-2\alpha_S^2 + \gamma_T(\alpha_S - \alpha_T - 2) - \alpha_S\alpha_T + \alpha_S + \alpha_T^2 + \alpha_T + t_C(\alpha_S - \alpha_T + 6))^2 + 8(\alpha_S + 1)(\gamma_T(\alpha_S + \alpha_T)(-\alpha_T + \gamma_T + 1) + \gamma_T t_C(-\alpha_S + \alpha_T + 6) - 2(\alpha_S - 3)t_C(\alpha_S - \alpha_T)))^{1/2})/(4(1 + \alpha_S))\}$.

Given the assumption $\gamma_S > \underline{\gamma}_S$, we only need to investigate the equilibrium outcomes in the following two regions in terms of γ_S: (i) $\gamma_A > \gamma_C > 0$ and (ii) $\gamma_C > \gamma_A > 0$.

Given the above profit differences, the equilibrium conditions in the first region ($\gamma_A > \gamma_C > 0$) are as follows:

When $\gamma_S > \gamma_A$, SS is the unique equilibrium. When $\gamma_A > \gamma_S > \gamma_C$, TS/ST is the unique equilibrium. When $\gamma_C > \gamma_S > 0$, TT is the unique equilibrium.

Given the above profit differences, the equilibrium conditions in the second region ($\gamma_C > \gamma_A > 0$) are as follows:

When $\gamma_S > \gamma_C$, SS is the unique equilibrium. When $\gamma_C > \gamma_S > \gamma_A$, TT and SS are both equilibria. When $\gamma_A > \gamma_S > 0$, TT is the unique equilibrium. This completes the proof of the discussion following Corollary 1.

□

Proof of Proposition 2

Proof. $\Pi_i^{TT*} = \frac{t_C+1-\alpha_T+\gamma_T}{2}$ and $\Pi_i^{SS*} = \frac{t_C+1-\alpha_S+\gamma_S}{2}$. Thus, $\Pi_i^{SS*} < \Pi_i^{TT*}$ iff $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$. Recall that when $\alpha_1 > \alpha_2 > \alpha_S > 0$ or $\alpha_2 > \alpha_1 > \alpha_S > 0$, SS is unique equilibrium. As a result, in this parameter range, SS is a Prisoner's Dilemma outcome when $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$.

□

Proof of Proposition 3

Proof. Consumer surplus when both platforms offer traditional ads is $CS(TT) = 2\int_0^{1/2}(u_0 - t_C x - p_{1C}^{TT} - \gamma_T/2)dx = u_0 + \alpha_T - 5t_C/4 - \gamma_T/2$. By contrast, consumer surplus when both platforms offer sponsored content ads is $CS(SS) = 2\int_0^{1/2}(u_0 - t_C x - p_{1C}^{SS} - \gamma_S/2)dx = u_0 + \alpha_S - 5t_C/4 - \gamma_S/2$. Therefore, the difference in consumer surplus across the two advertising formats is $CS(SS) - CS(TT) = \alpha_S - \alpha_T - \gamma_S/2 + \gamma_T/2$. This is positive when $\gamma_S \leq \gamma_T + 2(\alpha_S - \alpha_T) = \gamma_1$.

Advertiser surplus when both platforms offer traditional ads is $AS(TT) = 2\int_0^{1/2}(\alpha_T/2 - x - p_{1A}^{TT})dx = \alpha_T/2 - 5/4 - \gamma_T$. By contrast, advertiser surplus when both platforms offer sponsored content ads is $AS(SS) = 2\int_0^{1/2}(\alpha_S/2 - x - p_{1A}^{SS})dx = \alpha_S/2 - 5/4 - \gamma_S$. Therefore, the difference in advertisers' surplus across the two advertising formats is $AS(SS) - AS(TT) = \frac{\alpha_S - \alpha_T - 2\gamma_S}{2} + \gamma_T$. This is positive when $\gamma_S \leq \gamma_T + \frac{(\alpha_S - \alpha_T)}{2} = \gamma_2$.

Because $\alpha_S > \alpha_T$, we find that $\gamma_T + 2(\alpha_S - \alpha_T) > \gamma_T + \frac{(\alpha_S - \alpha_T)}{2}$, so that compared to advertiser surplus, it is more likely for consumer surplus to improve when platforms shift from traditional ads to sponsored content ads.

□

Proof of Lemma 2

Proof. When advertisers are multi-homing, consumers pay $p_{iC}^{SS*,M} = \frac{4t_C - \alpha_S(\alpha_S - 3\gamma_S)}{4}$, and when advertisers are single-homing, consumers pay $p_{iC}^{SS*} = t_C - \alpha_S$. First, note that $p_{iC}^{SS*,M}$ is always higher than p_{iC}^{SS*} (otherwise it would violate the condition that multi-homing advertisers' demand must be less than 1). Second, we also know that consumers experience more advertising under multi-homing as compared to that under single-homing. As a result, given that consumers' utility function is $U_{iC}^S = u_0 - t_C|x_{iC}^S - l_i| - p_{iC}^S - \gamma_S x_{iA}^{eS}$, and both p_{iC}^S and x_{iA}^{eS} are higher under multi-homing, total consumer surplus is lower under multi-homing compared to that under single-homing.

Advertisers' surplus when some of the advertisers are multi-homing is $AS(SS)^M = 2\int_0^{(\alpha_S - \gamma_S)/4}(\alpha_S/2 - x - p_{1A}^{SS,M})dx = \frac{(\alpha_S - \gamma_S)^2}{16}$. Advertisers' surplus when all the advertisers are single-homing is $AS(SS)^S = 2\int_0^{1/2}(\alpha_S/2 - x - p_{1A}^{SS})dx = \alpha_S/2 - 5/4 - \gamma_S$. Note that $(AS(SS)^M - AS(SS)^S)$ is a quadratic and convex function of γ_S. Thus, $AS(SS)^M > AS(SS)^S$ when $\gamma_S > \alpha_S - 8 + 2\sqrt{11 - 2\alpha_S}$ or $\gamma_S < \alpha_S - 8 - 2\sqrt{11 - 2\alpha_S}$. When $\alpha_S > 5.5$, both of the above cutoff values of γ_S are complex numbers, implying that $AS(SS)^M > AS(SS)^S$ always holds. On the other hand, when $\alpha_S < 5.5$, both of the above cutoff values of γ_S are negative numbers again implying that $AS(SS)^M > AS(SS)^S$. Thus, advertisers are better off under multi-homing.

Platforms' profit when some of the advertisers are multi-homing are $\Pi_i^{SS*,M} = \frac{8t_C - \alpha_S^2 + 6\alpha_S\gamma_S - \gamma_S^2}{16}$. When all the advertisers are single-homing, platforms' profits are $\Pi_i^{SS*,S} = \frac{1 + t_C - \alpha_S + \gamma_S}{2}$. $\Pi_i^{SS*,M} > \Pi_i^{SS*,S}$ when $4 + 3\gamma_S - 2\sqrt{2}(1 + \gamma_S) < \alpha_S < 4 + 3\gamma_S + 2\sqrt{2}(1 + \gamma_S)$. Given that each platform's demand from advertisers in equilibrium is between $\frac{1}{2}$ and 1 in the case of advertiser multi-homing, we obtain the following condition: $2 < \alpha_S - \gamma_S < 4$. Based on this condition, it can be easily shown that the inequalities $4 + 3\gamma_S - 2\sqrt{2}(1 + \gamma_S) < \alpha_S < 4 + 3\gamma_S + 2\sqrt{2}(1 + \gamma_S)$ always hold. Thus, platforms are better off under multi-homing.

$\square$

Proof of Proposition 4

Proof. In the case of multi-homing, consumers are better off in SS compared to that in TT when $\gamma_S \leq \gamma_3 = 2\alpha_S - \sqrt{3\alpha_S^2 + \alpha_T^2 + \gamma_T^2 - 4\alpha_T\gamma_T}$. By contrast, advertisers are better off in SS compared to that in TT when $\gamma_S \leq \gamma_4 = \gamma_T + (\alpha_S - \alpha_T)$. Recall that γ_1 and γ_2 are the corresponding thresholds in the case of single-homing.

$\gamma_3 < \gamma_1 = \gamma_T + 2(\alpha_S - \alpha_T) \Leftrightarrow (3\alpha_S^2 + \alpha_T^2 + \gamma_T^2 - 4\alpha_T\gamma_T) > (2\alpha_T - \gamma_T)^2$, which is always true. Similarly, it can be easily shown that $\gamma_4 > \gamma_2 = \gamma_T + \frac{(\alpha_S - \alpha_T)}{2}$ is also always true.

$\square$

Proof of Lemma 3

Proof. We first examine the impact of γ_S and α_S on the price for consumers. $\frac{\partial p_{iC}^{SS*}}{\partial \gamma_S} = \frac{6\alpha_S}{5} > 0$, $\frac{\partial p_{iC}^{SS*}}{\partial \alpha_S} = \frac{-2(1+6\alpha_S-9\gamma_S)}{15} < 0$ when $\frac{7+12\gamma_S}{9} < \alpha_S < \frac{4(1+\gamma_S)}{3}$ if $\gamma_S < \frac{17}{3}$.

Next, we examine the impact of γ_S and α_S on the price for advertisers. $\frac{\partial p_{iA}^{SS*}}{\partial \gamma_S} = \frac{2}{5} > 0$, $\frac{\partial p_{iA}^{SS*}}{\partial \alpha_S} = \frac{1}{5} > 0$.

$\square$

Proof of Proposition 5

Proof. In the SS equilibrium, platform i's profit is $\Pi_i^{SS*} = \frac{1-21\alpha_S^2-24\gamma_S^2+75t_C-4\alpha_S+2\gamma_S+96\alpha_S\gamma_S}{150}$, and thus we have $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} = -\frac{2+21\alpha_S-48\gamma_S}{75}$.

It is easy to see that $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S}\big|_{\alpha_S=\frac{7+12\gamma_S}{9}} = \frac{12\gamma_S-11}{45}$ and $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S}\big|_{\alpha_S=\frac{4(1+\gamma_S)}{3}} = \frac{4\gamma_S-6}{15}$. Therefore, when $\gamma_S < \frac{11}{12}$, $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} < 0$ holds; when $\gamma_S > \frac{3}{2}$, $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} > 0$ holds; otherwise, there exists $\frac{7+12\gamma_S}{9} < \alpha_S^* < \frac{4(1+\gamma_S)}{3}$ such that $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} > 0$ if $\alpha_S < \alpha_S^*$ and $\frac{\partial \Pi_i^{SS*}}{\partial \alpha_S} \leq 0$ if $\alpha_S \geq \alpha_S^*$.

A.2 Impact of Content from Sponsored Content Ads

Define the threshold $u^* = 6t_C - \alpha_T^2 + 3\alpha_T\gamma_T - \alpha_T - 2\gamma_T^2 - \gamma_T$ and assume that $u^* > |u_S|$.

$\Pi_1^{ST} - \Pi_1^{TT} = \frac{u_S(u_S+6t_C-\alpha_T^2+3\alpha_T\gamma_T-\alpha_T-2\gamma_T^2-\gamma_T)}{2(9t_C-2\alpha_T^2+5\alpha_T\gamma_T-2\gamma_T^2)} = \frac{u_S(u_S+u^*)}{2(9t_C-2\alpha_T^2+5\alpha_T\gamma_T-2\gamma_T^2)}$, and

$\Pi_1^{SS} - \Pi_1^{TS} = \frac{u_S(-u_S+6t_C-\alpha_T^2+3\alpha_T\gamma_T-\alpha_T-2\gamma_T^2-\gamma_T)}{2(9t_C-2\alpha_T^2+5\alpha_T\gamma_T-2\gamma_T^2)} = \frac{u_S(u^*-u_S)}{2(9t_C-2\alpha_T^2+5\alpha_T\gamma_T-2\gamma_T^2)}$.

$\Pi_1^{ST} - \Pi_1^{TT} > 0$ when $u_S > 0$ or when $u_S < 0$ and $|u_S| > u^*$ (which violates the assumption that $u^* > |u_S|$). By contrast, $\Pi_1^{SS} - \Pi_1^{TS} > 0$ when $0 < u_S < u^*$. As a result, SS is the unique equilibrium when $0 < u_S < u^*$. On the other hand, TT is the unique equilibrium when

$\Pi_1^{ST} - \Pi_1^{TT} < 0$ and $\Pi_1^{SS} - \Pi_1^{TS} < 0$, which translates to the following conditions: $u_S < 0$ and $|u_S| < u^*$.

A.3 Total Impact of Sponsored Content Ads

$\Pi_1^{ST} - \Pi_1^{TT} = \frac{\alpha_T - \gamma_T}{2} - \frac{(2(\alpha_T+\alpha_S-\gamma_T-u_S)(\alpha_T-\gamma_T-\gamma_S)(\alpha_S+\alpha_T-\gamma_S-\gamma_T)+t_C(\alpha_S-\alpha_T)(2\alpha_S+\gamma_S+\gamma_T)}{2((2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))-36t_C)}$ $-\frac{((2u_S-\alpha_S-\alpha_T-2\gamma_S)(2u_S-\gamma_S+\gamma_T)+6t_C(4u_S-\alpha_S-5\alpha_T+\gamma_S+5\gamma_T))}{2((2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))-36t_C)} > 0$ when $\alpha_S > \alpha_{S1}$ or $\alpha_S < \alpha_{S2}$, where

$\alpha_{S1} = \{(6t_C + 2t_C\alpha_T - 2\gamma_S^2 + \gamma_T - t_C\gamma_T - \alpha_T\gamma_T + \gamma_T^2 - \gamma_S(1 + t_C - \alpha_T + \gamma_T) + 2u_S(\alpha_T - \gamma_S - \gamma_T + 1)) + [((\alpha_T - 2\gamma_S - 1)\gamma_S + t_C(6 + 2\alpha_T - \gamma_S - \gamma_T) + 2u_S(\alpha_T - \gamma_S - \gamma_T + 1) + \gamma_T - (\alpha_T + \gamma_S)\gamma_T + \gamma_T^2)^2 + 8(t_C - \gamma_S)(2\gamma_S\gamma_T - 4u_S^2\gamma_S(\alpha_T + \alpha_T^2 + 2\gamma_S) + \alpha_T(1 - \alpha_T + \gamma_S)\gamma_T + \alpha_T\gamma_T^2 + 2u_S(\alpha_T^2 + \alpha_T(-2\gamma_S - 2\gamma_T + 1) + (\gamma_S + \gamma_T)^2 + 3\gamma_S - \gamma_T) - t_C(6(\gamma_S - \gamma_T) - \alpha_T(6 - \gamma_S - \gamma_T) - 24u_S))]^{1/2}\}/(4(t_C - \gamma_S))$,

$\alpha_{S2} = \{(6t_C + 2t_C\alpha_T - 2\gamma_S^2 + \gamma_T - t_C\gamma_T - \alpha_T\gamma_T + \gamma_T^2 - \gamma_S(1 + t_C - \alpha_T + \gamma_T) + 2u_S(\alpha_T - \gamma_S - \gamma_T + 1)) - [((\alpha_T - 2\gamma_S - 1)\gamma_S + t_C(6 + 2\alpha_T - \gamma_S - \gamma_T) + 2u_S(\alpha_T - \gamma_S - \gamma_T + 1) + \gamma_T - (\alpha_T + \gamma_S)\gamma_T + \gamma_T^2)^2 + 8(t_C - \gamma_S)(2\gamma_S\gamma_T - 4u_S^2\gamma_S(\alpha_T + \alpha_T^2 + 2\gamma_S) + \alpha_T(1 - \alpha_T + \gamma_S)\gamma_T + \alpha_T\gamma_T^2 + 2u_S(\alpha_T^2 + \alpha_T(-2\gamma_S - 2\gamma_T + 1) + (\gamma_S + \gamma_T)^2 + 3\gamma_S - \gamma_T) - t_C(6(\gamma_S - \gamma_T) - \alpha_T(6 - \gamma_S - \gamma_T) - 24u_S))]^{1/2}\}/(4(t_C - \gamma_S))$.

Similarly, $\Pi_1^{SS} - \Pi_1^{TS} = \frac{\gamma_S - \alpha_S + t_C}{2} - \frac{(2(\alpha_S-\gamma_S-\gamma_T)((u_S+\alpha_S+\alpha_T-\gamma_S)(\alpha_S+\alpha_T-\gamma_S-\gamma_T)+t_C(\gamma_S+\gamma_T-\alpha_S-3\alpha_T))}{2(-(2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))+36t_C)}$ $-\frac{(36t_C^2-t_C(4u_S+5\alpha_S+\alpha_T-5\gamma_S-\gamma_T)+(2u_S-\gamma_S+\gamma_T)(2u_S+\alpha_S+\alpha_T+2\gamma_T))}{2(-(2(\alpha_S+\alpha_T)-\gamma_S-\gamma_T)(\alpha_S+\alpha_T-2(\gamma_S-\gamma_T))+36t_C)} > 0$ if $\alpha_{S3} > \alpha_S > \alpha_{S4}$, where

$\alpha_{S3} = \{(2u_S(2\gamma_S + 2\gamma_T - 1 - \alpha_T)\gamma_S - \alpha_T\gamma_S + \gamma_S^2 - \gamma_T + \alpha_T\gamma_T + \gamma_S\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T)) + [\{(\gamma_S(1 - \alpha_T + \gamma_S) + 2u_S(1 + \alpha_T - 2\gamma_S - 2\gamma_T) - (1 - \alpha_T - \gamma_S)\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T))^2 + 4(2u_S + \gamma_S + \gamma_T)(4u_S^2 + \alpha_T\gamma_S(1 + \gamma_S) + (2\alpha_T^2 + 2\gamma_S - \alpha_T(1 + \gamma_S))\gamma_T - 2(1 + \alpha_T)\gamma_T^2 - 2u_S(\alpha_T(\gamma_S + \gamma_T - 1) + (\gamma_S + \gamma_T)^2 - \gamma_S + 3\gamma_T) + t_C(24u_S + 6(\gamma_S - \gamma_T) - \alpha_T(6 - 2\alpha_T - \gamma_S - \gamma_T)))\}^{1/2}]\}/(2(2u_S + \gamma_S + \gamma_T))$,

$\alpha_{S4} = \{(2u_S(2\gamma_S + 2\gamma_T - 1 - \alpha_T)\gamma_S - \alpha_T\gamma_S + \gamma_S^2 - \gamma_T + \alpha_T\gamma_T + \gamma_S\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T)) - [\{(\gamma_S(1 - \alpha_T + \gamma_S) + 2u_S(1 + \alpha_T - 2\gamma_S - 2\gamma_T) - (1 - \alpha_T - \gamma_S)\gamma_T - t_C(6 - 2\alpha_T - \gamma_S - \gamma_T))^2 + 4(2u_S + \gamma_S + \gamma_T)(4u_S^2 + \alpha_T\gamma_S(1 + \gamma_S) + (2\alpha_T^2 + 2\gamma_S - \alpha_T(1 + \gamma_S))\gamma_T - 2(1 + \alpha_T)\gamma_T^2 - 2u_S(\alpha_T(\gamma_S + \gamma_T - 1) + (\gamma_S + \gamma_T)^2 - \gamma_S + 3\gamma_T) + t_C(24u_S + 6(\gamma_S - \gamma_T) - \alpha_T(6 - 2\alpha_T - \gamma_S - \gamma_T)))\}^{1/2}]\}/(2(2u_S + \gamma_S + \gamma_T))$.

□

A.4 Multi-homing Analysis

When advertisers are multi-homing, the equilibrium profit differences are as follows,

$$\Pi_1^{TT} - \Pi_1^{ST} = \frac{(\alpha_S^2+\alpha_T^2+\gamma_S^2+\gamma_T^2-12t_C-4\alpha_S\gamma_S-4\alpha_T\gamma_T)^2(8t_C+6\alpha_T\gamma_T-\alpha_T^2-\gamma_T^2)-4((\alpha_T-\gamma_T)^2-2\alpha_S\gamma_S-6t_C)^2(8t_C-(\alpha_S-\gamma_S)^2+4\alpha_T\gamma_T)}{16(\alpha_S^2+\alpha_T^2+\gamma_S^2+\gamma_T^2-12t_C-4\alpha_S\gamma_S-4\alpha_T\gamma_T)^2}.$$

The above expression would be positive under the following sufficient conditions: $(8t_C + 6\alpha_T\gamma_T - \alpha_T^2 - \gamma_T^2) > 0$ and $(8t_C - (\alpha_S - \gamma_S)^2 + 4\alpha_T\gamma_T) < 0$. These two inequalities are satisfied when $\alpha_S > \alpha_{Sa} = \gamma_S + 2\sqrt{\alpha_T\gamma_T + 2t_C}$ and $\alpha_T < \alpha_{Ta} = 3\gamma_T + 2\sqrt{2}\sqrt{\gamma_T^2 + t_C}$.

Similarly, $\Pi_1^{TS} - \Pi_1^{SS} = \frac{4((\alpha_S-\gamma_S)^2-2\alpha_T\gamma_T-6t_C)^2(8t_C-(\alpha_T-\gamma_T)^2+4\alpha_S\gamma_S)-(8t_C+6\alpha_S\gamma_S-\alpha_S^2-\gamma_S^2)(\alpha_S^2+\alpha_T^2+\gamma_S^2+\gamma_T^2-12t_C-4\alpha_S\gamma_S-4\alpha_T\gamma_T)^2}{16(\alpha_S^2+\alpha_T^2+\gamma_S^2+\gamma_T^2-12t_C-4\alpha_S\gamma_S-4\alpha_T\gamma_T)^2}$.

The above expression would be positive under the following sufficient conditions: $(8t_C-(\alpha_T-\gamma_T)^2+4\alpha_S\gamma_S)>0$ and $(8t_C+6\alpha_S\gamma_S-\alpha_S^2-\gamma_S^2)<0$. These two inequalities are satisfied when $\alpha_S > \alpha_{Sb} = 3\gamma_S + 2\sqrt{2}\sqrt{\gamma_S^2+t_C}$ and $\alpha_T < \alpha_{Tb} = \gamma_T + 2\sqrt{\alpha_S\gamma_S + 2t_C}$.

Therefore, when $\alpha_S > \max\{\alpha_{Sa}, \alpha_{Sb}\}$ and $\alpha_T < \min\{\alpha_{Ta}, \alpha_{Tb}\}$, TT is the unique equilibrium. When $\alpha_S < \min\{\alpha_{Sa}, \alpha_{Sb}\}$ and $\alpha_T > \max\{\alpha_{Ta}, \alpha_{Tb}\}$, SS is the unique equilibrium. When $\alpha_{Sb} < \alpha_S < \alpha_{Sa}$ and $\alpha_{Ta} < \alpha_T < \alpha_{Tb}$, asymmetric equilibrium TS/ST occurs. Finally, when $\alpha_{Sa} < \alpha_S < \alpha_{Sb}$ and $\alpha_{Tb} < \alpha_T < \alpha_{Ta}$, multiple equilibria arise where both SS and TT are equilibria.

Prices and profits under each subgame are as follows,

$$p_{iC}^{TT*,M} = \frac{4t_C - \alpha_T(\alpha_T - 3\gamma_T)}{4}, \tag{1}$$

$$p_{iA}^{TT*,M} = \frac{(\alpha_T + \gamma_T)}{4}, \tag{2}$$

$$\Pi_i^{TT*,M} = \frac{8t_C - \alpha_T^2 + 6\alpha_T\gamma_T - \gamma_T^2}{16}, \tag{3}$$

$$p_{iC}^{SS*,M} = \frac{4t_C - \alpha_S(\alpha_S - 3\gamma_S)}{4}, \tag{4}$$

$$p_{iA}^{SS*,M} = \frac{(\alpha_S + \gamma_S)}{4}, \tag{5}$$

$$\Pi_i^{SS*,M} = \frac{8t_C - \alpha_S^2 + 6\alpha_S\gamma_S - \gamma_S^2}{16}, \tag{6}$$

$$p_{1C}^{TS*,M} = \frac{(6t_C - (\alpha_S - \gamma_S)^2 + 2\alpha_T\gamma_T)(4t_C + 2\alpha_S\gamma_S - \alpha_T(\alpha_T - \gamma_T))}{24t_C - 2(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2)}, \tag{7}$$

$$p_{2C}^{TS*,M} = \frac{(6t_C - (\alpha_T - \gamma_T)^2 + 2\alpha_S\gamma_S)(4t_C + 2\alpha_T\gamma_T - \alpha_S(\alpha_S - \gamma_S))}{24t_C - 2(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2)}, \tag{8}$$

$$p_{1A}^{TS*,M} = \frac{(6t_C - (\alpha_S - \gamma_S)^2 + 2\alpha_T\gamma_T)(\alpha_T + \gamma_T)}{24t_C - 2(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2)}, \tag{9}$$

$$p_{2A}^{TS*,M} = \frac{(6t_C - (\alpha_T - \gamma_T)^2 + 2\alpha_S\gamma_S)(\alpha_S + \gamma_S)}{24t_C - 2(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2)}, \tag{10}$$

$$\Pi_1^{TS*,M} = \frac{((\alpha_S - \gamma_S)^2 - 2\alpha_T\gamma_T - 6t_C)^2(8t_C - (\alpha_T - \gamma_T)^2 + 4\alpha_S\gamma_S)}{4(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2 - 12t_C)}, \tag{11}$$

$$\Pi_2^{TS*,M} = \frac{((\alpha_T - \gamma_T)^2 - 2\alpha_S\gamma_S - 6t_C)^2(8t_C - (\alpha_S - \gamma_S)^2 + 4\alpha_T\gamma_T)}{4(\alpha_S^2 - 4\alpha_S\gamma_S + \alpha_T^2 - 4\alpha_T\gamma_T + \gamma_S^2 + \gamma_T^2 - 12t_C)}. \tag{12}$$

Due to the analytical complexity, the analysis above uses a set of sufficient conditions to characterize the equilibrium outcomes. We can also fully characterize the equilibrium (with sufficient and necessary conditions) using the parameter t_C. Note that the signs of $(\Pi_1^{TT} - \Pi_1^{ST})$ and $(\Pi_1^{TS} - \Pi_1^{SS})$ are both concave functions of t_C. Denote the two roots of t_{Ca} and t_{Cb} (where $t_{Ca} > t_{Cb}$) such that $\Pi_1^{TT} - \Pi_1^{ST} = 0$ when $t_C = t_{Ca}$ or $t_C = t_{Cb}$. Similarly, denote the two roots of t_{Cc} and t_{Cd} (where $t_{Cc} > t_{Cd}$) such that $\Pi_1^{TS} - \Pi_1^{SS} = 0$ when $t_C = t_{Cc}$ or $t_C = t_{Cd}$. As a result, the necessary and sufficient conditions for each equilibrium outcome is given as follows. When $t_C > \max\{t_{Ca}, t_{Cc}\}$, or $t_C < \min\{t_{Cb}, t_{Cd}\}$, SS is the unique equilibrium. When $\max\{t_{Cb}, t_{Cd}\} < t_C < \min\{t_{Ca}, t_{Cc}\}$, TT is the unique equilibrium. When $\max\{t_{Ca}, t_{Cd}\} < t_C < t_{Cc}$, or $t_{Cd} < t_C < \min\{t_{Cc}, t_{Cb}\}$, asymmetric equilibrium TS/ST arises. Finally, when $\max\{t_{Cb}, t_{Cc}\} < t_C < t_{Ca}$, or $t_{Cb} < t_C < \min\{t_{Ca}, t_{Cd}\}$, both TT and SS are equilibria.

A.5 Incompletely Covered Advertising Market Analysis

In this section, we analyze the extension in which the consumer market is fully covered but the advertising market is partially covered. First, we present the optimal strategies for two platforms when they choose the same advertising strategies.

When both platforms offer sponsored content ads, platform 1's demand from consumers and advertisers are given by (those of platform 2's are symmetrically defined):

$$
\begin{aligned}
x_{1C}^{SS} &= \frac{p_{2C}^{SS} - p_{1C}^{SS} + t_C - \gamma_S x_{1A}^{eSS} + \gamma_S x_{2A}^{eSS}}{2t_C}, \\
y_{1A}^{SS} &= \frac{3(p_{1A}^{SS} - p_{2A}^{SS}) + 1 + 3\alpha_S(x_{1C}^{eSS} - x_{2C}^{eSS})}{6}, \text{advertisers located between (1/3, 2/3)}, \\
z_{1A}^{SS} &= \alpha_S x_{1C}^{eSS} - p_{1A}^{SS}, \text{advertisers located between (0, 1/3)}, \\
x_{1A}^{SS} &= y_{1A}^{SS} + z_{1A}^{SS} = \frac{3p_{2A}^{SS} - 9p_{1A}^{SS} + 1 + 9\alpha_S x_{1C}^{eSS} - 3\alpha_S x_{2C}^{eSS}}{6}.
\end{aligned}
$$

With the assumption of rational expectations, $x_{iC}^{SS} = x_{iC}^{eSS}$ and $x_{iA}^{SS} = x_{iA}^{eSS}$, we obtain the following prices and demand when both platforms offer sponsored content ads after solving the platforms' optimization problems:

$$
\begin{aligned}
p_{iC}^{SS*} &= \frac{(15t_C - 2\alpha_S) - 6\alpha_S(\alpha_S - 3\gamma_S)}{15}, \\
p_{iA}^{SS*} &= \frac{1 + 3\alpha_S + 6\gamma_S}{15}, \\
x_{iC}^{SS*} &= \frac{1}{2}, \\
x_{iA}^{SS*} &= \frac{1 + 3\alpha_S - 4\gamma_S}{10}.
\end{aligned}
$$

The platforms' profits are $\Pi_i^{SS*} = \frac{1-21\alpha_S^2-24\gamma_S^2+(75t_C-4\alpha_S+2\gamma_S)+96\alpha_S\gamma_S}{150}$.

When both platforms offer traditional ads, we obtain the following prices and demand after solving the platforms' optimization problems:

$$
\begin{aligned}
p_{iC}^{TT*} &= \frac{(15t_C - 2\alpha_T) - 6\alpha_T(\alpha_T - 3\gamma_T)}{15}, \\
p_{iA}^{TT*} &= \frac{1 + 3\alpha_T + 6\gamma_T}{15}, \\
x_{iC}^{TT*} &= \frac{1}{2}, \\
x_{iA}^{TT*} &= \frac{1 + 3\alpha_T - 4\gamma_T}{10}.
\end{aligned}
$$

The platforms' profits are $\Pi_i^{TT*} = \frac{1-21\alpha_T^2-24\gamma_T^2+(75t_C-4\alpha_T+2\gamma_T)+96\alpha_T\gamma_T}{150}$.

When two platforms offer different types of ads (e.g., platform 1 offers traditional ads and platform 2 offers sponsored content ads), we obtain the following prices after solving the platforms' optimization problem:

$p_{1C}^{TS*} = [(14t_C(90t_C - 5\alpha_S - 7\alpha_T + 3\gamma_S - 3\gamma_T) - (-6\alpha_S^3 - 26\alpha_S^2\alpha_T - 26\alpha_S\alpha_T^2 - 6\alpha_T^3 + 42\alpha_S^2\gamma_S + 60\alpha_S\alpha_T\gamma_S + 26\alpha_T^2\gamma_S - 36\alpha_S\gamma_S^2 - 24\alpha_T\gamma_S^2 + 8\alpha_S^2\gamma_T + 36\alpha_S\alpha_T\gamma_T + 36\alpha_T^2\gamma_T + 20\alpha_S\gamma_S\gamma_T - 24\alpha_T\gamma_S\gamma_T + 7\alpha_T - 3\gamma_S + 3\gamma_T) + 3t_C(99\alpha_S^2 + 76\alpha_S\alpha_T + 153\alpha_T^2 - 498\alpha_S\gamma_S - 76\alpha_T\gamma_S + 102\gamma_S^2 - 102\alpha_S\gamma_T - 348\alpha_T\gamma_T + 52\gamma_S\gamma_T + 6\gamma_T^2)) + 12(3\alpha_S^3(\alpha_T - 6\gamma_S - \gamma_T) + \alpha_S^2(10\alpha_T^2 - 15\alpha_T\gamma_S + 36\gamma_S^2 - 11\alpha_T\gamma_T + 15\gamma_S\gamma_T + \gamma_T^2) - \alpha_T(3\alpha_T^2(\gamma_S + 6\gamma_T) + \gamma_S(3\gamma_S^2 + 10\gamma_S\gamma_T + 3\gamma_T^2) - 2\alpha_T(5\gamma_S^2 + 6\gamma_S\gamma_T + 9\gamma_T^2)) + \alpha_S(3\alpha_T^3 - 2\gamma_S(3\gamma_S + \gamma_T)^2 - 4\alpha_T^2(5\gamma_S + 3\gamma_T) + \alpha_T(15\gamma_S^2 + 56\gamma_S\gamma_T + 9\gamma_T^2))))]/G$,

$p_{1A}^{TS*} = (84t_C - (12\alpha_S^2 + 16\alpha_S\alpha_T + 4\alpha_T^2 - 42\alpha_S\gamma_S - 22\alpha_T\gamma_S + 9\gamma_S^2 + 18t_C(3\alpha_S - 17\alpha_T - 9\gamma_S - 19\gamma_T) - 2\alpha_S\gamma_T - 38\alpha_T\gamma_T + 2\gamma_S\gamma_T + 21\gamma_T^2) - 3((3\gamma_S + \gamma_T)^2(\gamma_S + 3\gamma_T) + 6\alpha_S^2(4\alpha_T + 3\gamma_S + 5\gamma_T) - 8\alpha_T^2(\gamma_S + 6\gamma_T) + 2\alpha_T(9\gamma_S^2 - 14\gamma_S\gamma_T - 27\gamma_T^2) + \alpha_S(8\alpha_T^2 - 42\alpha_T\gamma_S - 27\gamma_S^2 + 10\alpha_T\gamma_T - 66\gamma_S\gamma_T - 19\gamma_T^2))))/G$,

$p_{2C}^{TS*} = [14t_C(90t_C - 7\alpha_S - 5\alpha_T - 3\gamma_S + 3\gamma_T) - (-6\alpha_S^3 - 26\alpha_S^2\alpha_T - 26\alpha_S\alpha_T^2 - 6\alpha_T^3 + 36\alpha_S^2\gamma_S + 36\alpha_S\alpha_T\gamma_S + 8\alpha_T^2\gamma_S + 26\alpha_S^2\gamma_T + 60\alpha_S\alpha_T\gamma_T + 42\alpha_T^2\gamma_T - 24\alpha_S\gamma_S\gamma_T + 20\alpha_T\gamma_S\gamma_T - 24\alpha_S\gamma_T^2 - 36\alpha_T\gamma_T^2 + 3t_C(153\alpha_S^2 + 99\alpha_T^2 + 6\gamma_S^2 + 4\alpha_S(19\alpha_T - 87\gamma_S - 19\gamma_T) + 52\gamma_S\gamma_T + 102\gamma_T^2 - 6\alpha_T(17\gamma_S + 83\gamma_T))) + 12(3\alpha_S^3(\alpha_T - 6\gamma_S -$

$\gamma_T) + 2\alpha_S^2(5\alpha_T^2 + 9\gamma_S^2 + 6\gamma_S\gamma_T + 5\gamma_T^2 - 2\alpha_T(3\gamma_S + 5\gamma_T)) + \alpha_S(3\alpha_T^3 - \alpha_T^2(11\ \gamma_S + 15\gamma_T) - \gamma_T(3\gamma_S^2 + 10\gamma_S\gamma_T + 3\gamma_T^2) + \alpha_T(9\gamma_S^2 + 56\gamma_S\gamma_T + 15\gamma_T^2)) + \alpha_T(-2\gamma_T(\gamma_S + 3\gamma_T)^2 - 3\alpha_T^2(\gamma_S + 6\gamma_T) + \alpha_T(\gamma_S^2 + 15\gamma_S\gamma_T + 36\gamma_T^2)))]/G$,

$p_{2A}^{TS*} = (84t_C + (-4\alpha_S^2 - 16\alpha_S\alpha_T - 12\alpha_T^2 + 38\alpha_S\gamma_S + 2\alpha_T\gamma_S - 21\gamma_S^2 + 22\alpha_S\gamma_T + 42\alpha_T\gamma_T - 2\gamma_S\gamma_T - 9\gamma_T^2 + 18t_C(17\alpha_S - 3\alpha_T + 19\gamma_S + 9\gamma_T)) - 3(8\alpha_S^2(\alpha_T - 6\gamma_S - \gamma_T) + (3\gamma_S + \gamma_T)\ (\gamma_S + 3\gamma_T)^2 + 6\alpha_T^2(5\gamma_S + 3\gamma_T) + 2\alpha_S(12\alpha_T^2 + 5\alpha_T\gamma_S - 27\gamma_S^2 - 21\alpha_T\gamma_T - 14\gamma_S\gamma_T + 9\gamma_T^2) - \alpha_T(19\gamma_S^2 + 66\gamma_S\gamma_T + 27\gamma_T^2)))/G$,

where $G = 3(420t_C - 54\alpha_S^2 - 54\alpha_T^2 + 53\alpha_T\gamma_S - 54\gamma_S^2 + 207\alpha_T\gamma_T - 52\gamma_S\gamma_T - 54\gamma_T^2 + \alpha_S(-52\alpha_T + 207\gamma_S + 53\gamma_T))$.

We can obtain platforms' profits by plugging in these optimal prices. Clearly, SS is the equilibrium when $\Pi_i^{SS*} > \Pi_i^{TS*}$ and $\Pi_i^{ST*} > \Pi_i^{TT*}$. Similarly, TT is the equilibrium when $\Pi_i^{TT*} > \Pi_i^{ST*}$ and $\Pi_i^{TS*} > \Pi_i^{SS*}$.

B Additional Analyses

B.1 Analysis of Monopoly

When the monopoly platform offers traditional ads, we assume that markets for both consumers and advertisers are incompletely covered. In this case, the platform's demand from consumers and advertisers is given by (superscript e denotes the expected value),

$$x_C^T = \frac{u_0 - p_C^T - \gamma_T x_A^{eT}}{t_C} \in (0,1), \tag{13}$$

$$x_A^T = \frac{\alpha_T x_C^{eT} - p_A^T}{t_A} \in (0,1). \tag{14}$$

As in the main model, we assume $t_A = 1$. Given consumers' disutility from seeing the ads, their demand decreases in the externality parameter γ_T and their expected number of ads on the platform, x_A^{eT}. By contrast, given advertisers' utility from reaching consumers, their demand increases in the externality parameter α_T and their expected number of consumers on the platform, x_C^{eT}. The platform's profit is then given by $\Pi^T = p_C^T x_C^T + p_A^T x_A^T$. We assume that both consumers and advertisers have rational expectations: $x_C^T = x_C^{eT}$ and $x_A^T = x_A^{eT}$. Solving the platform's optimization problem, we obtain the following prices, demand and profits when the platform offers traditional ads.

$$p_C^{T*} = \frac{2t_C u_0 - u_0\alpha_T(\alpha_T - \gamma_T)}{4t_C - (\alpha_T - \gamma_T)^2}, \tag{15}$$

$$p_A^{T*} = \frac{u_0(\alpha_T + \gamma_T)}{4t_C - (\alpha_T - \gamma_T)^2}, \tag{16}$$

$$x_C^{T*} = \frac{2u_0}{4t_C - (\alpha_T - \gamma_T)^2}, \tag{17}$$

$$x_A^{T*} = \frac{u_0(\alpha_T - \gamma_T)}{4t_C - (\alpha_T - \gamma_T)^2}, \tag{18}$$

$$\Pi^{T*} = \frac{u_0^2}{4t_C - (\alpha_T - \gamma_T)^2}. \tag{19}$$

Next, we analyze the optimal strategies for the monopoly platform when it offers sponsored content ads. Similarly, we assume that markets for consumers and advertisers are incompletely covered. In this case, consumers' utility is given by $u_0 + u_S - t_C x_C^S - p_C^S - \gamma_S x_A^{eS}$, and advertisers' utility is given by $\alpha_S x_C^{eS} - x_A^S - p_A^S$. Therefore, the platform's demand from consumers and advertisers are given by,

$$x_C^S = \frac{u_0 + u_S - p_C^S - \gamma_S x_A^{eS}}{t_C} \in (0,1), \tag{20}$$

$$x_A^S = \alpha_S x_C^{eS} - p_A^S \in (0,1). \tag{21}$$

The platform's profit is given by $\Pi^S = p_C^S x_C^S + p_A^S x_A^S$. Given our assumptions on rational expectations, we again have $x_C^S = x_C^{eS}$, and $x_A^S = x_A^{eS}$. Solving the platform's optimization problem, we obtain the following prices, demand and profits when the platform offers sponsored content ads.

$$p_C^{S*} = \frac{2t_C(u_0 + u_S) - (u_0 + u_S)\alpha_S(\alpha_S - \gamma_S)}{4t_C - (\alpha_S - \gamma_S)^2}, \tag{22}$$

$$p_A^{S*} = \frac{(u_0 + u_S)(\alpha_S + \gamma_S)}{4t_C - (\alpha_S - \gamma_S)^2}, \tag{23}$$

$$x_C^{S*} = \frac{2(u_0 + u_S)}{4t_C - (\alpha_S - \gamma_S)^2}, \tag{24}$$

$$x_A^{S*} = \frac{(u_0 + u_S)(\alpha_S - \gamma_S)}{4t_C - (\alpha_S - \gamma_S)^2}, \tag{25}$$

$$\Pi^{S*} = \frac{(u_0 + u_S)^2}{4t_C - (\alpha_S - \gamma_S)^2}. \tag{26}$$

Comparing the platform's profits with the two different ad formats, we see that if the externality parameters in both cases are identical (i.e., $\alpha_S = \alpha_T, \gamma_S = \gamma_T$), then for any $u_S > 0$, offering sponsored content ads is the strictly dominant equilibrium strategy. Similarly, for any $u_S < 0$, offering traditional ads is the strictly dominant equilibrium strategy.

When the externality parameters are different and $u_S = 0$, then offering sponsored content ads would be a strictly dominant strategy as long as $(\gamma_S - \gamma_T) < (\alpha_S - \alpha_T)$.

B.2 Free Content for Consumers

We already know that consumers' equilibrium price from sponsored content advertising is $p_{iC}^{SS*} = t_C - \alpha_S$. When $\alpha_S > t_C$, the media content is free for the consumers. We assume that α_T is also greater than t_C, so that regardless of the ad format, the media content is always free for the consumers. As a result, platforms' revenues now only depend on the revenues from the advertisers' side: $\Pi_i = p_{iA}^{vw} x_{iA}^{vw}$.

When both platforms offer sponsored content ads, we obtain the following prices, demands and profit functions after solving the platforms' optimization problems.

$$p_{iC}^{SS*} = 0, \tag{27}$$

$$p_{iA}^{SS*} = 1 + \frac{\alpha_S \gamma_S}{t_C}, \tag{28}$$

$$x_{iC}^{SS*} = \frac{1}{2} = x_{iA}^{SS*}, \tag{29}$$

$$\Pi_i^{SS*} = \frac{1}{2}(1 + \frac{\alpha_S \gamma_S}{t_C}). \tag{30}$$

The prices, demand and profit functions from the case of TT are symmetric and given as follows, $p_{iC}^{TT*} = 0, p_{iA}^{TT*} = 1 + \frac{\alpha_T \gamma_T}{t_C}, x_{iC}^{TT*} = x_{iA}^{TT*} = \frac{1}{2}$, and $\Pi_i^{TT*} = \frac{1}{2}(1 + \frac{\alpha_T \gamma_T}{t_C})$.

The prices, demand and profit functions from the case of TS/ST are as follows,

$$p_{1C}^{TS*} = 0, \quad p_{1A}^{TS*} = \frac{t_C(6 - \alpha_S + \alpha_T) + (\alpha_S + \alpha_T)(2\gamma_S + \gamma_T)}{6t_C}, \tag{31}$$

$$p_{2C}^{TS*} = 0, \quad p_{2A}^{TS*} = \frac{t_C(6 + \alpha_S - \alpha_T) + (\alpha_S + \alpha_T)(\gamma_S + 2\gamma_T)}{6t_C}, \tag{32}$$

$$x_{1C}^{TS*} = \frac{12t_C^2 + (\alpha_S + \alpha_T)(\gamma_S - \gamma_T)(\gamma_S + \gamma_T) + 2t_C((3 + 2\alpha_S + \alpha_T)\gamma_S - (3 - 2\alpha_S - \alpha_T)\gamma_T)}{6t_C(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}, \tag{33}$$

$$x_{2C}^{TS*} = \frac{12t_C^2 - (\alpha_S + \alpha_T)(\gamma_S - \gamma_T)(\gamma_S + \gamma_T) + 2t_C((3 + \alpha_S + 2\alpha_T)\gamma_T - (3 - \alpha_S - 2\alpha_T)\gamma_S)}{6t_C(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}, \tag{34}$$

$$x_{1A}^{TS*} = \frac{t_C(6 - \alpha_S + \alpha_T) + (\alpha_S + \alpha_T)(2\gamma_S + \gamma_T)}{3(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}, \tag{35}$$

$$x_{2A}^{TS*} = \frac{t_C(6 + \alpha_S - \alpha_T) + (\alpha_S + \alpha_T)(\gamma_S + 2\gamma_T)}{3(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}, \tag{36}$$

$$\Pi_1^{TS*} = \frac{(t_C(6 - \alpha_S + \alpha_T) + (\alpha_S + \alpha_T)(2\gamma_S + \gamma_T))^2}{18t_C(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}, \tag{37}$$

$$\Pi_2^{TS*} = \frac{(t_C(6 + \alpha_S - \alpha_T) + (\alpha_S + \alpha_T)(\gamma_S + 2\gamma_T))^2}{18t_C(4t_C + (\alpha_S + \alpha_T)(\gamma_S + \gamma_T))}. \tag{38}$$

We see that the biggest change of results comes in terms of the effect of an increase in α_S on platforms' profits with sponsored content advertising. Now, as α_S increases, so do the profits (from sponsored content ads) of the platforms. Since the consumers do not pay any price, an increase in α_S does not reduce consumers' price. As a result, the only effect of an increase in α_S is an increase in advertisers' price which in turn increases platforms' profits (recall that when the content is not free for the consumers, α_S does not affect advertisers' price). Furthermore, as long as $\alpha_S \gamma_S > \alpha_T \gamma_T$ (which always holds under the assumption $\alpha_S > \alpha_T$ and $\gamma_S > \gamma_T$), advertisers pay a higher price and platforms earn greater profits under sponsored content ads compared to that under traditional ads. The equilibrium conditions can be easily obtained by comparing the profit differences across different subgames.

B.3 The Case with No Ads

In the main text, we assumed that each platform displays either the traditional ads or the sponsored content ads. In this extension, we analyze the situation where the platforms do not offer either type of ads. In particular, the two competing platforms trade off between choosing the sponsored content ads and the no ads strategy (denoted by N).

When neither platform offers any ad, they compete only in the consumer market. Their profits are given by $\Pi_i^{NN} = p_{iC}^{NN} x_{iC}^{NN}$. The optimal prices and profits are given as follows:

$$p_{1C}^{NN*} = p_{2C}^{NN*} = t_C, \quad \Pi_1^{NN*} = \Pi_2^{NN*} = \frac{t_C}{2}.$$

When both platforms offer the sponsored content ads, they compete in both sides of the market. Their profit functions are given by $\Pi_i^{SS} = p_{iC}^{SS} x_{iC}^{SS} + p_{iA}^{SS} x_{iA}^{SS}$. The optimal prices and profits are given as follows:

$$p_{1C}^{SS*} = p_{2C}^{SS*} = t_C - \alpha_S,\ p_{1A}^{SS*} = p_{1A}^{SS*} = 1 + \gamma_S,\ \Pi_1^{SS*} = \Pi_2^{SS*} = \frac{1 + t_C - \alpha_S + \gamma_S}{2}.$$

When one platform (e.g., platform 1) offers the sponsored content ads and the other platform (e.g., platform 2) offers no ads, they compete in the consumer market. At the same time, the platform offering the sponsored content ads acts as a monopoly in the advertising market. The two platforms' profits are given by $\Pi_1^{SN} = p_{1C}^{SN} x_{1C}^{SN} + p_{1A}^{SN} x_{1A}^{SN}$ and $\Pi_2^{SN} = p_{2C}^{SN} x_{2C}^{SN}$. The optimal prices and profits are given below:

$$\begin{aligned}
p_{1C}^{SN*} &= \frac{(3t_C + \alpha_S\gamma_S)(4t_C + \alpha_S\gamma_S - \alpha_S^2)}{12t_C + 4\alpha_S\gamma_S - \alpha_S^2 - \gamma_S^2}, \\
p_{2C}^{SN*} &= \frac{(6t_C - (\alpha_S - \gamma_S)^2)(2t_C + \alpha_S\gamma_S)}{12t_C + 4\alpha_S\gamma_S - \alpha_S^2 - \gamma_S^2}, \\
p_{1A}^{SN*} &= \frac{(\alpha_S + \gamma_S)(3t_C + \alpha_S\gamma_S)}{12t_C + 4\alpha_S\gamma_S - \alpha_S^2 - \gamma_S^2}, \\
\Pi_1^{SN*} &= \frac{(8t_C - (\alpha_S - \gamma_S)^2)(3t_C + \alpha_S\gamma_S)^2}{(12t_C + 4\alpha_S\gamma_S - \alpha_S^2 - \gamma_S^2)^2}, \\
\Pi_2^{SN*} &= \frac{(2t_C + \alpha_S\gamma_S)(6t_C - (\alpha_S - \gamma_S)^2)^2}{(12t_C + 4\alpha_S\gamma_S - \alpha_S^2 - \gamma_S^2)^2}.
\end{aligned}$$

Clearly, when $\Pi_1^{SS*} \geq \Pi_1^{NS*}$ and $\Pi_1^{SN*} \geq \Pi_1^{NN*}$, both platforms prefer to offer the sponsored content ads, and SS is the dominant outcome. Similarly, we can analyze the competing platforms' trade-off between offering the traditional ads and no ads. When the following conditions are satisfied, NN (neither platform offering any ad) is never going to be the equilibrium:

$$\begin{aligned}
(1 + t_C - \alpha_v + \gamma_v)(12t_C + 4\alpha_v\gamma_v - \alpha_v^2 - \gamma_v^2)^2 - 2(2t_C + \alpha_v\gamma_v)(6t_C - (\alpha_v - \gamma_v)^2)^2 > 0, \\
2(8t_C - (\alpha_v - \gamma_v)^2)(3t_C + \alpha_v\gamma_v)^2 - t_C(12t_C + 4\alpha_v\gamma_v - \alpha_v^2)^2 > 0,\ v \in \{S, T\}.
\end{aligned}$$

In other words, NN is dominated by SS or TT when these conditions are satisfied.