Social Media and the News Industry

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Abstract

This papers explores news providers' choice of quality when they compete in the presence of a monopolistic social network (platform) that strategically decides on the mix of content that its members are exposed to. Consumers are assumed to divide their time between the platform and the news publishers' sites depending on their relative preferences for consuming 'User-Generated Content' (UGC) and professional news, as well as, on the platform's 'content policy' (e.g. the design of its 'newsfeed'). The goal is to assess publishers' incentive to invest in the *quality* of news depending on the platform's optimal newsfeed and the level of competition among publishers. First, we find that, in case of a monopolist publisher, the platform always shows news in its newsfeed. As a result, the equilibrium quality of news rarely increases and only under specific conditions. However, the news publisher is always worse off when the newsfeed integrates news. Next, in a model, where the publisher can opt-out of the newsfeed, news quality is always lower. For consumers, by distorting consumers' optimal consumption mix and by leading to lower quality, the platform tends to decrease overall consumer surplus (there may be exceptions in the special cases when quality increases). In an extensions, we also show that a newsfeed customized to consumer preferences allows the platform to monopolize consumers' attention. In this case, as the publisher's profit declines, again it has less incentive to invest in quality. Finally, under competition, although the quantity of news shown by the platform has a U-shaped effect on quality, in equilibrium, news quality is lower in the presence of the social network.

Keywords: User-Generated Content (UGC), Media Competition, News Quality

1   Introduction

With hundreds of millions of daily active users, a few large social networks have become the dominant online media outlets for most people. The largest among these, Facebook has over 1.7 billion active members across the globe who, on average, spend about an hour each day on the platform. In China, where Facebook is not allowed to operate, Tencent's WeChat, a mobile messaging-based social network represents the dominant medium for about 800 million Internet users. In other parts of Asia, Line, a Korean application similar to WeChat is the most used social network, while most Russians use the social platform VKontakte. Large social networks have considerable monopoly power in their respective geographies due to strong network effects. While some multi-homing occurs, most people predominantly use one platform.

Beyond connecting people and allowing them to share a large variety of content, social networks also act as an important source of news for most of their members. A recent study by the Pew Research Center shows that, in the U.S., over 60% of consumers get at least some of their news on their preferred social network (Gottfried and Shearer, 2016, Mitchell et al., 2017). Allcott and Gentzkow (2017) find consistent numbers highlighting that only about 14% of people use social media as their *"most important"* source of news. Internationally, the Reuters Institute for the Study of Journalism reports that, across 26, mostly developed countries 51% of consumers use social media as a source of news, while about 12% consider it to be their main source.[1] This trend is confirmed by other data published by Parse.ly, which reveals that, since 2015, the primary source of traffic to most news publishers' sites is Facebook (today, about 46% on average), taking over from Google (currently, at around 40%) (Alpert, 2015, Constine, 2016). For some news providers, Facebook's dominance is even more pronounced. For example, Buzzfeed, a leading online publisher valued at close to $1.5 billion derives 75% of its traffic from Facebook. Yet, social networks are not the only online news source for consumers: there is good evidence that "social media *and* news websites are the most common pathways to online news" (Mitchell et al., 2017). Allcott and Gentzkow (2017) also confirm this pattern.

The central question of this paper is: what is the long-term impact of social networks on the quality of news? The question is important because the availability of high quality news is essential for a well-functioning democracy. There has been much debate about the effects of social networks on the news industry. In particular, in relation to the recent U.S. presidential election a lot of discussion focused on the emergence of echo-chambers and fake news on social media. However, evidence as to the importance of these effects compared to the pre-social media world is scarce. A notable exception

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[1]See, Reuters Institute Digital News Report, 2016, University of Oxford.

is Allcott and Gentzkow (2017) who show that fake news on social media could have hardly had an important effect on the election. While our models may have implications for these debates, our central focus is elsewhere. We believe that the more fundamental question is how the increasing dominance of social networks changes the competitive landscape in the news industry and how this leads to changes in news providers' quality choices.

Our basic framework consists of a monopolistic social network and a number of news publishers. Consumers are time-constrained and have heterogeneous preferences for two different content types: (i) news and (ii) user-generated content (UGC). Consumers cannot directly consume their preferred content mix, they can only allocate their time across media firms, i.e. across the social network and publisher(s). We assume that the social network can manipulate the mix of content available on its platform by setting the algorithm of its, so-called 'newsfeed'. For simplicity we assume that the newsfeed algorithm sets the proportion of news content presented to the platform's members. The publisher chooses the level of quality for news. Firms generate revenues from advertising. If news content appears on the social network, then the network and the publisher share the corresponding advertising revenues.

This setup captures the basic characteristics of a social network that essentially acts as an aggregator of content for its members. Of particular importance for these social platforms is UGC, which consists of pictures, posts, music and other forms of content that have generally been created or shared by the user with his/her friends. At the outset, most social networks were setup to allow the sharing of such content between members. However, as social network membership grew to the hundreds of millions and time spent on the platforms started rivaling mainstream media usage, publishers have increasingly sought to reach consumers on social networks - rather than waiting for consumers to logon to their sites, download their apps or reach them via search engines. Similarly, social networks have become interested in presenting professional content on their platform, thereby increasing the total time spent there by consumers. In this context, of central importance to the social network is the careful design of consumers' (often personalized) newsfeed, which is the predominant surface of interaction with the platform. The content policy (i.e. the design) of the newsfeed is central to the platform's value proposition to its members.

It is important to note that we do not explicitly model the differences in the consumption of the two types of content, news and UGC. What matters for our framework is that UGC is a qualitatively different content type from news and that the platform providing it has strong market power, i.e. it is the sole provider of this content. Indeed, due to the strong network effects that characterise the consumption and generation of UGC, social networks tend to be powerful monopolies, generally dominant in the population of large geographic

areas (countries or even continents). For similar reasons, we assume that the quality of UGC is exogenous. In contrast, newspapers - even if dominant in a particular segment - could never become a credible source of UGC content for consumers. On the other hand, they have direct control on the quality of content that they publish. Another aspect of our model that is relevant for our results is that consumers cannot easily remix the kind of content they are offered on the platform and the news providers' websites. They can only decide the amount of time they spend on each site.[2] The newsfeed's "editorial technology" is of central importance in this regard, in that the social network can easily aggregate different types of content in it and consumers cannot easily separate this bundle by content type.

Social networks have tremendous discretion on the design of their newsfeed, whose algorithm is proprietary and complex. Yet, recently (largely due to accusations of left-leaning bias in reporting about the presidential campaign), Facebook has published the broad principles driving its design (Constine, 2016). Not surprisingly, Facebook's overall objective is to keep users happy to maximize the total time members spend on the platform. It has also been confirmed that a particularly important consideration is the relative weight given to UGC and third-party content (including news).[3] In this respect, Facebook has recently made a drastic change to the newsfeed algorithm: it revealed that from June 29, 2016 a much higher weight is given to UGC than before, leading to a substantial drop in traffic for publishers (up to 25-40% for some, according to Filloux, 2016). This anecdotal evidence clearly highlights that social platforms have a major impact on news providers' traffic and associated revenues. Given the dominance of social platforms it is essential to examine their impact on the long-term quality of news.

We start our analysis considering a single publisher. We first show that, even though news generate lower ad revenues than UGC for the platform, the latter finds it optimal to show news stories to its users. Indeed, by doing so, the platform attracts more of the attention of consumers who have a strong taste for news, and who would otherwise spend more time on the newspaper's website. Interestingly, the fact that the platform distorts consumers' optimal UGC-news bundle may lead to over-consumption of news, in some cases, forcing some "news drop-outs" to read news. We then discuss how news showing by the platform affects the newspaper, including its incentive to provide quality. Because the newspaper benefits from consumers reading news through the platform, competition to attract attention is softened. On the other hand, traffic to the newspaper's website may become more sensitive to quality, potentially offsetting the softening effect. We provide

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[2]If such remixing would be possible, then social networks would have no effect on newspapers' competition and the associated choice of quality.

[3]Evidently, changes to these weights is critical to news providers as was made clear by a coding glitch that occurred on May 1, 2015 at a previous adjustment of the newsfeed algorithm, which cut popular news sites completely off Facebook (Alpert, 2015).

conditions on the model's primitive for either effect to dominate. Regarding profits, we show that the newspaper is unambiguously worse-off compared to a benchmark where the platform cannot show news.

We next examine a number of extensions to the basic model. Given the adverse effect of including news in the newsfeed on newspaper profits, we study the possibility of opting out by the newspaper. We show that the platform offers a contract to the newspaper that makes the newspaper indifferent. However, equilibrium quality is lower than under the benchmark where the platform cannot show news. Next, we examine the case when the platform can offer personalized newsfeed to consumers. This case is relevant as in practice the newsfeed is indeed personalized, albeit imperfectly. We show that perfect personalization allows the platform to monopolize consumers' attention. The newspaper's incentives to invest in quality are, again, unambiguously lower in this case.

Having studied a model of "inter-competition" between the platform and a monopolist newspaper, we next turn to a model of "intra-competition", where two newspapers invest in quality to gain market shares, but where total demand for news is fixed (i.e. news and UGC are not substitutes). In such a model, even though the quantity of news showed by the platform has a U-shaped effect on quality, in equilibrium, quality and newspapers' profits are lower than under the benchmark where the platform does not show news. Overall, exploring a variety of scenarios, our models indicate that the presence of dominant social networks exerts a strong downward force on the equilibrium quality of news. This result tends to contradict previous research on news aggregators, whose presence is predicted to increase news quality.

The paper is organized as follows. In the next section, we review the relevant literature. The model section starts with the consideration of a benchmark, that of a "passive" social network that only hosts UGC. Next, we build a model with endogenous newsfeed. We consider a variety of extensions, including the possibility of opting out by the newspaper, personalized newsfeed and the case of competition between content providers. The paper ends with a general discussion and concluding remarks.

2   Relevant literature

The paper is related to a number of literature streams, first, and foremost to the broadening literature on news/media "aggregators". As in our paper, the central question is how these intermediaries impact the consumption of news as well as the quality of content produced. For example, Jeon and Nasr (2016) consider a model with horizontal and vertical differentiation between newspapers that choose the quality of news on multiple

issues. The aggregator is modeled as an exogenous process that helps consumers discover quality news items. They identify the main trade-off faced by newspapers, namely the relative impact of the aggregator's business-stealing effect and demand-expansion effect, and predict that the presence of an aggregator leads newspapers to increase their quality investments. In earlier work Dellarocas, Katona, and Rand (2013) come to a similar conclusion using a model where the aggregator emerges endogenously in a model where sites can link to each others' content.[4] Importantly, this body of research argues that the quality of news is likely to increase as the presence of aggregators provides a strong incentive to (over)invest in quality. Our results show the opposite.

A recent group of empirical papers examine the impact of aggregators on the news industry. Using disputes between Google News and Spanish publishers (Athey, Mobius, and Pal (2017), Calzada and Gil (2016)) or the Associated Press (Chiou and Tucker (2015)), empirical research finds that Google News increases overall news consumption. In particular, Athey, Mobius, and Pal (2017) document that this effect is mostly present for small publishers, who cannot rely on brand recognition to attract users and therefore benefit most from the aggregator. In relation to the theoretical work on aggregators, these papers suggest that the demand-expansion effect of aggregators dominates. We find a similar effect: the social platform tends to increase the aggregate consumption of news. However, we find that publishers are always worse off as they cannot capture enough of this demand to compensate for the lost consumer attention on their sites.

Our work focuses on social networks as news intermediaries, the major difference being that these platforms also host user-generated content (UGC) that directly competes with the content of publishers. This is relevant because, increasingly, it is such platforms (as opposed to search engines) that generate traffic to news content. In this sense, the paper is similar to de Cornière and Taylor (2014), where a publisher's content might be neglected by a search engine that favours its own content for display. That model is tailored to the search context and does not consider quality choice by publishers. Theoretical research on UGC and social networks specifically is scarce. There is a sizable literature focusing on network formation; see, for example Bala and Goyal (2000) and Jackson and Wolinsky (1996) for earlier models, and Jackson (2010) for a good summary. Zhang and Sarvary (2015) model competition between social platforms by highlighting the impact of *local* network effects, which may lead to a fragmented membership base resonating to current discussions on isolated member groups (echo chambers) on the same network. Our work does not consider the formation of, or the competition between social networks. Instead,

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[4]See also Rutt (2011) who focuses on newspapers' revenue models and finds that increased competition among news providers increases the advertising-based (as opposed to subscription-based) revenue model and also leads to higher equilibrium content quality.

we assume a monopolistic platform with a given audience and the platform only decides on what content mix to serve to its members.[5]

Finally, our framework assumes multi-homing but we abstract away from the core concern of the multi-homing literature, namely that it may lead to inefficient (duplicate) advertising when an advertiser is present on multiple publishers (see, Ambrus, Calvano, and Reisinger (2014), Athey, Calvano, and Gans (2017), and Anderson, Foros, and Kind (2016) for a detailed treatment of this issue). As Alaoui and Germano (2016), we also assume that consumers are time constrained in their consumption of media and our results resonate to theirs in that competition between content suppliers (including the social network) distort consumers' media consumption. However, we focus on consumers' time allocation across qualitatively different content providers and we abstracts away from the editorial process of publishers when multiple topics are present. Interestingly, in our framework, multi-homing does *not* result in increased competition (or less differentiation) and actually softens competition in many cases. This softening of competition contributes to the decrease in the equilibrium quality of news.

3 The model

We consider a model where a social platform (indexed by 0) and a news publisher (or newspaper, indexed by 1) compete for consumers attention.

3.1 Content types, distribution and advertising

There are two types of content. (1) News content is exclusively produced by the newspaper, and is costly to produce: the newspaper incurs a cost $c(q)$ to produce content of quality q. (2) Social content, or user-generated content (UGC), is produced by the users of the social platform. We assume that the platform does not incur any cost to produce UGC, and that the quality of UGC is exogenous.

The platform offers a mix of content to its users. On the one hand they are exposed to UGC, but on the other hand they can also see news stories from the publisher that other platform users have shared. The decision about the relative prominence of each type of content is made by the platform, through the choice of a *newsfeed algorithm*. We capture the design of the newsfeed algorithm by assuming that the platform chooses a share λ of its content devoted to news: when a consumer allocates t units of attention to the platform, his consumption of news on the platform is λt, and his consumption of UGC is

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$(1 - \lambda)t$. Each unit of attention spent on the platform generates an advertising revenue of 1. However, while the platform can capture the whole revenue associated with consumption of UGC, it can only get a fraction ϕ of the revenues associated to news consumption on the platform, and the publisher receives the remaining $1 - \phi$ share of revenue.

The newspaper has a website, which only shows news stories. As for the platform, direct traffic to this website generates advertising revenues, which we normalize to 1 per unit of time spent on the website. However, this revenue is entirely captured by the newspaper. Therefore, if a consumer allocates t units of attention to the platform, and $1 - t$ units of attention to direct traffic the publisher, and if the newsfeed parameter is λ, the platform's revenue from this consumer is $t\,(1 - \lambda + \lambda\phi)$, and the publisher's revenue is $1 - t + t\lambda(1 - \phi)$.

3.2 Preferences and demand for content

Consumers derive utility from consuming a quantity of news x and a quantity of UGC y, and have heterogeneous preferences. The utility function of a consumer of type θ is $U(x, y, q, \theta)$, increasing in both x and y and continuously differentiable everywhere. The type θ captures the relative preference for news: $\frac{\partial^2 U}{\partial x \partial \theta} \geq 0$. The quality of news q also affects the marginal value of news consumption: $\frac{\partial^2 U}{\partial x \partial q} \geq 0$. However, the effect of quality of news is decreasing with q: $\frac{\partial^3 U}{\partial x \partial q \partial q} < 0$. At this point, we impose no restriction on the sign of $\frac{\partial^3 U}{\partial x \partial q \partial \theta}$. If positive, consumers with a stronger preference for news (high θ) see their marginal utility from news increase more than the low types when quality increases.

Consumers have an *attention constraint*: $x + y \leq 1$. For a given quality q, a type θ consumer's desired news consumption $\hat{x}(\theta, q)$ is the solution to

$$\max_{x,y} U(x, y, q, \theta) \quad \text{s.t} \quad x \geq 0, \quad y \geq 0 \quad \text{and} \quad x + y \leq 1.$$

From our assumptions, $\hat{x}(\theta, q)$ is increasing in both its arguments, and concave in q. $\hat{y}(\theta, q) = 1 - \hat{x}(\theta, q)$ is the desired consumption of UGC.

We assume that θ is a consumer's private information,[6] distributed according to a continuous c.d.f. F, of density f, on a support $[\underline{\theta}, \overline{\theta}]$. For simplicity we assume that the distribution of types has no atoms.

We stress that preferences are over the *content* that consumers read, not over which *media* (platform or newspaper's website) they get it from. We assume that consumers can

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[6]Later, we explore the implications of relaxing this assumption.

choose freely how they allocate their attention between the platform and the newspaper, but, when on the platform, they consume the mix offered by the platform. We denote by t the decision of how much time to spend on the platform.

Examples For the sake of illustration, we will sometimes use the following functional forms for $\hat{x}(\theta, q)$: (i) in the *additive example*, $\hat{x}(\theta, q) = \theta + q$. An increase in quality has the same *absolute* effect on desired news consumption for all consumer types ($d\hat{x}/dq = 1$).[7] (ii) In the *multiplicative example*, we have $\hat{x}(\theta, q) = \theta q$. Here, high quality has a larger absolute effect on high types. However, the *relative* effect is constant across types ($(d\hat{x}/dq)/\hat{x} = 1/q$).

3.3 Timing and equilibrium

The timing is as follows: at $\tau = 1$, the newspaper chooses a quality q, publicly observed, and incurs the cost $c(q)$. At $\tau = 2$, the platform chooses the newsfeed design parameter λ, publicly observed. At $\tau = 3$, consumers choose $t(\theta, q, \lambda)$, the time they spend on the platform as a function of their type, of the quality and of the newsfeed design. We look for subgame perfect equilibria.

4 Equilibrium analysis

4.1 Benchmark: UGC-only newsfeed

As a benchmark, we start with the case in which the platform does not have the ability to show news content from the newspaper to its users ($\lambda = 0$).

After observing q, consumers choose how much attention to allocate to the platform and to the newspaper. Because the platform only offers UGC, and there are no cost associated to switching from one media to the next, consumers can consume their desired basket of content. A consumer of type θ spends $\hat{x}(\theta, q)$ (if this is less than one) on the newspaper site, and $1 - \hat{x}(\theta, q)$ on the platform. The total time spent on the newspaper's website is therefore

$$T_1(q, \lambda)|_{\lambda=0} = \int_{\underline{\theta}}^{\overline{\theta}} \min\{\hat{x}(\theta, q), 1\} dF(\theta). \tag{1}$$

The optimal quality for the newspaper, denoted $q_\emptyset$, is the solution to $\max_q R_1(q, 0) - c(q)$, that is $q_\emptyset$ solves:

$$\frac{\partial T_1(q_\emptyset, 0)}{\partial q} = c'(q_\emptyset). \tag{2}$$

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[7]If the support of θ is such that $\theta + q > 1$ for some θ, we take $\hat{x}(\theta, q) = \min\{\hat{x}(\theta, q), 1\}$, in which case the absolute effect on high types is smaller.

We now turn to the analysis of the game where the platform can freely choose λ, and proceed by backward induction.

4.2 Consumers: optimal allocation of attention

If news quality is q, a consumer of type θ would like to consume a quantity $\hat{x}(\theta, q)$ of news. By spending t units of time on the platform, and $1 - t$ on the newspaper, he gets a quantity of news, $x(t, \lambda) = t\lambda + (1 - t)$ and a quantity of UGC, $y(t, \lambda) = t(1 - \lambda)$.

If $\lambda \geq \hat{x}(\theta, q)$, the consumer's demand for news is more than satisfied by the platform alone. Such a consumer then decides to spend all his time on the platform, $t(\theta, q, \lambda) = 1$. Consumers such that $1 > \hat{x}(\theta, q) > \lambda$ can reconstitute their optimal content mix by spending $t(\theta, q, \lambda)$ on the platform such that

$$t(\theta, q, \lambda)(1 - \lambda) = 1 - \hat{x}(\theta, q) \Leftrightarrow t(\theta, q, \lambda) = \frac{1 - \hat{x}(\theta, q)}{1 - \lambda}.$$

Finally, if $\hat{x}(\theta, q) \geq 1$, the consumer allocates all his attention to the newspaper, that is $t(\theta, q, \lambda) = 0$.

We denote by $\hat{\theta}_1(q, \lambda)$ the solution to $\hat{x}(\theta, q) = \lambda$, i.e. the largest type who does not visit the newspaper, and by $\hat{\theta}_2(q)$ the solution to $\hat{x}(\theta, q) = 1$, i.e. the smallest type who does not visit the platform. We sometimes omit the arguments and simply write $\hat{\theta}_1$ and $\hat{\theta}_2$. Summarizing, we obtain Lemma 1 below.

Lemma 1. (*Optimal allocation of attention*) *When the newspaper is of quality q and the platform shows a share λ of news content in the newsfeed, a consumer of type θ allocates a share $t(\theta, q, \lambda)$ of his attention to the platform, where*

- $t(\theta, q, \lambda) = 1$ *if $\theta \leq \hat{\theta}_1$,*

- $t(\theta, q, \lambda) = \frac{1 - \hat{x}(\theta, q)}{1 - \lambda}$ *if $\theta \in \left(\hat{\theta}_1, \hat{\theta}_2\right)$,*

- $t(\theta, q, \lambda) = 0$ *if $\theta \geq \hat{\theta}_2$.*

Discussion   In the benchmark where $\lambda = 0$, consumers allocate a share $\hat{x}(\theta, q)$ of their attention to the newspaper. When $\lambda > 0$, that share is lower, because part of the demand for news is already satisfied by visiting the platform. More generally, any increase in λ shifts attention from the newspaper to the platform, a point we elaborate on when we discuss the choice of λ. While this effect does not directly affect consumers such that $\theta > \hat{\theta}_1$, whose consumption of news is still $\hat{x}(\theta, q)$, it introduces a consumption distortion on lower types, who, even though they stop visiting the newspaper, end up consuming too

much news (λ) relative to what they would like, that is $\hat{x}(\theta, q)$. It is important to see that "too much news" does not mean that consumers are forced to consume news content that brings them negative utility. They enjoy the news content, but would prefer UGC instead.

4.3   Platform: design of the newsfeed

Suppose that news quality is q. If the platform displays a share λ of news content in its newsfeed, the total amount of attention that it receives is

$$T_0(q, \lambda) = \int_{\underline{\theta}}^{\bar{\theta}} t(\theta, q, \lambda) dF(\theta). \tag{3}$$

Each unit of attention generates a revenue $(1 - \lambda + \lambda\phi)$, so that the platform's profit is $\pi_0(q, \lambda) = (1 - \lambda + \lambda\phi)T_0(q, \lambda)$.

The platform's trade-off is the following: by showing more news content (increasing λ), the platform can receive more of the consumers' attention, by the logic discussed in the previous subsection. However, showing more news leads to lower advertising revenue per-unit of attention. The next proposition is our first main result:

Proposition 1. *Assume F has no atom. The platform always shows some news content: $\lambda^* > 0$.*

Proof. The derivative of the platform's profit with respect to λ is

$$\frac{\partial \pi_0(q, \lambda)}{\partial \lambda} = -(1 - \phi)T_0(q, \lambda) + (1 - \lambda(1 - \phi))\frac{\partial T_0(q, \lambda)}{\partial \lambda}. \tag{4}$$

Using Lemma 1 and equation (3), we have

$$\frac{\partial T_0(q, \lambda)}{\partial \lambda} = \frac{\partial \hat{\theta}_1}{\partial \lambda} f(\hat{\theta}_1) - \frac{\partial \hat{\theta}_1}{\partial \lambda} \underbrace{\frac{1 - \hat{x}(\hat{\theta}_1, q)}{1 - \lambda}}_{=1} f(\hat{\theta}_1) + \int_{\hat{\theta}_1}^{\hat{\theta}_2} \frac{1 - \hat{x}(\theta, q)}{(1 - \lambda)^2} dF(\theta). \tag{5}$$

Evaluating the derivative of the profit at $\lambda = 0$, we thus get

$$\frac{\partial \pi_0(q, 0)}{\partial \lambda} = \phi T(q, 0) - F\left(\hat{\theta}_1(q, 0)\right). \tag{6}$$

By our assumption that $\hat{x}(\theta, q) > 0$ for all $\theta > \underline{\theta}$, we have $\hat{\theta}_1(q, 0) = \underline{\theta}$. Because F is atomless, we thus obtain $\frac{\partial \pi_0(q,0)}{\partial \lambda} = \phi T(q, 0) > 0$. This proves the result.   ∎

Discussion   The intuition for Proposition 1 is the following. When $\lambda = 0$, consumers get all their news from the publisher. By slightly increasing λ, the platform displaces part of this news consumption towards itself, thereby increasing the attention it receives,

attention valued at ϕ. The potential cost of doing so is to show news to some users who would have preferred to see UGC. Because λ is very small, this effect is negligible. The result is sensitive to our assumption that the mass of consumers who want to consume no news is zero. Indeed, if such a mass was large enough, the cost of serving news instead of UGC to these "news drop-outs" could overcome the benefit from increased attention by news consumers. However, note that the result also holds for F with a small enough atom. In this case, for given quality, the platform reduces the number of news drop-outs. In general, for given quality, total news consumption increases. This may not necessarily hold in equilibrium though as total consumption of news may decrease compared to the benchmark case if the newspaper's quality is lower.

Examples To better understand some of the forces that determine the optimal choice of λ, we use our additive and multiplicative models, assuming that the distribution of types is uniform on $[0, 1]$. In the additive model (when $\hat{x}(\theta, q) = \theta + q$), we find that $\lambda^*(q) = q + \frac{\phi}{2(1-\phi)}$. Here, an increase in the quality of news shifts' every consumer's demand for news upwards (except for those with a demand for news already close to 1). Because the minimal demand for news in the population is q, it is always profitable for the platform to show at least a share q of news. Above this level, the profitability of showing more news depends on ϕ, the share of advertising revenues that accrues to the platform when it shows news.

In the multiplicative model (when $\hat{x}(\theta, q) = \theta q$), we find that the optimal λ does not depend on q: $\lambda^* = \frac{\phi}{2(1-\phi)}$. Here, an increase in q mostly affects the demand for news of the high types. While it would make sense for the platform to show more news to cater to these consumers, doing so would impose a large distortion on the low types, and force the platform to forgo too much advertising revenue.

4.4   Effects on the newspaper

4.4.1   Effect of newsfeed (λ^*) on news quality

Besides understanding the strategic incentives of the platform to provide news content to its users, one of our main interests is to assess the effects of such practice on the news industry, i.e. on newspaper's profit and choice of quality. The newspaper's profit is

$$\pi_1(q, \lambda) = T_1(q, \lambda) + (1 - \phi)\lambda T_0(q, \lambda) - c(q) \equiv R_1(q, \lambda) - c(q),$$

where $R_1(q, \lambda)$ denotes the newspaper's advertising revenues, which we assume is concave in q.[8] Similarly, define $R_0(q, \lambda) \equiv (1 - \phi(1 - \lambda))T_0(q, \lambda)$, which represents the platform's

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[8]Concavity holds either in the additive or the multiplicative models with uniform distribution of types.

revenues. Notice that $R_0(q, \lambda) + R_1(q, \lambda) = T_0(q, \lambda) + T_1(q, \lambda) = 1$ for any (q, λ).

Acting as a Stackelberg leader, the newspaper knows that the platform will choose $\lambda = \lambda^*(q)$. Its objective function is thus

$$\pi_1(q, \lambda^*(q)) = R_1(q, \lambda^*(q)) - c(q) = 1 - R_0(q, \lambda^*(q)) - c(q).$$

Because $\lambda^*(q)$ maximizes $R_0(q, \lambda)$, the envelope theorem implies that $\frac{d\pi_1(q,\lambda^*(q))}{dq} = \frac{\partial\pi_1(q,\lambda^*(q))}{\partial q}$. Using the notation $\lambda^* = \lambda^*(q^*)$, the newspaper's first-order condition writes

$$(1 - (1 - \phi)\lambda^*)\frac{\partial T_1(q^*, \lambda^*)}{\partial q} = c'(q^*). \tag{7}$$

Comparing (2) and (7), one can distinguish two effects of the platform's showing news. First, the value of a marginal increase in attention spent on the newspaper's website is now $1 - (1 - \phi)\lambda^*$ instead of 1. Indeed, consumers who allocate one unit of attention to the platform are still going to be exposed to a share λ^* of news, and the newspaper receives a share $1 - \phi$ of revenues from such indirect attention. This softens competition and tends to reduce the incentive to invest in quality.

The second effect is a change in the sensitivity of direct traffic (T_1) with respect to q, from $\frac{\partial T_1(q,0)}{\partial q}$ to $\frac{\partial T_1(q,\lambda^*)}{\partial q}$. This effect can itself be decomposed in two: (i) consumers who multi-home (i.e. such that $\theta \in (\hat\theta_1, \hat\theta_2)$) become more sensitive to a change in q as λ increases ($t^*(\theta, q, \lambda) = \frac{\hat x(\theta,q)-\lambda}{1-\lambda}$ and thus $\partial t^*/\partial q = \frac{\partial \hat x}{\partial q}\frac{1}{1-\lambda}$); (ii) there are fewer multi-homers when λ increases ($\hat\theta_1$ increases as well).[9]

Examples In the additive model (when $\hat x(\theta, q) = \theta + q$) with uniform distribution of types over $[0, 1]$, we have $T_1(q, \lambda) = q + \frac{1-\lambda}{2}$. The second effect above is thus mute ($\frac{\partial^2 T_1(q,\lambda)}{\partial q \partial \lambda} = 0$), and equilibrium quality is lower than under the benchmark where the platform does not show any news content.

In the multiplicative model (when $\hat x(\theta, q) = \theta q$), we have $T_1(q, \lambda) = \frac{1-\lambda}{2q}$, and therefore $\frac{\partial^2 T_1(q,\lambda)}{\partial q \partial \lambda} > 0$: direct attention is more sensitive to quality when the platform shows some news, and the two effects thus go in opposite directions. More generally, when $\hat x(\theta, q) = \theta + q + \gamma\theta q$, with $\gamma \in (-1, 1)$, we have $T_0(q, \lambda) = \frac{1-\lambda+2(1+\gamma)q}{2+2\gamma q}$. Thus $\frac{\partial^2 T_1(q,\lambda)}{\partial q \partial \lambda}$ is of the same sign as γ. If increased quality mostly affect low types' demand for news ($\gamma \leq 0$), then equilibrium quality is lower when the platform shows news. In the case where quality mostly affects high types' demand ($\gamma > 0$) it is possible for quality to increase compared

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[9]These two effects can be seen in the following cross-derivative: $\frac{\partial^2 T_1(q,\lambda)}{\partial q \partial \lambda} = -\frac{\partial \hat\theta_1(q,\lambda)}{\partial \lambda}\frac{\partial n(\hat\theta_1,q)}{\partial q}\frac{1}{1-\lambda}f(\hat\theta_1(q, \lambda)) + \int_{\hat\theta_1(q,\lambda)}^{\hat\theta_2(q)} \frac{\partial \hat x(\theta,q)}{\partial q}\frac{f(\theta)}{(1-\lambda)^2}d\theta$.

to the benchmark, provided ϕ is high enough (i.e. the newspaper does not get much from indirect traffic).

4.4.2 Effect on newspaper profits

Proposition 2. *When the platform can show some news, the newspaper's profit decreases.*

Proof. Because λ is chosen optimally by the platform, we have, for any q, $R_0(q, \lambda^*(q)) > R_0(q, 0)$. This is true in particular for $q = q^*$: $R_0(q^*, \lambda^*) > R_0(q^*, 0)$. Since $R_0(q, \lambda) + R_1(q, \lambda) = 1$, the previous inequality rewrites $R_1(q^*, \lambda^*) < R_1(q^*, 0)$. Substracting $c(q^*)$ from each side, we get $\pi_1(q^*, \lambda^*) < \pi_1(q^*, 0)$. By revealed preferences, we know that $\pi_1(q^*, 0) \leq \pi_1(q^\emptyset, 0)$, which implies that $\pi_1(q^\emptyset, 0) > \pi_1(q^*, \lambda^*)$. ∎

Discussion Even though news showing by the platform sometimes softens competition and increases total news consumption, it never benefits the newspaper. The reason is that λ is chosen optimally by the platform to increase its revenue, which mechanically reduces the newspaper's revenue. The potential saving on costs is never enough to compensate this loss.

While the analysis presented so far sheds light on some consequences of the platform's strategy when the newspaper cannot control the availability of its content through the platform (which might correspond to users copying and pasting the url of news stories), the fact that the newspaper is unambiguously worse-off compared to the benchmark raises the question of what would happen if it could restrict access to its content by the platform. We now turn to this question.

5   Possibility of newspaper opting out

Suppose that the newspaper can decide to opt-out from its content being linked to by the platform. We now allow the platform to offer a contract at the beginning of the game. Absent such a possibility of contracting ex ante, the newspaper would always opt-out from Proposition 2. A contract takes the form (λ, ϕ): a share of news from the newspaper appearing on the platform, and a revenue sharing agreement ϕ (ϕ is the share accruing to the platform).[10]

The timing is the following: At $t = 1$ the platform offers a contract (λ, ϕ) to the newspaper. The newspaper accepts or rejects the offer. At $t = 2$ the newspaper chooses its quality q. At $t = 3$ consumers observe q and λ and allocate their attention optimally (according to Lemma 1).

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[10]An alternative way of contracting would be to have an ex ante transfer from the platform to the newspaper. We focus on revenue-sharing agreements because they are more often used in practice.

Proposition 3. *Suppose that the newspaper can opt-out. Then the platform offers a contract that is accepted in equilibrium. Compared to the benchmark where the platform does not show news, news quality is lower.*

Proof. Suppose that the newspaper accepts a contract (λ, ϕ). It then chooses q so as to maximize $R_1(q, \lambda, \phi) - c(q)$. Let $\hat{q}(\lambda, \phi)$ be the quality chosen by the newspaper, and $\hat{\pi}_1(\lambda, \phi)$ the newspaper's profit. $\hat{\pi}_1(\lambda, \phi)$ is a continuous and decreasing function of ϕ (from the envelope theorem). Let $\hat{\pi}_0(\lambda, \phi)$ be the associated platform's profit.

We use the superscript $\emptyset$ to designate the equilibrium strategies and payoffs when the newspaper opts-out (i.e. the benchmark equilibrium, see subsection 4.1).

Claim 1: The set $\{(\lambda, \phi) | \hat{\pi}_i(\lambda, \phi) > \pi_i^{\emptyset} \quad \text{for } i = 1, 2\}$ is non-empty.

Proof: To prove this, we start from $(\lambda, \phi) = (1, R_0^{\emptyset})$. We use the tie-breaking rule that if $\lambda = 1$ (i.e. the platform only shows news), people spend all their time on the platform.[11] We have $R_0(1, R_0^{\emptyset}) = R_0^{\emptyset}$. We also have $R_1(1, R_0^{\emptyset}) > R_1^{\emptyset}$. Indeed the newspaper gets the same revenue $R_1^{\emptyset}$ but saves on costs because $\hat{q}(1, \phi) = 0$ for any ϕ (there is no point investing in quality since there is no competition when $\lambda = 1$). Now, since $\pi_0(\lambda, \phi)$ and $\pi_1(\lambda, \phi)$ are respectively increasing and decreasing in ϕ, for η positive but small enough, we have $\hat{\pi}_i(1, R_0^{\emptyset} + \eta) > \pi_i^{\emptyset}$. Q.E.D.

By Claim 1, we know that there exist contracts that Pareto dominate opt-out, and therefore in equilibrium the newspaper will not opt-out. Let $(\hat{\lambda}, \hat{\phi})$ be the contract that maximizes the platform's profit. This contract necessarily strictly dominates the opt-out profit for the platform: omitting the arguments $(\hat{\lambda}, \hat{\phi})$, we have $\hat{\pi}_0 > \pi_0^{\emptyset}$, i.e. $\hat{R}_0 > R_0^{\emptyset}$. Because $R_0 + R_1 = 1$, this implies that $\hat{R}_1 < R_1^{\emptyset}$. Moreover, for the newspaper to accept, it must be that $\hat{\pi}_1 \geq \pi_1^{\emptyset}$. If the contract lowers revenues for the newspaper without lowering profits, it must be that the cost, i.e. the quality, is reduced. ∎

Discussion Intuitively, the contracting stage allows the firms to increase their joint profit. Given that the total revenue is constant, profits go up if and only if costs go down.

The assumption that news is exclusively produced by one newspaper is a strong one. In practice, when consumers can get news from more than one source, opting out is less likely to be a plausible threat, as removing its content from the platform would have a small effect on direct traffic to a newspaper's website. The situation can then be thought of as a prisoner's dilemma, where newspapers would collectively be better-off opting out of

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[11]Without this tie-breaking rule we would set $\lambda = 1 - \epsilon$ with ϵ arbitrarily close to zero and get the same result.

the platform, but where each newspaper has an incentive to opt-in. We do not formalize this argument, but turn to the study of competition between newspapers in section 7.

6 Personalized newsfeed

In the previous analysis, the platform does not have the ability to customize the mix of content it offers to each consumer. In practice however, a firm like Facebook offers different mixes to different users, leveraging the considerable amount of data it has gathered about them. We now introduce personalization to our model by assuming that the platform can observe consumers' types and can condition λ on both q and θ.

The timing is thus as follows: at $\tau = 1$, the newspaper chooses q. At $\tau = 2$ the platform observes q and θ, and chooses $\lambda(\theta, q)$. At $\tau = 3$, consumers optimally allocate their attention between the newspaper and the platform. Let $\hat{q}$ be the equilibrium quality in this case. We have the following proposition:

Proposition 4. *When the platform can personalize the newsfeed:*

 1. *The platform chooses $\lambda(\theta, q) = \hat{x}(\theta, q)$.*

 2. *Consumers allocate all their attention to the platform.*

 3. *News quality is lower than under the benchmark: $\hat{q} < q^{\emptyset}$.*

Proof. Given θ and q, the platform clearly wants to offer $\lambda(\theta, q) = \hat{x}(\theta, q)$: showing less news would induce the consumer to allocate some of his attention to the newspaper, while consuming the same amount of UGC. Showing more news would not increase the time spent on the platform, but would reduce the profitability of this time. Consumers then find it optimal to allocate all their attention to the platform.

To see that quality is lower than under the benchmark, note that, for a given q, the overall consumption of news is $\int \lambda(\theta, q)dF(\theta) = \int \hat{x}(\theta, q)dF(\theta) = T_1(q, 0)$ (see expression (1)). Because all the news consumption occurs on the platform, the newspaper's profit is then $(1 - \phi)T_1(q, 0) - c(q)$. The marginal return to investment is lower than under the benchmark. ∎

Discussion Perfect personalization allows the platform to monopolize consumers' attention, turning the newspaper purely into a content supplier to the platform. For a given quality level q, consumers' utility is maximized. However, by lowering the returns to investment compared to the benchmark, this leads to a decreased quality of news.

The assumption of perfect personalization allows us to get a clean result, but is a strong one. An alternative way to model personalization would be to assume that the platform can partition its customers into subgroups. For instance, suppose that the interval is partitioned into K intervals $I_k = [\theta_{k-1}, \theta_k)$, with $\underline{\theta} = \theta_0 < \theta_1 < ... < \theta_K = \overline{\theta}$. The platform only observes which interval I_k each consumer belongs to. Then for each interval the platform chooses a λ_k. For each interval I_k, the analysis of consumers' behaviour as well as of the platform's newsfeed design mirrors that of subsections 4.2 and 4.3. As K goes to infinity, we would converge to perfect personalization.

7   Competing newspapers

We now turn our attention to a situation in which the news market is competitive. More specifically, we assume that there are two newspapers, $i \in \{1, 2\}$, of quality q_i, and a platform which shows a mix of UGC and news content taken from the two newspapers. Consumers have a taste for diversity for news content, and can multi-home between the three websites. We make two further simplifying assumptions: (i) All consumers have the same preferences between the two newspapers, (ii) news quality only affects the relative preferences between the newspapers, not the relative preferences between news and UGC. Formally, these assumptions translate into the following: a consumer of type θ would like to allocate a share θ of his attention to news content, of which $s_i(q_i, q_j)\theta$ units of attention should go to newspaper i. We assume that s_i, is increasing in q_i and decreasing in q_j, and such that $s_i(q_i, q_j) - c(q_i)$ is concave in q_i.

In this context, whatever value of λ the platform chooses, a share s_i of this should come from newspaper i. Indeed, for a given λ, if the platform were to show $\lambda\sigma_i > \lambda s_i$ news from i, it could increase the time spent on the platform by slightly decreasing σ_i without changing its per-unit-of-attention revenue.

7.1   Consumers' allocation of attention

Given that news showed on the platform reflect the desired shares s_1 and s_2, consumers regard news on the platform as a perfect substitute to news obtained from direct traffic. Consumers such that $\theta \leq \lambda$ want to consume more UGC than what the platform is offering. Therefore they allocate all their attention to the platform, $t^*(\theta, \lambda) = 1$, and end up consuming too much news. Consumers with $\theta > \lambda$ optimally choose $t^*(\theta, \lambda) = \frac{1-\theta}{1-\lambda}$ and consume their ideal mix.

The total traffic to the platform is independent of q_1 and q_2 and writes

$$T_0(\lambda) = \int t^*(\theta, \lambda) dF(\theta). \tag{8}$$

7.2 Firms' actions

Platform   From (8), one sees that the optimal λ does not depend on q_1 and q_2. Let λ^* be the solution to $\max_\lambda T_0(\lambda)(1 - \lambda + \lambda\phi)$.

Newspapers   Given that λ^* is independent of q_1 and q_2, newspapers take it as given when choosing their quality. Let $T_N(\lambda) = 1 - T_0(\lambda)$ be the total time spent on newspapers' websites. The profit of newspaper i writes

$$\pi_i(q_i, q_j, \lambda) = s_i(q_i, q_j) \left(T_N(\lambda) + (1 - \phi)\lambda T_0(\lambda) \right) - c(q_i). \tag{9}$$

Let $q^*(\lambda)$ be the symmetric equilibrium quality when the platform chooses λ, and $R_N(\lambda) \equiv T_N(\lambda) + (1 - \phi)\lambda T_0(\lambda)$ the total revenue of the news industry.

Proposition 5. *Compared to the benchmark with $\lambda = 0$, (i) equilibrium news quality decreases when the platform shows news: $q^*(\lambda^*) \leq q^*(0)$; (ii) newspapers' profits also decrease.*

Proof. Part (i) of Proposition 5 follows from the following two lemmas.

Lemma 2. *$q^*(\lambda) \geq q^*(\lambda')$ if and only if $R_N(\lambda) \geq R_N(\lambda')$.*

Proof of Lemma 2: The best-response of newspaper i is given by $\frac{\partial s_i(q_i,q_j)}{\partial q_i} R_N(\lambda) - c'(q_i) = 0$. One can readily check that $dq_i/dR_{N(\lambda)>0}$, i.e. an increase in $R_N(\lambda)$ shifts out the reaction functions. Because, by symmetry, the reaction functions intersect on the 45° line, the equilibrium quality is necessarily higher.[12] Q.E.D.

Lemma 3. *$R_N(\lambda^*) \leq R_N(0)$.*

Proof of Lemma 3: The platform's profit is $\pi(\lambda) = T_0(\lambda)(1 - \lambda(1 - \phi)) = 1 - R_N(\lambda)$. By revealed preferences, $\pi(\lambda^*) \geq \pi(0)$, i.e. $R_N(\lambda^*) \leq R_N(0)$. Q.E.D.

To show part (ii) of the proposition, note that $R_N(\lambda^*) \leq R_N(0)$ implies that:

$$\pi_i(q^*(\lambda^*), q^*(\lambda^*), \lambda^*) = s_i(q^*(\lambda), q^*(\lambda))R_N(\lambda^*) - c(q^*(\lambda^*)) \leq s_i(q^*(\lambda), q^*(\lambda))R_N(0) - c(q^*(\lambda^*)).$$

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[12]Absent symmetry, a shift out of the reaction functions does not guarantee that equilibrium quality increases, unless the reaction functions are upward sloping. We checked a number of specifications with asymmetric newspapers and downward sloping reaction functions, and found that equilibrium qualities increase in $R(\lambda)$.

Because $q^*(\lambda) \leq q^*(0)$ and s_i is decreasing in q_j, we also have $s_i(q^*(\lambda), q^*(\lambda))R_N(0) - c(q^*(\lambda^*)) \leq s_i(q^*(\lambda), q^*(0))R_N(0) - c(q^*(\lambda^*)) = \pi_i(q(\lambda^*), q^*(0), 0) \leq \pi_i(q^*(0), q^*(0), 0)$, the last inequality a consequence of the fact that $q^*(0) = \operatorname{argmax}_{q_i} \pi_i(q_i, q^*(0), 0)$. ∎

Discussion Notice that Proposition 5 is a comparison of the benchmark ($\lambda = 0$) to the case where the platform behaves optimally ($\lambda = \lambda^*$). In particular, it does not say that any increase in λ starting from $\lambda = 0$ will lead to a lower quality. Indeed, an increase in λ has two effects on R_N:

$$R'_N(\lambda) = (1 - \phi)T_0(\lambda) - (1 - \lambda(1 - \phi))T'_0(\lambda).$$

The first term corresponds to a market expansion effect: for a given allocation of attention between the platform and the newspapers, an increase in the prominence of news on the platform benefits newspapers. The second term, however, shows that an increase in λ leads consumers to reallocate some of their attention to the platform, thereby reducing the newspapers' advertising revenues.

8 Discussion and concluding remarks

Social networks have gained tremendous importance in the last decade, fundamentally transforming media consumption. These platform's core content offer, so-called "user-generated content" (UGC) grabbed a significant share of consumer attention. Moreover, social networks naturally benefit from strong network effects and, as a result, have gained considerable market power. With large captive audiences, they increasingly act as content aggregators expanding the original, UGC-based content bundle provided to their members by also including third-party (professional) content in their members', so-called "newsfeeds". The broad question asked by this paper is how the presence of a dominant social network will impact the long-term choice of quality by professional content providers. We focus more specifically on news publishers, where content quality is of general public interest.

Our models reduce the sophisticated business of a social network to an agent choosing a single strategic parameter, λ, that essentially defines consumers' newsfeed. Essentially, the newsfeed encapsulates the platform's editorial policy, i.e. defines the bundle of content that the social network offers to its members. In practice, the newsfeed algorithm is complex, partly personalized and adaptive over time; it is proprietary and is constantly fine-tuned by the platform. Yet, we argue that, for third-party content providers, the newsfeed's relevant feature is the proportion of their content in the overall bundle presented to the social network's members. We explore what is the optimal choice of this

proportion for the platform and how, in turn this affects the choice of quality for publishers.

Our first result is that, unless there is a large number of consumers who are *not* interested in reading news, the social network always has an incentive to bundle news in its newsfeed. For constant quality, this distorts consumers' news consumption, forcing consumers to consume more news than they would otherwise do. Under some conditions, it can even lead to a reduction of 'news drop-outs'. However, the bundling of news in the newsfeed unambiguously decreases the newspaper's profits. This happens independently from the fact that equilibrium news quality may decrease or increase, the latter being the case only when increased quality mostly affects consumer demand for the segment of consumers who value quality a lot.

Given the unambiguous negative impact on the newspaper's profits, it is worthwhile to ask what may happen when the newspaper can opt-out of the newsfeed. This case may be relevant to newspapers with strong market power (e.g. having a strong brand name such as *The New York Times* or having very unique content such as *The Economist*). Under possibility of opting out, the platform offers a contract that makes the newspaper indifferent. However, in this case, equilibrium news quality unambiguously declines. We also analyzed the case where the platform can perfectly personalize the newsfeed for its members. In this case, it chooses the ideal content bundle for each consumer, which leads to consumers allocating all their attention to the platform. In equilibrium, news quality unambiguously declines compared to the base case when the platform only provides UGC to its members.

In summary, we show that the capacity of the social network to include news in its members' newsfeed represents a great danger for the profitability of a newspaper even if it has considerable market power (e.g. it is a monopolist). We also identified strong forces that push down the equilibrium quality of news when it is bundled in the newsfeed. This also means that consumer surplus is likely to decrease compared to the case when the platform only offers UGC. This is unambiguously the case when news quality declines in equilibrium. When quality increases, consumer surplus may still go down if the positive effect of increased quality is compensated by the demand distortion effect of the newsfeed.

In a second stage, we turned our analysis to competition between (differentiated) newspapers who compete in quality. We find that equilibrium quality as well as newspapers' profits unambiguously decline with the introduction of news in the social network's content bundle, reinforcing our previous results.

Overall, we conclude that the presence of social networks are "bad news" for the vast

majority of the news industry. With the exception of a small number of well-differentiated firms, catering to consumers who value high quality, social networks are likely to lead to lower content quality. Both of these findings resonate to today's discussions on the negative impact of social networks on the quality of news and on publishers' revenues. These results are also in striking contrast to what previous literature found on news aggregators, such as, for example, Google News. Note that these institutions help consumers select the highest quality news providers. As such, they provide an incentive to increase news quality. While this may still lead to lower profitability for some news providers, it results in higher equilibrium quality for news. While a social network can be considered an aggregator, it actually softens the incentive of the publishers to provide higher quality. Given that an increasing proportion of news consumption is migrating to social networks, it is important to recognize this change in incentives.

Our analysis considered specifically a social network and news publishers. Our modeling framework seems to be applicable to a broader set of interactions between a (dominant) multi-sided platform and third-party 'content' providers. Staying in the domain of media, in many Asian countries (e.g. Japan or Korea) portals, as opposed to search engines represent the entry point to the Internet. In Japan, Yahoo! largely dominates Google as the dominant "opening page". Similarly, in Korea, Naver is the dominant platform to access the Internet. These firms are portals that offer consumers a pre-edited menu of third-party links. Again, bringing a publisher's link on the portal has similar economic effect on the online publisher than the ones we have identified in the paper. More broadly, other sorts of media platforms may include video distribution platform such as Netflix, Hulu or Amazon Prime Video. Here the role of newspapers is played by movie studios or TV networks who can monetize their content independently but are attracted by the platforms' captive customers. While these are markets where consumers pay for access, these examples still retain the core characteristic of competition between a hybrid platform and a traditional content provider.

Examples with similar characteristics can be found outside of media as well. For instance, a dominant retail platform, such as Amazon or a popular department store can offer product categories on its site from third-party manufacturers. In fact, a large part of Amazon's business today is to be an online storefront for third-party retailers. Similarly, department stores often allow third-party retailers to operate boutiques on their sites for a fee. The dynamics of competition in these cases may have an element that is similar to the ones we analyze in our models.

Yet, caution is needed to draw equivalence between the case of news publishers and the examples mentioned above. In the case of news publishers, we argue that the models'

dynamics are *the* key drivers of competition. In all the other examples mentioned, there are important institutional details that lead to other strategic considerations (such as, for example, the moral hazard issues in the case of an e-commerce platform or the fact that for many of the media products mentioned above the revenue model is subscription-based).

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