Social Media and News: Attention Capture via Content Bundling

Preliminary - comments welcome

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Abstract

The growing influence of internet platforms acting as content aggregators is one of the most important challenges facing the media industry. We develop a simple model to understand the impact of content bundling by a social platform. In our model consumers can access news either directly through a newspaper's website, or indirectly through a platform, which also offers social content. Even though the platform shares revenues with newspapers whose content it publishes, content bundling harms newspapers. Its effect on news quality depends on the cost of providing quality and on the media market structure.

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

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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 reached over two billion active members across the globe who, on average, spend about an hour each day on the platform. In line with its significant consumer attention share, Facebook captured almost $40 billion of advertising revenues in 2017 corresponding to 19% of worldwide digital advertising. Other successful social platforms include Tencent's WeChat in China and VKontakte in Russia.

If, in their early days, social networks were mostly used as a way for users to share personal stories and pictures, their role has progressively evolved into one of content aggregation: an important share of the content displayed on their websites is produced by third-party publishers, who use the platforms as an alternative to their own website to reach consumers.

The news industry in particular has been affected by this change: studies show that more than 50% of consumers use social media as a source of news, and 14% as their main source (Gottfried and Shearer, 2016; Mitchell et al., 2017; Reuters, 2016). Facebook has recently surpassed Google as the main external source of traffic to newspapers' websites (Alpert, 2015; Constine, 2016).[1] This situation is a double-edged sword for publishers: social platforms provide the opportunity to reach a wider audience, yet newspapers worry about the growing power of platforms, for fear of losing their privileged relationship with readers, and eventually most of their revenues (Thompson, 2017).

The new role of social media in the news industry has recently been the subject of heated controversies. Platforms have been accused of fostering echo chambers, or of not doing enough to prevent the spread of fake news. Some of their critics argue that platforms should be held responsible for the content displayed on their websites.

The central focus of this paper is the key feature of social platforms that gives them the ability to curate the content that consumers are exposed to, by providing a mix of *user-generated content* (UGC) and of professional content produced by third parties (in particular news organizations), a practice we refer to as *content bundling*. A major strategic choice faced by the platforms then concerns the design of the "newsfeed", i.e. the relative prominence of UGC and news shown to its users.[2]

[1] 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.

[2] See for instance Constine (2016) and Bradshaw (2017) for reports on how platforms such as Facebook and Snapchat have redesigned their newsfeeds.

We develop a simple model of competition for attention between a social platform and a newspaper that allows us to make two contributions. First, we shed light on a platform's incentives to use content bundling as a strategy to capture consumers' attention.Our second contribution is then to draw out the implications of content bundling on the news industry, in particular with respect to news quality, newspapers' profits and consumers' news consumption. We show that content bundling generally harms newspapers. However, news quality may actually increase with content bundling for high-quality newspapers and decrease for low quality ones. Thus, our model predicts that content bundling by social media is likely to increase the variance of quality in the news market. Furthermore, we also find that content bundling is likely to increase newspapers' quality under newspaper competition.

In our basic framework, a social platform and a newspaper (or publisher), both advertising-supported, compete for consumers' attention.[3] The newspaper produces news stories and maintains a website which only offers news content. The social platform relies on its users to produce *user-generated content* (UGC), such as personal stories or pictures. On its website, the platform can bundle UGC with content produced by the newspaper, in which case the platform and the newspaper share advertising revenues.

Consumers have limited attention, and are heterogeneous in their demand for news, that is in the share of their attention they would like to devote to news content. The demand for news also depends on its quality, which is the result of an investment by the newspaper. Consumers can freely allocate their attention across the two websites, but, when on the platform, have to consume the bundle that is offered to them.

By bundling news and UGC, the platform diverts news consumption away from the newspaper's website, and onto its own. Moreover, for a given quality of news, content bundling increases total news consumption by distorting upwards the consumption of consumers with a low demand for news. However this increase in news consumption is never large enough to compensate the newspaper for the fact that a part of it occurs through the platform. The driving force behind this result is that the extent of content bundling (i.e. the share of news content that platform users are exposed to) is strategically chosen by the platform so as to increase its advertising revenues, which comes at the expense of the newspaper.

The effect of Content bundling also affects the newspaper's incentives to invest in quality. Several opposing forces are at play, so that the overall effect is ambiguous in general. Using a specification where quality has a uniform effect on the demand for news

[3]We present our results for a model with advertising only but we did explore a model with advertising *and* subscription and the results are similar. We discuss them at the end of the paper.

across consumers, we find that content bundling increases quality if the cost of producing quality is small, and decreases it otherwise. In other words, the model predicts an increase in quality dispersion under content bundling.

Our baseline model, analyzed in Sections 3 and 4, considers a single newspaper and relies on a number of simplifying assumptions. In Section 5 we discuss the robustness of our results by studying variations of the model that bring back important institutional details. Specifically, we allow for the personalization of the platform's content, the possibility for the newspaper to prevent content bundling, and the presence of significant switching costs across websites for consumers.

In Section 6 we then extend our framework to allow for competition between newspapers. We again show that newspapers are made worse-off by content bundling, but we find that news quality increases.

2 Relevant literature

The paper is related to a number of literature streams, first, and foremost to the broadening literature on news/media "aggregators" (see Peitz and Reisinger (2015) for an extensive summary on this literature). As in our paper, the central question is how these intermediaries impact the consumption of news as well as the quality of content produced. On the theory side, Jeon and Nasr (2016) and Dellarocas, Katona, and Rand (2013) model aggregators as enabling consumers to find high quality news more easily. They find that the entry of an aggregator tends to increase competition among websites, leading to higher quality. The impact on newspapers profit depends on which effect is stronger: business stealing or market expansion. Rutt (2011) studies how the presence of an aggregator affects newspapers' choice of business model, and shows that it has different effects on the quality provided by free versus paying outlets. In George and Hogendorn (2012), the aggregator reduces the cost of multihoming for consumers. Unlike here, in these papers aggregators are non-strategic and do not produce their own content, but merely replicate the experience of a newspaper. Even though we also have a trade-off between business stealing and market expansion, our focus on social network leads us to emphasize a different set of issues.

A recent series 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. George and Hogendorn (2013) studies the consequences of a redesign of Google News, and find that news aggregators can potentially change the composition of news consumption.

Our work specifically 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 (see Luca (2015) for a summary of the economics literature on UGC). This is relevant because, increasingly, it is such platforms (as opposed to search engines) that generate traffic to news content. Yildirim, Gal-Or, and Geylani (2013) study the effect of UGC on the horizontal competition between news providers, but they do not consider the presence of an endogenous intermediary as we do. Theoretical research on UGC and social networks specifically is scarce and focuses mostly on network formation.[4]

In our model, the platform allocates consumers' attention by choosing the mix of content that it displays. In this respect it is similar to a search engine, which allocates traffic through its ranking and design (see de Cornière and Taylor (2014) or Burguet, Caminal, and Ellman (2015)). However, in these papers the intermediary enjoys an exogenous bottleneck position: consumers have to use the search engine to find content. In contrast, our mechanism is one where the allocation of attention while on the platform (i.e. content bundling) determines how consumers allocate their attention between the platform and the newspaper. The gatekeeping role of the platform thus emerges endogenously.

Our framework assumes multi-homing but we abstract away from the core concern of the multi-homing literature applied to media, 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 abstract away from the editorial process of publishers when multiple topics are present.

Finally, our paper is related to the literature on bundling (see e.g. Nalebuff (2003) for an overview). The reason for content bundling differs from some of the standard

[4]See, for example Bala and Goyal (2000) and Jackson and Wolinsky (1996) for earlier models, and Jackson (2010) for a review. See also Zhang and Sarvary (2015) who consider local network effects.

explanations of bundling, such as price-discrimination or leverage of market power. Here, the platform bundles its own content with that of its rival in order to capture more attention from consumers.

3 Baseline model

We consider a model where consumers can consume two kinds of content: news and user-generated content (UGC). To convey the core intuitions we make a number of simplifying assumptions that we relax in Sections 5 and 6. Specifically, we start with a monopolist newspaper (indexed by 1), who must invest $c(q)$ to produce news stories of quality q, where $c(.)$ is increasing and convex. User-generated content is produced by users of a monopolist social platform (indexed by 0), at no cost for the platform. UGC quality is exogenous.

Consumers have heterogeneous preferences regarding content. A consumer of type θ who consumes a quantity x of news (of quality q) and y of UGC derives a utility $U(x, y, q, \theta)$, non-decreasing in x and y. We assume that $U_{x,\theta} \geq 0$,[5] i.e. that high types have a larger marginal utility for news content. News quality increases the marginal utility of news consumption: $U_{x,q} > 0$. However, this effect is weaker for higher levels of quality: $U_{x,q,q} \leq 0$.[6] We assume that θ is distributed according to a continuous c.d.f. F, of density f, on a support $[\underline{\theta}, \overline{\theta}]$. In the baseline model, θ is a consumer's private information. We relax this assumption in Section 5, when we allow the platform to personalize consumers' newsfeed.

Consumers have an *attention constraint*: $x + y \leq 1$.[7] For a given quality q, a type θ consumer's demand for news $\hat{x}(\theta, q)$ is the solution to

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

From our assumptions, $\hat{x}(\theta, q)$ is non-decreasing in both its arguments. Moreover, we assume that $\hat{x}(\theta, q) > 0$ for all $\theta > \underline{\theta}$, and that $\hat{x}(\theta, q)_{q,q} \leq 0$. Similarly, $\hat{y}(\theta, q)$ is the demand for UGC. We assume that consumers have no outside option, so that the attention constraint is always binding and $\hat{y}(\theta, q) = 1 - \hat{x}(\theta, q)$.

[5] $U_{x,\theta}$ is the cross derivative of U with respect to x and θ.

[6] $U_{x,q,q}$ is the third-order partial derivative. At this point, we impose no restriction on the sign of $U_{x,q,\theta}$, that is, we do not specify whether high types' or low types' demand for news is more sensitive to quality.

[7] The main results of the baseline model continue to hold in a variant of the model where the total attention is itself endogenous. Such a model is less amenable to extensions though.

Example: For the sake of illustration, we sometimes assume that θ is uniformly distributed on $[0,1]$ and we use the following utility function:

$$U(x,y,q,\theta) = (\theta+q)x - \frac{(1-y)^2}{2}. \tag{1}$$

A consumer's demand for news is then $\hat{x}(\theta,q) = \min\{\theta+q,1\}$. We refer to this as the *additive model*. It allows us to obtain closed-form solutions.[8]

Even though consumers have preferences over content, they cannot directly choose which content they consume. Instead, they allocate their unit of attention across two websites: one operated by the newspaper, and one by the platform. While the newspaper's website can only offer news content, the key feature of our model is the platform's ability to display news from the newspaper alongside its own UGC. Such *content bundling* is a strategic choice: the platform decides the share λ of news that consumers are exposed to when they visit its website. If a consumer spends t_0 units of time on the platform's website, he therefore consumes a quantity $t_0(1-\lambda)$ of UGC, and a quantity $t_0\lambda$ of news (on top of the news he gets directly from the newspaper's website).

Websites are purely advertising-supported.We normalize the monetary value of one unit of attention by a consumer to one.[9] Thus, when a consumer spends t_1 units of time on the newspaper's website (what we call direct traffic), the newspaper generates direct revenues of t_1. The newspaper also derives revenues from indirect traffic, i.e. from the news stories that consumers are exposed to while on the platform's website. More specifically, we assume that if the platform shows a share λ of news and if a consumer spends t_0 units of time on its website, the newspaper's indirect revenue is $t_0\lambda(1-\phi)$, where $\phi \in [0,1]$ is the share of news-related ad revenues that the platform keeps for itself. The platform's revenue is then $t_0(1-\lambda+\lambda\phi)$.

One can interpret the (exogenous) $(\phi, 1-\phi)$ sharing rule either as explicit payments from the firm collecting the revenues to the other, or, more broadly, as capturing the idea that (i) direct traffic is more valuable to the newspaper than indirect traffic, and (ii) the platform would prefer to show UGC if the allocation of attention was fixed. Under this second interpretation, one could imagine that the sum of the shares add up to more or less than one. Provided that the sum is not too far away from one, our results will continue to apply.[10]

[8] We also sometimes mention results obtained under the multiplicative model, where $U(x,y,q,\theta) = \theta qx - \frac{(1-y)^2}{2}$ and $\hat{x}(\theta,q) = \min\{\theta q,1\}$. Closed-form solutions are then harder to obtain.

[9] A priori, we have no reason to assume that either website is more efficient at advertising. We discuss this assumption below.

[10] We allow for endogenous ϕ in Section 5.3.

Timing and equilibrium: The timing is as follows: at $\tau = 1$, the newspaper chooses a quality q, publicly observed, and incurs the cost $c(q)$. We view q as a long-term strategic choice. At $\tau = 2$, the platform chooses the share of news λ it shows to its users. At $\tau = 3$, consumers observe λ and choose $t_0(\theta, q, \lambda)$, the time they spend on the platform as a function of their type, of the quality of news and of the platform's content mix. The resulting news consumption is $x = \lambda t_0 + t_1$. 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 cannot bundle news content alongside UGC (i.e. $\lambda = 0$).

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 costs associated to switching from one website to the next, consumers can consume their desired mix of content. A consumer of type θ then spends $\hat{x}(\theta, q)$ on the newspaper site, and $\hat{y}(\theta, q) = 1 - \hat{x}(\theta, q)$ on the platform. The total time spent on the newspaper's website and the newspaper's profit are therefore

$$T_1(q, \lambda)|_{\lambda=0} = \int_{\underline{\theta}}^{\overline{\theta}} \hat{x}(\theta, q) dF(\theta) \quad \text{and} \pi_1(q, 0) = T_1(q, 0) - c(q). \tag{2}$$

Profit is concave in q, and the optimal quality for the newspaper, denoted $\tilde{q}$, is the solution to

$$\frac{\partial T_1(\tilde{q}, 0)}{\partial q} = c'(\tilde{q}). \tag{3}$$

Let $\tilde{\pi}_1$ be the newspaper's associated profit.

Example In the additive model ($\hat{x}(\theta, q) = \min\{\theta + q, 1\}$) with a uniform distribution of types on $[0, 1]$, the total time spent on the newspaper is

$$T_1(q, 0) = \int_0^1 \hat{x}(\theta, q) d\theta = \int_0^{1-q} (\theta + q) d\theta + \int_{1-q}^1 d\theta = \frac{1 + 2q - q^2}{2}.$$

If the cost of quality is $c(q) = cq^2/2$, the equilibrium quality level and profit in the benchmark are

$$\tilde{q} = \frac{1}{1 + c} \quad \text{and } \tilde{\pi}_1 = \frac{2 + c}{2 + 2c}. \tag{4}$$

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

4.2 Consumers: allocation of attention with content bundling

At $\tau = 3$, 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_0 units of time on the platform, and $1 - t_0$ on the newspaper, he gets a quantity of news, $x(t_0, \lambda) = t_0\lambda + (1 - t_0)$ and a quantity of UGC, $y(t_0, \lambda) = t_0(1 - \lambda)$.

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, $t_0(\theta, q, \lambda) = 1$. Consumers such that $1 > \hat{x}(\theta, q) > \lambda$ can achieve their optimal content mix by spending $t_0(\theta, q, \lambda)$ on the platform such that

$$t_0(\theta, q, \lambda)(1 - \lambda) = \hat{y}(\theta, q) \Leftrightarrow t_0(\theta, q, \lambda) = \frac{\hat{y}(\theta, q)}{1 - \lambda}.$$

Finally, if $\hat{x}(\theta, q) = 1$, the consumer allocates all his attention to the newspaper, that is $t_0(\theta, q, \lambda) = 0$.

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 smallest solution to $\hat{x}(\theta, q) = 1$, i.e. the lowest type who does not visit the platform. We sometimes omit the arguments and simply write $\hat{\theta}_1$ and $\hat{\theta}_2$. Consumers with $\theta < \hat{\theta}_1$ single-home on the platform. Consumers with $\theta > \hat{\theta}_2$ single-home on the newspaper's website. The rest of the consumers multi-home between the two websites. 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, a consumer of type θ allocates a share $t_0(\theta, q, \lambda)$ of his attention to the platform, where*

- $t_0(\theta, q, \lambda) = 1$ *if* $\theta \leq \hat{\theta}_1$,
- $t_0(\theta, q, \lambda) = \frac{1 - \hat{x}(\theta, q)}{1 - \lambda}$ *if* $\theta \in \left(\hat{\theta}_1, \hat{\theta}_2\right)$,
- $t_0(\theta, q, \lambda) = 0$ *if* $\theta \geq \hat{\theta}_2$.

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 relative to what they would like ($\lambda > \hat{x}(\theta, q)$).[11]

Lemma 1 implies the following intermediary result:

Proposition 1. *Suppose that news quality is fixed at some level q. Total news consumption is a non-decreasing function of λ. In particular, for a given q, news consumption is higher under content bundling than under the benchmark ($\lambda = 0$).*

Proof. A consumer's news consumption is $\max\{\hat{x}(\theta, q), \lambda\}$, which is non-decreasing in λ. ■

Proposition 1 highlights the potential benefit that the newspaper can derive from content bundling: news consumption goes up, and the newspaper gets a positive share of the revenues generated by news consumption through the platform. After endogenizing the choices of λ and q, we will see that this effect is never strong enough so as to make the newspaper better-off than under the benchmark.

4.3 Platform: optimal content bundling

At $\tau = 2$, suppose that news quality is q. If the platform displays a share λ of news content, the total amount of attention that it receives is

$$T_0(q, \lambda) = \int_{\underline{\theta}}^{\overline{\theta}} t_0(\theta, q, \lambda) dF(\theta). \tag{5}$$

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 gives a lower bound on the optimal λ:

Proposition 2. *The optimal content bundling strategy is such that $\lambda^*(q) \geq \hat{x}(\underline{\theta}, q)$.*

Proof. Take $\lambda < \hat{x}(\underline{\theta}, q)$, i.e. $\hat{\theta}_1(q, \lambda) < \underline{\theta}$. By Lemma 1, all consumers with $\theta \leq \hat{\theta}_2(q)$ spend $t_0(\theta, q, \lambda) = \frac{1 - \hat{x}(\theta, q)}{1 - \lambda}$ units of time on the platform.[12] The platform's profit is

$$\int_{\underline{\theta}}^{\hat{\theta}_2} (1 - \lambda + \lambda\phi) t_0(\theta, q, \lambda) f(\theta) d\theta = \int_{\underline{\theta}}^{\hat{\theta}_2} \left(1 - \hat{x}(\theta, q) + \lambda\phi \frac{1 - \hat{x}(\theta, q)}{1 - \lambda}\right) f(\theta) d\theta.$$

[11] "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.

[12] Recall that $\hat{\theta}_2(q)$ is the smallest solution to $\hat{x}(\theta, q) = 1$ and thus does not depend on λ.

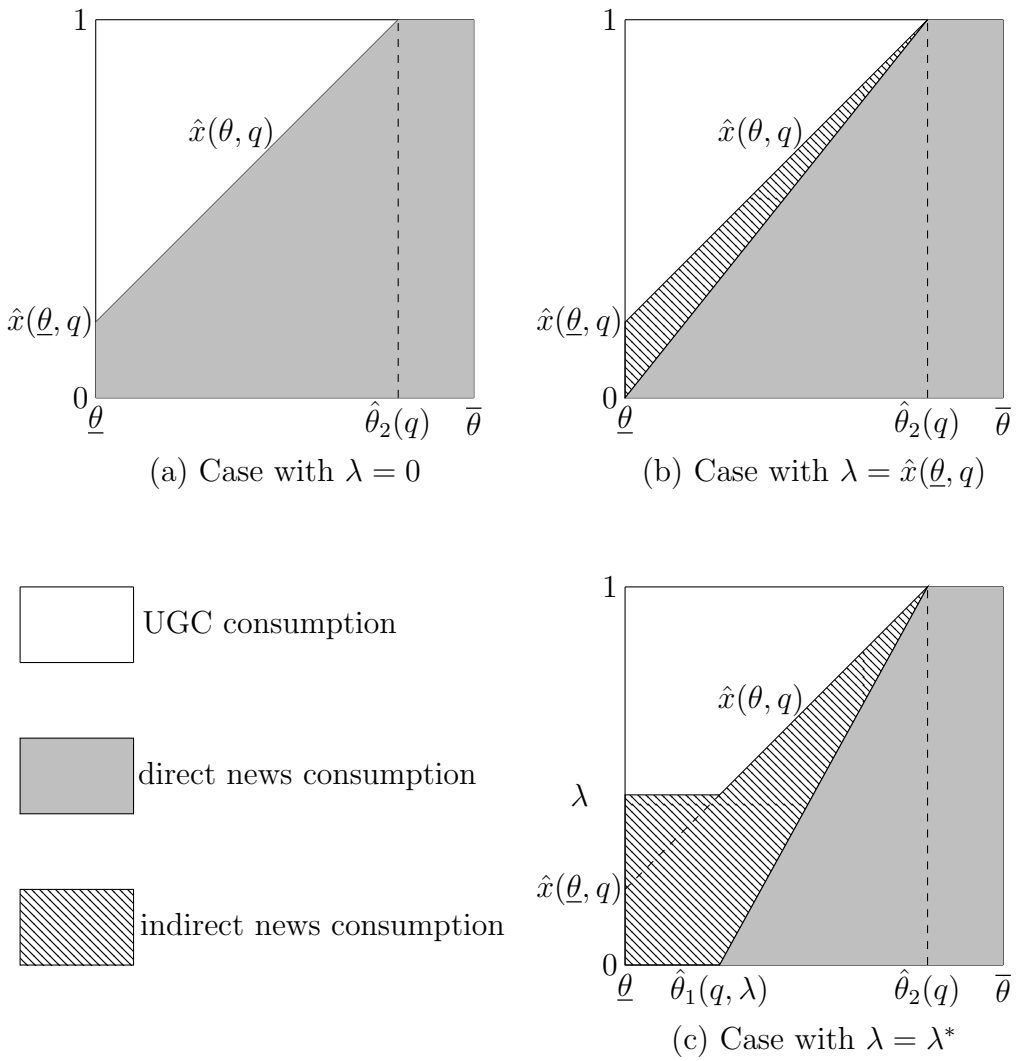

Figure 1: Content consumption for different values of λ. We assume $\hat{x}(\theta, q) = \theta + q$, $\theta \hookrightarrow \mathcal{U}[0, 1]$, $q = 1/5$, $\phi = 1/3$. See discussion in the text.

This is an increasing function of λ, so $\lambda^*(q)$ must be no smaller than $\hat{x}(\underline{\theta}, q)$. ■

Intuitively, an increase in λ only harms the platform through the consumers who spend all their time on its website. For these consumers, a higher λ translates into less revenue per-unit of attention and a constant attention. The other consumers, who allocate their attention so as to consume their preferred mix of content, adjust their behavior following an increase in λ by spending more time on the platform. The platform continues to fully monetize their (unchanged) consumption of UGC, and on top of that it captures a share of the revenue associated with their news consumption. This is why the platform will always provide at least the minimal demand for news in the population ($\hat{x}(\underline{\theta}, q)$).

Additive model Figure 1 illustrates the result in the additive model. The figure depicts the allocation of attention between news and UGC depending on the value of λ. In panel

(a), $\lambda = 0$, and each type θ consumes his desired quantity of news $\hat{x}(\theta, q)$ through the newspaper's website (*direct* news consumption). The platform's revenue corresponds to the white area. In panel (b), the platform sets $\lambda = \hat{x}(\underline{\theta}, q)$. The relative consumption of news and UGC does not change, but part of the news consumption happens through the platform (*indirect* news consumption). The platform's revenue equals the white area plus ϕ times the dashed area, and therefore is larger than in panel (a). In panel (c) λ is chosen optimally: the types $\theta < \hat{\theta}_1(q, \lambda)$ consume more news than they would like (and therefore the platform generates less revenue from them), but all the types between $\hat{\theta}_1(q, \lambda)$ and $\hat{\theta}_2(q)$ spend more time on the platform in order to maintain their desired consumption of UGC.

Analytically, in the additive model we have $\hat{\theta}_1(q, \lambda) = \lambda - q$ and $\hat{\theta}_2(q) = 1 - q$. Using Lemma 1 to obtain t_0 and t_1, the total time spent on the platform is, for any $\lambda \geq q$:[13]

$$T_0(\lambda, q) = \int_0^{\hat{\theta}_1} d\theta + \int_{\hat{\theta}_1}^{\hat{\theta}_2} \frac{1 - (\theta + q)}{1 - \lambda} d\theta = \frac{1 + \lambda - 2q}{2}. \tag{6}$$

The platform's profit $(1 - \lambda + \lambda\phi)T_0(\lambda, q)$ is maximized for $\lambda^*(q) = q + \frac{\phi}{2(1-\phi)}$. The first term ($q$) corresponds to the demand for news of the lowest type ($\theta = 0$). Beyond this quantity, the platform's optimal strategy depends on the share ϕ of revenues it captures when it shows news: for large values of ϕ the platform has an incentive to show a lot of news content to its users.

4.4 Newspaper: choice of quality

Besides understanding the strategic incentives of the platform to provide news content to its users, we seek to assess the effects of content bundling 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. We assume that the primitives are such that this profit is quasi-concave in q.[14] Similarly, define $R_0(q, \lambda) \equiv (1 - \lambda(1 - \phi))T_0(q, \lambda)$, which represents the platform's revenues. Notice that $R_0(q, \lambda) + R_1(q, \lambda) = T_0(q, \lambda) + T_1(q, \lambda) = 1$ for any (q, λ).

In period $\tau = 1$, acting as a Stackelberg leader, the newspaper knows that the platform will choose $\lambda = \lambda^*(q)$. Its objective function is thus

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

[13] Which is always true in equilibrium, by Proposition 2.

[14] This is true in the additive model with uniform distribution of types.

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 then writes

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

Comparing (3) and (7), one can distinguish two effects of content bundling by the platform: a softening and a composition effect. The softening effect corresponds to the smaller return to a marginal increase in direct traffic T_1, from 1 (in the benchmark) to $1-(1-\phi)\lambda^*$. When the platform bundles content, the newspaper collects a share of its revenues, and increasing T_1 is less valuable. The softening effect reduces the incentives to invest under content bundling.

The composition effect works as follows: under the benchmark, an increase in q raises the news consumption of all types between $\underline{\theta}$ and $\hat{\theta}_2$ by $\frac{\partial \hat{x}}{\partial q}dq$. With content bundling, only the consumers with $\theta \in [\hat{\theta}_1, \hat{\theta}_2]$ change their behaviour.[15] However these consumers are more responsive than under the benchmark: their demand increases by $\frac{1}{1-\lambda}\frac{\partial \hat{x}}{\partial q}dq$. The overall sign of the composition effect, and therefore the effect of content bundling on news quality, is ambiguous in general.

Focusing on the additive model allows us to obtain further results.

Proposition 3. *Suppose that $\hat{x}(\theta,q) = \min\{\theta+q,1\}$, that θ is uniformly distributed on $[0,1]$, and that $c(q) = cq^2/2$. Equilibrium quality is lower under content bundling than under the benchmark if $c>1$, and higher if $c<1$.*

Proof. Using equation (6) we have $T_1(q,\lambda) = q + \frac{1-\lambda}{2}$. Solving equation 7 then leads to

$$q^* = \frac{2-\phi}{2(1+c-\phi)}. \tag{8}$$

Comparing this to the benchmark quality level (see Equation (4)) then gives the result. ■

A similar result holds in the multiplicative model ($\hat{x}(\theta,q) = \min\{\theta q, 1\}$): content bundling increases quality, if and only if, the cost of producing quality is low.[16]

Proposition 3 suggests that content bundling has a heterogeneous effect on newspapers: high quality newspapers (with low c) react to content bundling by increasing their level of investment, while low quality newspapers reduce their quality under content bundling. A testable prediction of the model is that content bundling should increase the variance of the distribution of quality. Notice that this results holds independently of ϕ.

[15] The fact that λ will increase following a rise in q does not affect the newspaper's tradeoff, by the envelope theorem.

[16] For the multiplicative model, we can only obtain analytical results for the case where c is small. When c is large we rely on numerical results. Details are available from the authors upon request.

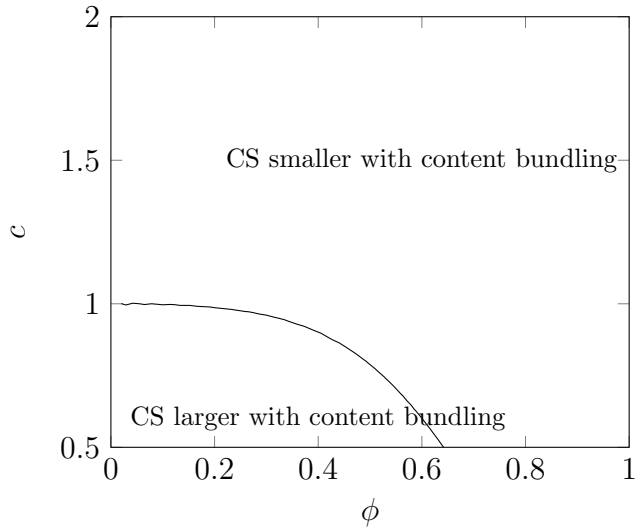

Figure 2: Effect of content bundling on consumer surplus, CS.

Newspaper profits

While in equilibrium news quality may increase or decrease, we find that the newspaper's profit unambiguously declines with content bundling by the platform:

Proposition 4. *The newspaper's profit is lower under content bundling than under the benchmark.*

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 $\pi_1(q^*, 0) \leq \pi_1(\tilde{q}, 0)$, which implies that $\pi_1(\tilde{q}, 0) > \pi_1(q^*, \lambda^*)$. ■

Even though content bundling by the platform may soften competition and increase total news consumption, it cannot benefit 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.

The result again does not depend on ϕ, this time even outside the additive model.

4.5 Welfare analysis

For a given quality level, content bundling harms consumers because it distorts lower types' consumption towards too much news. If news quality decreases, consumers are therefore unambiguously worse-off under content bundling. They can be better-off only if quality increases enough to offset the distortion. Figure 2 illustrates this phenomenon in

the additive model: surplus increases when both c and ϕ are small.

Regarding total welfare (that is, if we add quality costs to the calculation), we obtain a similar figure, albeit with a smaller area where content bundling is desirable. Indeed, a higher quality comes at a higher cost, so that consumer surplus gains are partially offset by profit losses. In terms of the magnitude of the effect, our results suggest that surplus and welfare gains in the lower left area are small relative to surplus and welfare losses in the other areas.

5 Extensions

This section explores three extensions to the basic model, still assuming a monopolist newspaper. In the first, we allow the platform to offer personalized content to each of its users. In the second we assume that consumers face large switching costs and cannot multihome. In the third, we allow the newspaper to remove its content from the platform, and look at a bargaining game between the two firms.

5.1 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.

We make the tie-breaking assumption that consumers who only want to consume news allocate all their attention to the newspaper.[17] Let $\hat{q}$ be the equilibrium quality in this case. We have the following proposition:

Proposition 5. *When the platform can personalize the newsfeed:*

1. *The platform chooses $\lambda(\theta, q) = \hat{x}(\theta, q)$.*
2. *Consumers such that $\hat{x}(\theta, \hat{q}) < 1$, i.e. $\theta < \hat{\theta}_2(\hat{q})$ allocate all their attention to the platform.*

[17] Even though the platform would offer them a personalized mix of only news, so that they would be indifferent (see below). This tie-breaking assumption could be justified, for instance, if there was a minimal amount of UGC, $\epsilon > 0$ that the platform had to show.

3. The newspaper's profit is lower than without content bundling.

4. News quality can be higher or lower than under the benchmark.

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 with a positive demand for UGC (such that $\theta < \hat{\theta}_2(\hat{q})$) then find it optimal to allocate all their attention to the platform, and thus only consume news indirectly. Then the newspaper's profit is:

$$\pi_1(q) = (1-\phi)\int_{\underline{\theta}}^{\hat{\theta}_2(q)} \hat{x}(\theta, q) f(\theta) d\theta + \int_{\hat{\theta}_2(q)}^{\overline{\theta}} 1 f(\theta) d\theta - c(q),$$

which can be rewritten

$$\pi_1(q) = T_1(q, 0) - \phi \int_{\underline{\theta}}^{\hat{\theta}_2(q)} \hat{x}(\theta, q) f(\theta) d\theta - c(q).$$

It follows that the newspaper's profit is lower than under the benchmark, $\tilde{\pi_1} = \max_q T(q, 0) - c(q)$.

The first-order condition is

$$\pi_1'(q) = 0 \Leftrightarrow \frac{\partial T_1(q,0)}{\partial q} - \phi \left(\frac{\partial \hat{\theta}_2(q)}{\partial q} f(\hat{\theta}_2(q)) + \int_{\underline{\theta}}^{\hat{\theta}_2(q)} \frac{\partial \hat{x}(\theta, q)}{\partial q} f(\theta) d\theta \right) = c'(q).$$

Comparing this to the first-order condition without content bundling (see equation (3)), we see that quality is higher under personalized content bundling if

$$\frac{\partial \hat{\theta}_2(q)}{\partial q} f(\hat{\theta}_2(q)) + \int_{\underline{\theta}}^{\hat{\theta}_2(q)} \frac{\partial \hat{x}(\theta, q)}{\partial q} f(\theta) d\theta < 0. \tag{9}$$

The first term is non-positive, because $\frac{\partial \hat{\theta}_2(q)}{\partial q} \leq 0$: a higher quality of news cannot reduce the share of consumers who want to only consume news. The second term is non-negative: a higher q leads all consumers to demand more news content. The overall effect is therefore ambiguous. ■

Examples To see that both cases are possible, consider the two following examples: (i) In the additive model with $\theta \hookrightarrow \mathcal{U}[0, 1]$, condition (9) holds: quality goes up with personalized bundling.(ii) With a Cobb-Douglas utility function $U(x, y, \theta, q) = \alpha(\theta, q) ln(x) + ln(y)$ with α increasing in q and θ, we have $\hat{x}(\theta, q) = \frac{\alpha(\theta,q)}{\alpha(\theta,q)+1} < 1$ for all θ, q. We then have $\frac{\partial \hat{\theta}_2(q)}{\partial q} = 0$, and (9) does not hold, so that quality is lower under personalized content bundling.

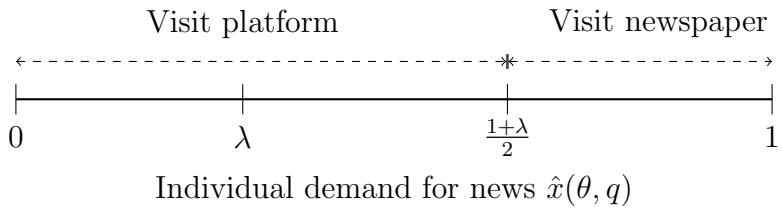

Figure 3: Consumer decision under singlehoming

With personalization, there are two changes compared to the benchmark of no bundling. (1) increasing the demand for news of "interior" consumers (those who also consume UGC) is less valuable to the publisher, because they will consume this extra content through the platform. (2) Turning a marginal UGC consumer into an exclusive news consumer brings a larger payoff. For instance, take a consumer such that $\hat{x}(\theta, q) = 0.9$. Suppose that a Δ increase in quality makes her only want to consume news ($\hat{x}(\theta, q + \Delta) = 1$). In the benchmark without content bundling, the gain to the publisher over this consumer is $\hat{x}(\theta, q + \Delta) - \hat{x}(\theta, q) = 0.1$. Under personalized bundling, the gain is $\hat{x}(\theta, q + \Delta) - (1 - \phi)\hat{x}(\theta, q) = 0.1 + 0.9\phi$.

5.2 Single-homing consumers

An important modeling choice that we make in this paper is to assume that the only source of friction is that users cannot choose what content they consume while on the platform. In particular, we ignore another potential source of friction, namely the existence of switching costs between websites, which could deter consumers from consuming their optimal mix of content. In this subsection we evaluate the robustness of our results by assuming that consumers incur large switching costs and are constrained to visit only one website (i.e. to singlehome).

If the platform offers a share λ of news, a consumer has a choice between consuming a mix $(x, y) = (\lambda, 1-\lambda)$ on the platform and a mix $(1, 0)$ on the newspaper's website. The platform therefore attracts all the consumers of type θ such that $U(\lambda, 1-\lambda, \theta, q) \geq U(1, 0, \theta, q)$. To analyze this model we focus on the additive model.

Suppose that the platform offers $\lambda \geq q$.[18] Then, consumers who choose to use the platform are such that $|1 - \hat{x}(\theta, q)| > |\lambda - \hat{x}(\theta, q)|$, i.e. such that $\hat{x}(\theta, q) < \frac{1+\lambda}{2}$ (see Figure 3). The total time spent on the platform is then $T_0^{SH}(q, \lambda) = \frac{1+\lambda-2q}{2}$. Notice that this is precisely the time spent on the platform when consumers can multihome at no cost (see

[18] This is true when there is content bundling, by the same logic as Proposition 2.

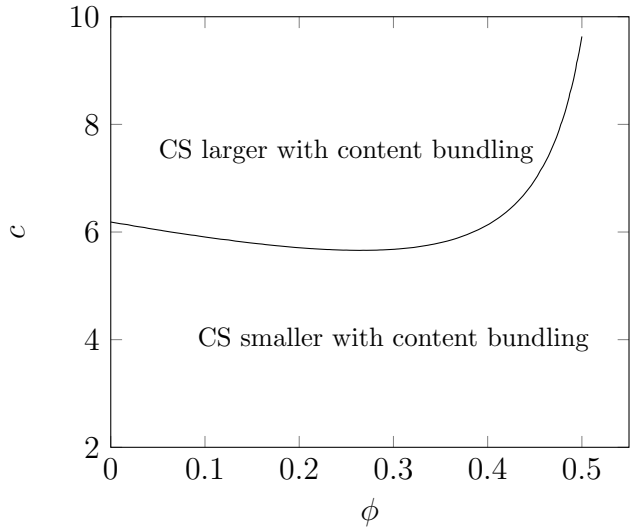

Figure 4: Change in consumer surplus, CS when consumers single home.

Equation (6)). The equilibrium values of λ and q are therefore the same as in Section 4. In particular, $T_1(q,\lambda) = \frac{1+2q-\lambda}{2}$ and $q^* = \frac{2-\phi}{2(1+c-\phi)}$.

Under the benchmark, the consumers who visit the newspaper are such that $\theta + q \geq 1/2$, i.e. $T_1(q,0) = \frac{1}{2} + q$. The solution to $\max_q\{T_1(q,0) - cq^2/2\}$ is $\tilde{q} = 1/c$, which is larger than q^*. Intuitively, the marginal effect of q on T_1 is the same in both cases, but under content bundling the value of inducing a consumer to switch is smaller because the newspaper receives a share of the revenues if the consumer visits the platform.

Regarding profits, Proposition 4 still applies.

Proposition 6. *In the additive model with single-homing consumers, both newspaper's quality and profit are lower under content bundling than under the benchmark.*

Even though quality unambiguously goes down under content bundling, consumers may be better-off than under the benchmark because content bundling allows them to consume both news and UGC. This is illustrated in Figure 4.

5.3 Newspaper opt-out

In practice, a newspaper with sufficient resources has the ability to remove its content from social platforms, or at least to make it harder for the platforms to show news. Given the adverse effect of content bundling on the newspaper's profit, here, we investigate how the ability to opt-out affects the equilibrium outcome.

Consider the following extension of our baseline model: at $\tau = 0$, the platform offers a contract of the form (F, ϕ) to the newspaper. F is a fixed payment, and ϕ is the share of the advertising revenue that the platform keeps whenever it shows some news to its consumers.[19] At $\tau = 1$ the newspaper accepts or rejects the contract, and chooses a quality q. At $\tau = 2$ the platform chooses λ if the newspaper has not opted-out. $\lambda = 0$ otherwise. At $\tau = 3$ consumers observe q and λ and optimally allocate their attention among the two websites.

Starting from $\tau = 1$, the game is the same as in our baseline model. In particular, if the newspaper rejects the contract, its profit is $\tilde{\pi}_1$. To be accepted, the contract must then deliver a payoff at least equal to $\tilde{\pi}_1$ to the newspaper. Of course the platform does not need to offer more, and so in equilibrium the newspaper is indifferent between accepting and rejecting the offer. The platform's profit is then equal to the industry profit minus $\tilde{\pi}_1$.

At $\tau = 0$, the platform therefore chooses ϕ so as to maximize the industry profit. Because the industry revenue is constant and equal to one, the profit is maximized when the cost - i.e. the quality - is minimized. One way to do so is to offer $\phi = 1$, i.e. to not share revenue with the newspaper. Indeed in that case, at $\tau = 2$, the platform finds it optimal to choose $\lambda = \hat{x}(\overline{\theta}, q)$ i.e. the highest desired news consumption for a quality q in the population, because by doing so it ensures that consumers spend all their time on its website (no consumer wants more news than what the platform offers). Unlike when $\phi < 1$, there is no cost for the platform associated with showing news, because it keeps all the revenue. The newspaper then anticipates that it will get no direct traffic no matter its quality choice, and therefore chooses to not invest in quality.

Proposition 7. *When the platform offers a contract and the newspaper can opt-out, equilibrium quality of news is minimal.*

In the next section we consider a model with multiple publishers. Among other things, this will allow us to show that newspapers' ability to opt-out is less critical in that context, because the platform can rely on a prisoner's dilemma logic and ensure newspapers' participation without having to offer fixed payments.

6 Multiple publishers

The assumption that the newspaper is the unique producer of news is clearly not innocuous. Indeed, it drives to a certain extent the "softening effect": all the news consumed through

[19] Absent the fixed payment the newspaper would always reject the offer, as per Proposition 4. This simple two-part tariffs is actually enough to maximize profit, so there is no need to study more involved schemes (e.g. contracts dependent on q).

the platform come from the monopolist newspaper, who therefore has less of an incentive to compete with the platform for direct traffic. In reality, social networks may bundle many news outlets on consumers' newsfeeds.

To capture this idea, suppose that there is a continuum of symmetric newspapers on the market. Each newspaper has a mass one of traditional readers, who decide how to allocate their time between the newspaper and the social platform. When a traditional reader of newspaper i visits the platform, he is exposed to UGC and news, in proportions $1-\lambda$ and λ. Due to the atomistic nature of the market, we assume that the news a consumer is exposed to while on the platform comes from different outlets than his usual newspaper. Newspapers are local monopolists in the sense that consumers cannot read other newspapers directly. However they are perfect substitutes: consumers only care about the quality of news, not about which newspaper they read. Advertising revenues are the same as in the baseline model. In particular, the platform captures a share ϕ of revenues when it displays news.

The timing is the following: at $\tau = 1$ newspapers simultaneously choose their quality q, at a cost $c(q)$. The quality of a newspaper is observed by the platform and by its traditional readers. At $\tau = 2$ the platform chooses the share of news it displays, λ. Consumers observe λ. At $\tau = 3$ consumers decide how to allocate their time between their usual newspaper and the platform. We look for a perfect Bayesian equilibrium where firms play a symmetric strategy and consumers form rational expectations about newspapers' quality choice (aside from their usual one, which they observe).

We restrict ourselves to the additive model: reading an amount x of news of quality q delivers a utility of $(\theta + q)x$, while reading an amount y of UGC delivers a utility of $-\frac{(1-y)^2}{2}$. We also assume quadratic costs: $c(q) = cq^2/2$, and a uniform distribution of θ over $[0, 1]$.

Benchmark (no content bundling): Without content bundling consumers have the choice between news from their usual newspaper and UGC from the platform. Each consumer then spends a share $\hat{x}(\theta, q)$ of his time reading news. The situation is the same as in the baseline model with a single newspaper: A newspaper's profit is

$$\tilde{\pi}_1 = \int_0^1 \hat{x}(\theta, q)d\theta - cq^2 = \int_0^{1-q} (\theta + q)\, d\theta + \int_{1-q}^1 d\theta - \frac{cq^2}{2} = \frac{1 + 2q - (1 + c)q^2}{2}.$$

The equilibrium quality is then $\tilde{q} = \frac{1}{1+c}$.

Content bundling: At $\tau = 3$, suppose that a consumer's usual newspaper has quality q and that the news quality he expects to obtain while on the platform is q^*. The

consumer then chooses the time he spends on the platform, t_0, so as to maximize $(1-t_0)q + t_0\lambda q^* + 1 - \frac{(1-\theta-(1-\lambda)t_0)^2}{2}$. The solution to this maximization problem is $t_0(\theta,\lambda,q,q^*) = \max\{\min\{\frac{1-q-\theta-(1-q^*-\theta)\lambda}{(1-\lambda)^2},1\},0\}$. Let $\hat{\theta}_1(\lambda,q,q^*)$ be the largest solution to $t_0(\theta,\lambda,q,q^*)=1$, and $\hat{\theta}_2(\lambda,q,q^*)$ the smallest solution to $t_0(\theta,\lambda,q,q^*)=0$.

At $\tau=2$, the platform chooses λ to maximize its profit. Because newspapers are atomistic, λ does not depend on a single newspaper's decision. If all newspapers except a finite number play q^*, the platform receives a total amount of attention $T_0(\lambda,q^*) = \frac{1+\lambda-2q^*}{2}$ per Equation (6). Its profit is then maximized by setting $\lambda(q^*) = \min\{q^* + \frac{\phi}{2(1-\phi)},1\}$.

At $\tau=1$, suppose that newspaper i expects all other newspapers to play q^*. Its profit writes

$$\pi_1 = \int_{\max\{\hat{\theta}_1(\lambda,q_i,q^*),0\}}^{\min\{\hat{\theta}_2(\lambda,q_i,q^*),1\}} (1-t_0(\theta,\lambda,q_i,q^*))\,d\theta + \int_{\min\{\hat{\theta}_2(\lambda,q_i,q^*),1\}}^{1} d\theta + \lambda(1-\phi)\left[\int_0^{\max\{\hat{\theta}_1(\lambda,q^*,q^*),0\}} d\theta + \int_{\max\{\hat{\theta}_1(\lambda,q^*,q^*),0\}}^{\min\{\hat{\theta}_2(\lambda,q^*,q^*),1\}} t_0(\theta,\lambda,q^*,q^*)d\theta\right] - c(q). \quad (10)$$

The first two integrals represent direct traffic to the newspaper, i.e. traffic from its usual readers, who actually observe the choice q_i. The first integral is traffic by the usual readers who also visit the platform, while the second corresponds to usual readers who do not. The term between brackets corresponds to indirect traffic, i.e. consumers who access the newspaper through the platform: the third integral corresponds to consumers who only visit the platform, while the fourth one represents consumers who also spend time on their usual newspaper. Importantly, these consumers do not observe the actual q chosen by newspaper i, but rather form an expectation over the quality of news they expect to receive on the platform q^*, so that indirect traffic is not sensitive to q_i.

In a symmetric configuration, we have $\hat{\theta}_1(\lambda,q^*,q^*) = \lambda - q^* \geq 0$ and $\hat{\theta}_2(\lambda,q^*,q^*) = 1-q^* < 1$. The first-order condition for a symmetric equilibrium can then be written:

$$\int_{\hat{\theta}_1(\lambda(q^*),q^*,q^*)}^{\hat{\theta}_2(\lambda(q^*),q^*,q^*)} -\frac{\partial t_0(\theta,\lambda(q^*),q^*,q^*)}{\partial q}d\theta - c'(q^*) = 0 \Leftrightarrow \int_{\lambda(q^*)-q^*}^{1-q^*} \frac{d\theta}{(1-\lambda(q^*))^2} = cq^*$$
$$\Leftrightarrow q^* = \frac{1}{c(1-\lambda(q^*))}. \quad (11)$$

Comparing q^* and $\tilde{q}$, we have the following result:

Proposition 8. *In the model with monopolistic competition with additive preferences, equilibrium quality is higher with content bundling. Newspapers' profits are lower.*

Remember that in the baseline model with a single newspaper and additive preferences

content bundling could lower equilibrium quality. The intuition for the reversal of the result in a model with monopolistic competition is as follows. First, content bundling no longer creates a softening effect: when a consumer reduces the time he spends on newspaper i's website and increases the time he spends on the platform, newspaper i does not get any indirect revenue from that consumer. Therefore, the cost for a newspaper of losing direct traffic is the same with and without content bundling. Second, with content bundling, direct traffic to newspaper i is more sensitive to q_i under monopolistic competition than under monopoly. Indeed, under monopoly, investment in quality by the newspaper also increases the quality of news that consumers get while on the platform. Under competition on the other hand, an increase in q_i makes newspaper i more attractive without changing the value consumers expect to get from the platform. Formally, we have $-\frac{\partial t_0(\lambda,\theta,q_i,q^*)}{\partial q_i}|_{\text{ competition}} = \frac{1}{(1-\lambda)^2} > \frac{1}{1-\lambda} = -\frac{\partial t_0(\lambda,\theta,q)}{\partial q}|_{\text{ monopoly}}$.

An interesting difference with the model with a single newspaper has to do with the possibility for newspapers to opt-out of the platform. Even though newspapers' profit is lower with content bundling (by a similar argument as under monopoly), newspapers face a prisoner's dilemma: opting-out of the platform leads a newspaper to lose indirect traffic from consumers who would not have read it otherwise, and does not allow to increase direct traffic from its usual readers. It is therefore not a viable strategy for newspapers.

To achieve tractability, we have assumed that indirect traffic to newspaper i does not depend on q_i, i.e. that the platform grants equal prominence to newspapers irrespective of their quality. If the platform were to favor high quality newspapers, then this would increase incentives to invest even further, reinforcing Proposition 8.

7 Discussion and concluding remarks

Social networks have gained tremendous importance in the last decade, claiming a significant share of consumer attention. They have achieved such prominence by leveraging network effects *and*, more recently, by successful content bundling, whereby third party content is presented in their users' "newsfeed". This strategy, in turn, has started to fundamentally transform media production and consumption, a phenomenon of general public interest given the importance of a healthy news industry. Our main contribution is to develop a simple model of competition for attention between a social platform and newspapers, allowing us to shed light both on the strategic motives for content bundling and on its implications on the news industry.

The two main results of our analysis are that content bundling allows the platform to increase the share of attention it captures, and that newspapers' profits are reduced

even though news consumption may increase. Regarding the former result, an interesting phenomenon is that content bundling allows a sort of endogenous gatekeeping phenomenon, whereby consumers read news content through the platform even though they could bypass it. This is especially true when bundles can be personalized: consumers allocate all their attention to the platform. The key driver for the profit-reduction result is that content bundling is a strategic choice by the platform, which ensures that it is always chosen so as to increase the platform's revenues.

Regarding the quality of news content, we uncover several opposing forces that make the overall effect ambiguous. Our analysis suggests that under content bundling, quality is more likely to decrease

The result that newspapers are unambiguously harmed by content bundling begs the question:

From a welfare perspective, content bundling distorts low type consumers' ideal mix of content. Importantly, *for a given quality*, content bundling increases overall news consumption. While this may be desirable under certain circumstances (e.g. when there are positive externalities from news consumption), the distortion reduces consumer surplus. Moreover, if news quality decreases significantly under content bundling, news consumption may actually decrease in equilibrium.

In our baseline model content bundling does not *directly* generate any efficiencies, because consumers can choose their content mix costlessly absent bundling.[20] We show that an alternative way of modelling the situation, where switching costs prevent consumers from "mixing and matching", generates the same predictions regarding profits and quality, suggesting a certain robustness of our results. Of course the welfare implications are then quite different:

Our analysis focused on the impact of a social network on news publishers. Our model readily applies to publishers in other content domains who also seek to be present in consumers' 'newsfeed' on social media. Beyond social networks narrowly defined, the modeling framework also seems to be applicable to a broader set of interactions between multi-sided platforms and third-party 'content' providers. For example, video distribution platforms such as Netflix, Hulu or Amazon Prime Video all bundle third party content in their offering. 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

[20]There could be some indirect efficiencies, if the resulting incentives to provide quality were increased for example.

customer base. Music streaming platforms (such as Spotify or Deezer) also share these features. While these examples still retain the core characteristic of hybrid competition between a platform and traditional content providers, some important differences subsist, for instance the fact that the platforms charge consumers for access .

Future research exploring these related, yet different environments is probably warranted as are some of the aspect that our model omitted. For example, we did not explicitly consider network effects except for the fact that they confer some market power to the platform. Indeed, it is easy to show that without market power the platform would have to set $\lambda = 0$. Similarly, we did not consider heterogeneity across newspapers. Including these features would be fruitful avenues for future research.

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