Revenue Sharing and Subscription Platforms for Digital Content Distribution

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Abstract

We analyze distribution decisions by content creators for digital information goods like books and music. There are two creators (low and high quality) that sell content through the same platform, and may choose whether to distribute their content a la carte, via a subscription service, or both. Each creator may set the price of her a la carte offerings, while the platform keeps a percentage of revenue from each sale. The platform determines the subscription service fee and what fraction of revenue to distribute to content creators, who are paid proportional to the revenue share chosen by the platform and the percentage of total "use" that they generate on the subscription service (e.g., their fraction of total pages read in a month). We show the platform cannot induce only the high quality creator to list on the subscription service; thus, subscription offerings are always weakly lower in quality than a la carte offerings. Moreover, we find that in many cases, to maximize profit, the platform should either induce only the low quality creator to sell via subscription, or it should shut down a la carte sales altogether; inducing high quality on the subscription service is excessively costly, a result which may help to explain the relative low quality of product offerings on these services in practice. We also show that this effect can be mitigated—and inducing high quality on the subscription service can be optimal for the platform—in the presence of a large "subscription only" consumer segment.

Keywords: *information goods; digital distribution; subscription platform; e-books*

1 Introduction

With the rise of digital content distribution in the last two decades, retailers and creators of information goods such as books and music have access to a wider range of selling strategies than ever before. Books, for example, have long been sold as a la carte physical goods, with readers typically purchasing each book that they wish to read, a single unit at a time. Recent advances in e-book technology, most notably Amazon's release of the Kindle e-reader device in 2007, have enabled a new selling strategy: authors or publishers—whom we jointly refer to as content creators—may still sell their content as a la carte digital goods, but they may also include their books in a subscription service, such as Amazon's Kindle Unlimited or Rakuten's Kobo. In such a service, subscribers pay

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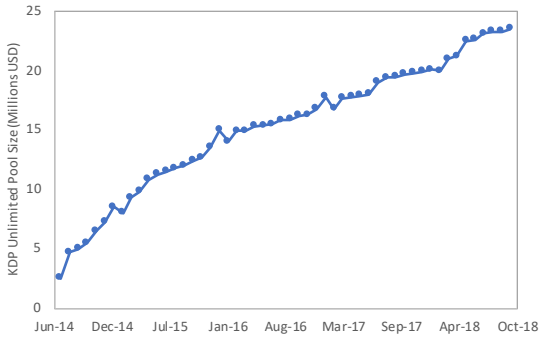

Figure 1. Growth of the monthly Kindle Direct Publishing (KDP) Unlimited Funding Pool from July 2014 to October 2018. Source: The Digital Reader (2018).

a fixed monthly fee in exchange for unlimited reading access to a library of content from multiple content creators who have all chosen to participate by listing their products on the subscription service. This allows subscribers to consume as much content (e.g., read as many books) from the library as they want each month for a flat fee. Aside from books, a similar model can be found in music (e.g., Apple and Amazon both offer music subscription services) and video (e.g., Netflix and Hulu). With most subscription services for digital content, platforms typically collect monthly fees from all active subscribers and keep a fixed percentage of these revenues. The remaining amount, also known as a "funding pool," is distributed amongst content creators who have listed on the service based on a relative metric of how much their product was consumed by users, e.g., the proportion of total page reads that their book accounted for in a month, or proportion of total downloads their song accounted for in a month. As a result, the author with the most enjoyable content—content that generates the most volume on the subscription platform—will receive more revenue. As shown in Figure 1, since launching in July 2014, the Kindle Unlimited funding pool (the amount of money dispersed to authors) for creators publishing directly via Amazon (i.e., not including authors working with a publisher) has steadily increased and now exceeds $20 million per month.

A subscription service can be attractive for content creators because it allows them to reach more consumers. For some readers, the a la carte price of a book may deter them from purchasing a book by a new, unknown author who they may or may not like: once an a la carte purchase has been made, the consumer may discover that they do not like the book, and as a result they wasted the money they paid for the a la carte item. However, with a subscription service, the per-unit consumption cost is zero. This allows consumers to "try out" content of uncertain or variable quality that they may have chosen not to try via a la carte sales. As summarized in a recent article

from *The Atlantic* (Semuels, 2018), "readers who might not be willing to pay outright for books by unknown writers will read those books on Kindle Unlimited, where they feel free." Thus, by lowering the per-unit consumption cost to zero, subscription services allow consumers to try the content of a wider variety of creators than they might with only a la carte purchases; in turn, this can benefit creators by expanding their audiences.

On the other hand, platforms are interested in subscription services because they may attract a larger population of customers and authors by promising a high variety of content and a substantial collective funding pool for royalties, respectively. This creates a virtuous cycle: more content creators (and consequentially more books) on a platform makes the subscription fee appear more attractive to consumers, and more consumers means a larger funding pool which then further attracts content creators. Over the long term, the platform maximizes its profit by increasing the number of subscribers, since it takes a percentage cut of total subscription fees, and hence it benefits from providing a service that creators find valuable and are eager to participate in.

Despite their seeming advantages, subscription services for digital goods also lead to some challenges for platforms and content creators. In many traditional business models that involve bundling or subscription (for example, bundles of software licenses or a set of cleaning products), the seller chooses both the contents and the price of the bundle. These choices are frequently made because of complementary consumption behaviors or to "even out" unknown individual consumer valuations for each item in the bundle. Subscription platforms for digital goods that we consider in this paper differ in that the platform sets the subscription price and sells directly to consumers, but does not (directly) choose what is in the subscription bundle. Instead, the platform can only offer the option of listing in the subscription service to content creators, and can attempt to influence precisely how content creators choose to distribute their products by setting the contract parameters for both the a la carte and subscription channels.

Creators, on the other hand, must individually choose how best to sell their own products: on the subscription platform, a la carte, or both. Because some consumers may utilize both the subscription and a la carte channels, for a content creator, while listing on a subscription service can be an additional source of demand, it can also result in cannibalization of a la carte sales. In particular, listing a product on the subscription service may result in a consumer who would have otherwise paid a full a la carte price consuming it via subscription instead. Because of this, many content creators choose not to list on subscription services; on Amazon's Kindle Unlimited, for instance, 1.4 million books are included in the subscription service, but 3.7 million books are sold

a la carte in the Kindle Store (Kowalczyk, 2017). In addition, on the subscription service, creators must share revenue not just with the platform but also with one another, and the sharing fraction *between* creators is directly proportional to their relative levels of consumption. As a result, the introduction of this new distribution strategy raises several interesting challenges for the creators and platforms involved in the digital content supply chain.

In this paper, we explore precisely these issues as we consider how content creators should sell their work, how platforms should set revenue sharing parameters for a la carte and subscription sales, and what these choices mean for the overall digital content supply chain. We study the following main research questions. First, for content creators, given a set of revenue shares for the a la carte and subscription channels: should a product be sold via a traditional a la carte strategy, a subscription strategy, or a combination of both? Second, for platforms, how should revenue shares of the subscription and a la carte options be set? Does the answer to this question change depending on whether the platform is myopically maximizing immediate expected profits, versus if it seeks to promote the subscription service by inducing content creators to list on the service? And third, for platforms and creators, how should contracts be structured to maximize the efficiency of the digital content supply chain?

To answer these questions, we develop a stylized model of content creators who choose how to sell their products, consumers that choose how to buy them, and a platform that chooses how to price its services and share its revenue with creators. Specifically, we model two heterogeneous content creators selling via a single platform that controls both the a la carte and subscription channels. One content creator is "high quality" and sells a product that yields high consumer value, while the other is "low quality" and sells a product with lower consumer value. The platform in our model first chooses the share of revenue from a la carte and subscription sales to give to the creators. After these revenue shares have been set, content creators choose whether to sell via one channel, both channels, or neither. After distribution channels have been chosen, content creators set the price of any goods they are selling a la carte, while the platform sets the price of the subscription service. Finally, consumers arrive and choose whether to subscribe to the service and whether to consume either of the creators' products. Consumers in our base model are one of two types: *a la carte only* consumers and *hybrid* consumers. A la carte only consumers do not consider a subscription and will only purchase content individually. These consumers may represent those with lower consumption quantities or infrequent consumption rates who would not benefit from a subscription model; alternatively, these could be consumers who experience some intrinsic

value from "owning" a copy of the product rather than "renting" via a subscription service. Hybrid consumers, on the other hand, are willing to pay for a subscription, but will also purchase products they desire a la carte if they are not available on the subscription service. However, if a product is available on both the subscription and a la carte channels, hybrid consumers will only consume from the subscription channel. (In an extension, we consider a third category of consumers: subscription only consumers.)

Our main findings are as follows. First, the platform cannot induce only the high type to list on subscription. This means that the average quality of the subscription library cannot exceed the average quality of all content creators who sell through this platform. Second, the profit maximizing choice for the platform is to always induce only the low type to list on the subscription service, or to effectively "shut down" the a la carte channel entirely and induce both creators to sell via subscription. Third, in order to induce the high type to list on subscription while also selling a la carte, the platform has to offer a subscription revenue share rate that is substantially higher than the a la carte rate. This rate increases as consumer tastes become more dispersed and rapidly increases for small and moderate differences between the high and low type's quality. Hence, the cost of inducing high quality creators to join the subscription service may be significant, perhaps explaining why many subscription services tend to exclude the most famous and popular content creators.

The remainder of this paper is organized as follows. In §2 we review the related literature on bundling and subscription goods, digital distribution, and supply chain coordination through contracts. In §3 we introduce the components of our model. In §4, we analyze the equilibrium selling strategies for content creators. §5 discusses platform decisions given the content creators' selling strategies. §6 extends our base model to include a "subscription only" consumer segment, and analyzes the creators' optimal selling strategies and the optimal platform decisions in the presence of such a population. §7 concludes the paper with a discussion of key managerial insights.

2 Literature Review

This paper lies at the intersection of three streams of literature: bundling and subscriptions, digital content distribution, and supply chain coordination via contracts.

Bundling and subscriptions. The literature on bundled and subscription (which may thought of as inter-temporally bundled) goods literature discusses many benefits of bundling, including

cost savings during production and transaction, complementary value of bundled elements, and improving pricing power by sorting consumers based on their valuations. The last of these is most closely related to our work. Stigler (1963) first discusses how bundling two movie rights could increase sellers' profits when consumer valuations for the two goods are negatively correlated. Adams & Yellen (1976) show with two goods that commodity bundling under monopoly allows for greater extraction of consumer surplus through comparing unbundled sales to sales under pure bundling and mixed bundling. Schmalensee (1984) models reservation prices as a bivariate Gaussian distribution and shows that pure bundling reduces the heterogeneity of the consumer population, allowing sellers to extract more consumer surplus. Hanson & Martin (1990) consider how a monopolist facing segmented consumer demand should determine product line breadth (similar to bundling) and pricing using a mixed integer linear program. Bakos & Brynjolfsson (1999) expand this to large bundles of goods and offer a framework for modeling value of bundling. Bakos & Brynjolfsson (2000) extend upon that work by including various forms of competition, including competition between two bundlers and competition between a bundler and a single-good seller. Bakos & Brynjolfsson (2001) generalize the framework from Bakos & Brynjolfsson (1999) by adding in the cost of digital distribution over a network to compare pricing strategies under aggregation and disaggregation. Hitt & Chen (2005) look at pricing strategies when the bundle is a consumers selected subset of a larger pool of available goods. Our work differs from these in several ways. Unlike these papers, our seller (the platform) does not decide what *content* is in the bundle (the subscription service), because this is typically the decision of the content creator. Moreover, these content creators, who effectively decide the content of the bundle, are in direct competition with one another for the limited pool of subscription fees that they share based on their relative popularity. In addition, in our model, since the platform only offers one subscription plan, there is also no consumer-customized bundling; instead, all items listed on the subscription service are bundled together. Lastly, the platform in our model does not set all of the prices for the products it sells; reflective of actual practice (e.g., book sales on Amazon), the content creator sets the price on the unbundled (a la carte) good and the platform sets the bundled (subscription) price.

Digital distribution. Most of the existing digital distribution (and specifically e-book) literature focuses on a la carte sale of e-books. Gilbert (2015) gives an overview of e-books and the underlying conflicts in pricing between publishers and retailers with an in-depth examination of Amazon, but focuses on a la carte pricing. More broadly, much of the existing work on digital goods, such as Lahiri & Dey (2013), Chellappa & Shivendu (2005), and Wu & Chen (2008), focus on how piracy

affects firms and how firms can react to piracy. We do not consider piracy in our work, and instead focus on selling digital content through subscription and/or a la carte channels, where both vertical and horizontal differentiation in quality determines pricing decisions. There are a few works related to digital retailing, specifically a common contract called the "agency model" where publishers set prices for e-books and then the electronic retailer takes a fixed percent of sales in exchange for listing the e-book. Tan *et al.* (2016) examines the agency model for digital goods and shows how it can mitigate the double marginalization effect and coordinate the digital supply chain with multiple competing retailers. Tan & Carrillo (2017), Johnson (2013), and Johnson (2017) compare the agency model and wholesale contracts for digital goods. Our paper differs in that we are not comparing contracts, but taking as given that agency contracts are used (i.e., the content creator sets the a la carte price of the e-book while the platform takes a fraction of the revenue) and the listing platform sets subscription prices for the library of opt-in e-books. Lastly, Lei & Swinney (2018) analyze supply chain design and coordination for substitutable digital (zero marginal cost) and physical (positive marginal cost) information goods, i.e., e-books and paper books; by contrast, we do not consider physical information goods in the present analysis.

Supply chain coordination via contracts. The current literature on supply chain coordination looks at three types of supply chain structures: bilateral monopolies, one manufacturer selling to multiple retailers, or multiple manufacturers selling through one common retailer. The last is closest to our paper. The marketing literature looks at contracts when multiple manufacturers sell through a common retailer using a wholesale price contract, e.g. Choi (1991), Trivedi (1998), and Lee & Staelin (1997). However, in our model, to reflect common practice for information goods like e-books, we have a revenue sharing contract for both the subscription (bundled) and a la carte (not bundled) sales, and moreover prices are set by two different parties: the platform sets the subscription price (bundled) and the content creator sets the a la carte prices (not bundled). Tsay *et al.* (1999), Cachon & Lariviere (2005), and Cachon (2003) provide surveys of incentive issues and coordination mechanisms under common supply chain contracts. Our work is also related to models of multi-channel retail distribution, including Balasubramanian (1998) and Chiang *et al.* (2003).

To summarize, our paper is the first, to our knowledge, to consider a competitive model of content creators selling on a common platform that allows creators to choose between a la carte and subscription distribution methods, a choice which, in turn, is determined by revenue sharing contract terms established by the platform.

3 Model

Two content creators each have a single product to sell. The product is sold via a platform (such as Amazon's Kindle store or Apple's iTunes store) that offers both a la carte sales and a subscription service. One creator is higher quality than the other: we call the high quality creator "H" and the low quality creator "L." The type of each creator is public information, i.e., it is known to all consumers, the creators, and the platform. For instance, one creator could be an author of low-quality pulp novels, while the other is a internationally recognized bestselling author. The creators do not *directly* compete with one another (e.g., via price competition): consumers have an inherent interest in the products of both creators, and will consume those products independently if they receive non-negative utility from doing so (as described below). However, creators *indirectly* compete with one another if both sell via the subscription platform, as their share of the revenue received depends on their relative quality levels.

Consumer Population. The utility that a consumer receives from the product of a type i creator is $v_i + \epsilon_i$, where $v_H \geq v_L$ are homogeneous between consumers. The "noise term" ϵ_i is a mean zero random variable, and each consumer-creator pair realizes an iid draw from the same distribution to generate ϵ_i. Let F be the distribution function and f be the density of ϵ_i. For ease of exposition, throughout this analysis we assume that $\epsilon_i \sim U[-\ell, \ell]$. This noise term represents the personal preferences and tastes of the individual. Here, ℓ can be thought of as a measure of how "dispersed" consumer tastes are. If ℓ is small, then consumers have very homogenous tastes for each product; if ℓ is large, they have very disparate tastes, and consequently have a wide range of values for the creators' products. We thus refer to ℓ as the "dispersion" of consumer valuations throughout the paper. Note that while the H creator's product does, on average, result in higher utility for consumers than the L creator's product, it's possible for an individual consumer to prefer the L creator's product, depending on the realization of her noise term ϵ_i for each creator. This reflects the fact that, for instance, while consumers may *usually* prefer books by J. K. Rowling to those by John Grisham, it is possible for an individual consumer to prefer a *particular* Grisham novel to a particular Rowling novel.

Consumers have a homogenous outside option value of zero, and prefer to consume the product if their utility net of their consumption cost is weakly greater than zero. We assume there are two populations of consumers: "a la carte" only consumers who only purchase goods that are sold a la carte, and "hybrid" consumers who consider both the subscription service and a la carte products

and, potentially, purchase both if they receive non-negative utility from doing so. (In §6, we extend the model to include a segment of consumers who only purchase via subscription.) The number of a la carte only consumers is N_A, and the number of hybrid consumers is N_H. This division of the consumer population is reflective of the observation that some consumers are receptive to subscription services while some are not; for instance, in a 2015 a survey of US millennials (consumers aged 18-34), 42% purchased a la carte e-books, while only 22% used subscription services (Statista, 2015); in 2017, 37% of all US consumers were "not at all interested" in an e-book subscription service, and only 14% were "very interested" (Statista, 2017a).

A la carte Consumption. Product i, if offered on the a la carte channel, is sold at price p_i. Consumers who purchase via the a la carte channel must buy the product before they observe their own personal ϵ_i. Because of the nature of the information goods we are considering, they may "sample" before they commit to fully consuming the good; this allows them to realize their value of ϵ_i prior to completing consumption of the product. For instance, they may read the first few chapters of a book, from this deduce their ϵ_i, and then compare their utility to their outside option (zero) and choose to either continue reading or abandon the book. We assume this initial sampling stage is instantaneous and costless to the consumer, and moreover the cost of the product (either a la carte or subscription) is sunk once this decision is made, thus they choose to fully consume the product if $v_i + \epsilon_i \geq 0$. Because of this, the fraction of users that consume the product is equal to $1 - F(-v_i)$.

Thus, ex ante (before making a purchase of the a la carte item), the homogeneous population of consumers thus perceives their probability of "liking" a product (enough to fully consume it) to be $1 - F(-v_i)$. The utility from consuming the product is $v_i + \epsilon_i$ if the consumer chooses to fully consume it, and zero otherwise, thus the expected utility at the time of purchase is

$$\begin{aligned} u_i &\equiv (1 - F(-v_i))E(v_i + \epsilon_i | v_i + \epsilon_i \geq 0) + F(-v_i)E(0 | v_i + \epsilon_i < 0) \\ &= (1 - F(-v_i))E(v_i + \epsilon_i | v_i + \epsilon_i \geq 0) \\ &= \int_{-v_i}^{\infty} (v_i + x) f(x) dx. \end{aligned}$$

Given the assumption of uniform noise on $[-\ell, \ell]$, $f(x) = \frac{1}{2\ell}$. Thus,

$$u_i = \int_{-v_i}^{\ell} (v_i + x) \frac{1}{2\ell} dx = \frac{(\ell + v_i)^2}{4\ell}.$$

Because $v_H \geq v_L$ and the ϵ_i noise term is iid, it follows that $u_H \geq u_L$. Consumers are willing to purchase the a la carte option as long as their expected surplus is non-negative, i.e., $u_i - p_i \geq 0$. We assume that the content creator sets the price of a la carte product (p_i), and it is clearly optimal to set $p_i = u_i$.

Subscription Consumption. Consumers who purchase via the subscription channel do so in a two step, sequential process. First, they pay the fee to subscribe. After paying the fee, they may begin to consume the products offered via subscription. Let C denote the set of creators who sell via the subscription service, i.e., $C \in \{\emptyset, L, H, L + H\}$. The price of the subscription service is p_S. Given this, expected (ex ante, at the time of signing up for the subscription service) net utility from the subscription service is

$$\sum_{i \in C} u_i - p_S.$$

If a product is sold both a la carte and via the subscription service, we assume that a hybrid consumer who has paid to use the subscription service will consume it via subscription. Consumers choose to subscribe to the service if doing so yields non-negative net utility. We assume that the platform sets the price of the subscription service (p_S) after content creators have chosen their selling strategies to maximize its own profit. We also assume that there is no direct competition between the platform and content creators via price on the subscription service and a la carte offerings: that is, hybrid consumers that consider both offerings will always choose the subscription service if it provides them non-negative net utility, and will only consider a la carte if the item want is not offered on subscription or if a subscription gives them negative net utility.

Creator Choice of Selling Strategy. The creators choose their selling strategy—i.e., which distribution channels they wish to use—simultaneously after the platform has chosen its revenue sharing parameters. Consistent with prevalent practice, we assume that there is no fixed or variable cost associated with either selling strategy (e.g., there is no per unit fee charged by the platform for each a la carte sale, and there is no "listing fee" for either distribution channel). If a creator is indifferent between using and not using a particular distribution channel, we assume the creator uses the channel in question.

Contracts and Revenue Sharing. The platform is assumed to receive a fixed fraction of the a la carte revenue, $1 - \phi_A$, leaving the content creator the remaining fraction (ϕ_A). Subscription revenue is determined as follows. First, the platform collects revenue from all consumers who pay for the service. Next, the platform keeps a fraction of this revenue, $1 - \phi_S$. Finally, the remaining

fraction of revenue, ϕ_S, is divided between the content creators based on the fraction of realized "complete consumptions." For example, if the L creator realizes 5 complete reads, and the H creator realizes 10 complete reads, then the L creator receives 1/3 of the revenue while the H creator receives 2/3. Further details of the revenue split are discussed below. The platform chooses the revenue share parameters at the start of the game to maximize its own profit, possibly subject to some reservation level of revenue sharing required by the creators to participate (more on this point will be discussed in §5).

Sequence of Events. The sequence of events is as follows:

1. The platform determines the revenue shares, ϕ_A and ϕ_S.
2. Creators simultaneously determine whether to sell a la carte, subscription, or both.
3. Creators simultaneously determine their a la carte prices, p_i, and the platform determines its subscription price, p_S.
4. Hybrid consumers determine whether to sign up for the subscription service.
5. All consumers determine whether (and how) to consume the products of the L and H creators.

We let Π_P be the profit of the platform, and Π_i be the profit of the type i creator. We refer to step 1 as the Contracting Stage, and steps 2-5 as the Selling Stage. We focus our initial analysis on the Selling Stage before considering the Contracting Stage.

4 The Selling Stage

In this section, we analyze the game beginning with step 2 in the sequence of events. At this point in the game, the revenue shares have been determined, and the creators must choose how to distribute their content. Each creator has three possible selling strategies: a la carte only (AO), subscription only (SO), and both (SA). Thus, in total, between the two creators there are nine possible combinations of selling strategies that may occur. We thus analyze the game by first enumerating each of these possible outcomes and deriving creator and platform profits that result, and then determine the equilibrium choice of selling strategies by creators on the platform. We let (X, Y) refer to the outcome in which the L creator uses selling strategy X and the H creator uses selling strategy Y. Throughout this section, we assume that both the a la carte and subscription channels are feasible for the creators (i.e., at the given ϕ_A and ϕ_S they are willing to participate);

in §5, we introduce the concept of a reservation revenue sharing value that is required to induce participation in each of the distribution channels.

4.1 Possible Selling Strategies

We begin with (AO, AO). In this case, no products are sold via subscription. The optimal a la carte price is $p_i = u_i$, and both creators earn this revenue from all hybrid and a la carte only customers, yielding total profits:

$$\Pi_P = (1 - \phi_A)(N_H + N_A)(u_L + u_H)$$
$$\Pi_L = \phi_A(N_H + N_A)u_L$$
$$\Pi_H = \phi_A(N_H + N_A)u_H$$

Next, we move to (AO, SO). In this case, the L product is only sold via a la carte and the H product is only sold via subscription. The optimal price of the L product is $p_L = u_L$, and the L creator earns this revenue from all hybrid and a la carte only customers. The only subscription product is the H product, so (ex ante) net consumer utility from the subscription is $u_H - p_S$. The optimal subscription price set by the platform is thus $p_S = u_H$. Total profits are:

$$\Pi_P = (1 - \phi_A)(N_H + N_A)u_L + (1 - \phi_S)N_H u_H$$
$$\Pi_L = \phi_A(N_H + N_A)u_L$$
$$\Pi_H = \phi_S N_H u_H$$

Note that by selling only via the subscription platform, the H creator has lost revenue from the N_A a la carte only customers.

In (AO, SA), the L product is only sold via a la carte and the H product is sold via both channels. The optimal price of the L product is $p_L = u_L$, and the L creator earns this revenue from all hybrid and a la carte only customers. The optimal a la carte price of the H product is $p_H = u_H$, and the H creator earns this revenue from all a la carte only customers. The only subscription product is the H product, so net consumer utility from the subscription is $u_H - p_S$. Hence, the optimal subscription price set by the platform is $p_S = u_H$, which extracts all surplus from hybrid customers and causes them to sign up for the subscription and consume the product via that channel (per our

earlier assumption). Total profits are:

$$\Pi_P = (1-\phi_A)(N_H+N_A)u_L + (1-\phi_A)N_A u_H + (1-\phi_S)N_H u_H$$
$$\Pi_L = \phi_A(N_H+N_A)u_L$$
$$\Pi_H = \phi_S N_H u_H + \phi_A N_A u_H$$

Note that for the H creator, this clearly dominates (AO, SO), as it provides access to an additional pool of consumers (the N_A a la carte only consumers). Moving next to (SO, AO), this case is the opposite of (AO, SO), and so by symmetry:

$$\Pi_P = (1-\phi_A)(N_H+N_A)u_H + (1-\phi_S)N_H u_L$$
$$\Pi_L = \phi_S N_H u_L$$
$$\Pi_H = \phi_A(N_H+N_A)u_H$$

In (SO, SO), both creators sell only via the subscription service. The optimal price is thus $p_S = u_L + u_H$. After the platform takes its cut of $1-\phi_S$, the remaining revenues for the creators are $\phi_S N_H(u_L+u_H)$. The total number of customers that read the L product is equal to $(1-F(-v_L))N_H$ while $(1-F(-v_H))N_H$ read the H product. Thus, the L creator is entitled to the following fraction of the shared revenue:

$$\alpha \equiv \frac{(1-F(-v_L))}{(1-F(-v_L))+(1-F(-v_H))} \tag{1}$$

while the H creator is entitled to a complementary fraction. Total profits are thus:

$$\Pi_P = (1-\phi_S)N_H(u_L+u_H)$$
$$\Pi_L = \alpha\phi_S N_H(u_L+u_H)$$
$$\Pi_H = (1-\alpha)\phi_S N_H(u_L+u_H)$$

Moving to (SO, SA), in this case both creators sell via the subscription service, but the H type sells via a la carte as well. Revenues from the subscription service follow as in the previous case, but the

H type enjoys the addition of a la carte revenues from N_A consumers. Total profits are thus:

$$\Pi_P = (1-\phi_A)N_A u_H + (1-\phi_S)N_H(u_L+u_H)$$
$$\Pi_L = \alpha\phi_S N_H(u_L+u_H)$$
$$\Pi_H = (1-\alpha)\phi_S N_H(u_L+u_H) + \phi_A N_A u_H$$

Note that for H creator, this clearly dominates (SO, SO), as (once again) it provides access to the a la carte only population of customers. (SA, AO) is the opposite of (AO, SA), and so by symmetry:

$$\Pi_P = (1-\phi_A)(N_H+N_A)u_H + (1-\phi_A)N_A u_L + (1-\phi_S)N_H u_L$$
$$\Pi_L = \phi_S N_H u_L + \phi_A N_A u_L$$
$$\Pi_H = \phi_A(N_H+N_A)u_H$$

Note that for L creator, this clearly dominates (SO, AO), for similar reasons as in the previously dominated cases. On the other hand, (SA, SO) is the opposite of (SO, SA), and so by symmetry:

$$\Pi_P = (1-\phi_A)N_A u_L + (1-\phi_S)N_H(u_L+u_H)$$
$$\Pi_L = \alpha\phi_S N_H(u_L+u_H) + \phi_A N_A u_L$$
$$\Pi_H = (1-\alpha)\phi_S N_H(u_L+u_H)$$

For L creator, this clearly dominates (SO, SO). Finally, in (SA, SA), both creators sell via both channels. Total profits are thus:

$$\Pi_P = (1-\phi_A)N_A(u_H+u_L) + (1-\phi_S)N_H(u_L+u_H)$$
$$\Pi_L = \alpha\phi_S N_H(u_L+u_H) + \phi_A N_A u_L$$
$$\Pi_H = (1-\alpha)\phi_S N_H(u_L+u_H) + \phi_A N_A u_H$$

Note that for H creator, this clearly dominates (SA, SO), while for the L creator, it dominates (SO, SA).

4.2 Equilibrium Analysis of the Selling Stage

Combining and summarizing the insights discussed above, we have our first result:

		H Creator	
		AO	SA
L creator	AO	$\phi_A(N_H + N_A)u_H$	$\phi_S N_H u_H + \phi_A N_A u_H$
	SA	$\phi_A(N_H + N_A)u_H$	$(1-\alpha)\phi_S N_H(u_L + u_H) + \phi_A N_A u_H$

Table 1. Payoffs for the H creator in the selling stage game.

Proposition 1. *For both creator types, strategy SA dominates strategy SO, regardless of the other creator's strategy.*

Proof. All proofs appear in Appendix A. □

When a content creator sells only via subscription versus selling on both subscription and a la carte, she is missing out on selling to a la carte only consumers. If she also lists on a la carte in addition to subscription and no one purchases a la carte, then she is no worse off than if she sold only on subscription. If even one a la carte only consumer purchases, then she realizes strictly greater profit; as a result, selling strategy SA (both channels) dominates SO (subscription only). However, this contrasts with a comparison between selling a la carte only versus selling both a la carte and on subscription. When the content creator sells only a la carte, she is capturing a mix of a la carte only consumers and hybrid consumers. When she adds the option of subscription, then hybrid consumers will switch to reading on subscription. Depending on the revenue sharing parameter and expected revenue share based on reads from subscription fees, the content creator could be better or worse off as a result. Thus, while it is always preferred for the content creator to list both on subscription and a la carte versus subscription only, the same is not always true for listing on both channels versus selling a la carte only.

Because of Proposition 1, we may restrict our analysis to only the AO and SA strategies, and the selling strategy choice reduces to a 2x2 normal form game in which each creator chooses either a la carte only, or subscription and a la carte. To analyze this game, we begin by considering the incentives of the H creator, whose payoffs from the selling stage game are given in Table 1. Conditional on the L creator playing AO, the H creator plays SA if and only if $\phi_S N_H u_H + \phi_A N_A u_H \geq \phi_A(N_H + N_A)u_H$, which reduces to $\phi_S \geq \phi_A$. Otherwise, the H creator plays AO. Conditional on the L creator playing SA, the H creator plays SA if and only if:

$$(1-\alpha)\phi_S N_H(u_L + u_H) + \phi_A N_A u_H \geq \phi_A(N_H + N_A)u_H,$$

		H Creator	
		AO	SA
L creator	AO	$\phi_A(N_H + N_A)u_L$	$\phi_A(N_H + N_A)u_L$
	SA	$\phi_S N_H u_L + \phi_A N_A u_L$	$\alpha\phi_S N_H(u_L + u_H) + \phi_A N_A u_L$

Table 2. Payoffs for L creator in the selling stage game.

which reduces to

$$(1-\alpha)\left(\frac{u_L+u_H}{u_H}\right) \geq \frac{\phi_A}{\phi_S}. \tag{2}$$

Consider the left hand side of this inequality. An alternate way of writing this expression is:

$$(1-\alpha)\left(\frac{u_L+u_H}{u_H}\right) = \frac{\frac{(1-F(-v_H))}{(1-F(-v_H))+(1-F(-v_L))}}{\frac{u_H}{u_L+u_H}},$$

i.e., it is the ratio between the H creator's fraction of *total consumption quantity* on the subscription platform and the H creator's contribution to the fraction of *total consumer utility* from a subscription. Note that, given our distributional assumption of uniform noise, $\frac{(1-F(-v_H))}{(1-F(-v_H))+(1-F(-v_L))} = \frac{\ell+v_H}{\ell+v_L+\ell+v_H}$ and $\frac{u_H}{u_L+u_H} = \frac{(\ell+v_H)^2}{(\ell+v_L)^2+(\ell+v_H)^2}$. In turn, this yields

$$(1-\alpha)\left(\frac{u_L+u_H}{u_H}\right) = \frac{(\ell+v_L)^2+(\ell+v_H)^2}{(\ell+v_H)(\ell+v_L)+(\ell+v_H)^2} \leq 1. \tag{3}$$

In other words, the H creator always contributes less to the *total consumption quantity* that it does to *total consumer utility* on the subscription service. Given that (2) must hold in order for the H creator to play SA conditional on the L creator playing SA, and the left hand side (2) is weakly less than 1 per (3), it follows that $\phi_A < \phi_S$ is necessary (but not sufficient) for (SA, SA) to be an equilibrium. Put another way, the H creator is not compensated enough for her contribution to overall consumer utility (and hence her contribution to subscription revenue) by allocating her share of the subscription revenue based on her fraction of consumption; this, in turn, implies that in order for the H creator to be induced to sell via the subscription service, more favorable terms (in the sense of a higher overall revenue share, ϕ_S) are required.

Next, we analyze the best response of the L creator. Payoffs for the L creator in the selling stage game are given in Table 2. Conditional on the H creator playing AO, the L creator plays SA if and only if $\phi_S N_H u_L + \phi_A N_A u_L > \phi_A(N_H + N_A)u_L$, which reduces to $\phi_S \geq \phi_A$. Otherwise, when $\phi_S < \phi_A$, conditional on the H creator playing AO, the L creator also plays AO. Conditional on

the H creator playing SA, the L creator plays SA if and only if

$$\alpha\phi_S N_H(u_L + u_H) + \phi_A N_A u_L \geq \phi_A(N_H + N_A)u_L,$$

which reduces to $\alpha\left(\frac{u_L+u_H}{u_L}\right) \geq \frac{\phi_A}{\phi_S}$. Similar to the H creator's payoffs analyzed above, the left hand side of this expression is the ratio between the L creator's fraction of *total consumption quantity* on the subscription platform and the L creator's contribution to the fraction of *total consumer utility* from a subscription. Given our distributional assumptions,

$$\alpha\left(\frac{u_L + u_H}{u_L}\right) = \frac{(\ell + v_L)^2 + (\ell + v_H)^2}{(\ell + v_H)(\ell + v_L) + (\ell + v_L)^2} > 1,$$

i.e., the L creator always contributes *more* to consumption quantity than she does to total utility generated on the subscription service by her presence. Hence, the L creator receives a disproportionately high share of the revenue split on the subscription service, while (as discussed above) the H creator receives a disproportionately low share of the revenue split. This fact leads to the following result:

Proposition 2. *Define* $\beta \equiv \left((1-\alpha)\frac{u_L+u_H}{u_H}\right)^{-1} = \frac{(\ell+v_L)(\ell+v_H)+(\ell+v_H)^2}{(\ell+v_L)^2+(\ell+v_H)^2} > 1$. *Then, the equilibrium to the selling stage exists and is unique, and is characterized as follows:*
(i) If $\phi_S \geq \beta\phi_A$, *both creators sell via both distribution channels.*
(ii) If $\beta\phi_A > \phi_S \geq \phi_A$, *the low quality creator sells via both channels, while the high quality creator sells only via the a la carte channel.*
(iii) If $\phi_S < \phi_A$, *both creators sell only via the a la carte channel.*

This proposition has several important implications. From part (iii), we see that when the subscription revenue share rate (the portion of subscription revenue given to content creators) is lower than that of a la carte sales, no content creator lists their work on subscription. The reason for this is that the entire customer population is receptive to a la carte sales; hence, creators may capture the entire market with a la carte, and if they cannot achieve a higher revenue share than a la carte sales with subscription, there is no reason for them to use the subscription service. Thus, if a content creator decides not to sell via subscription but only sell a la carte, it is not necessarily true that the other content creator chooses to list on subscription, despite the fact that she could capture the whole subscription reader base and associated profit, i.e., by yielding 100% of consumption on the subscription service. If the a la carte revenue share is higher than the subscription share, then

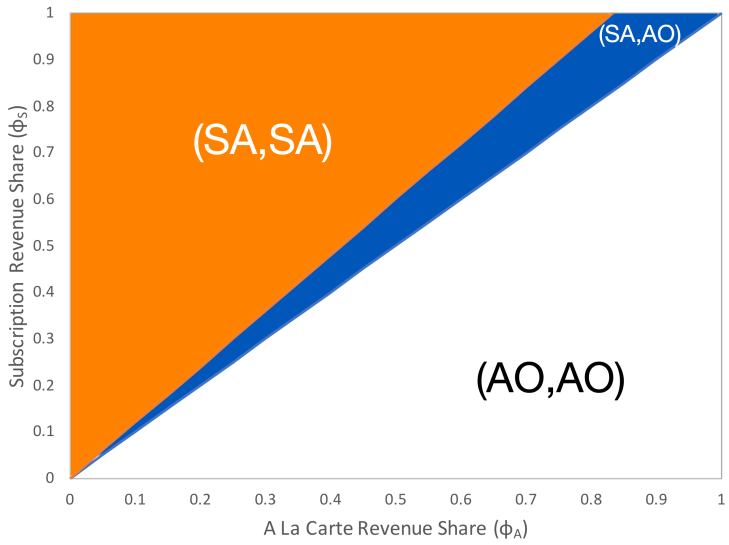

Figure 2. Selling Stage Equilibria for $\ell = 2, v_L = 5, v_H = 12\,(\beta = 1.2)$

both creators will make more per unit of consumption on a la carte than they would by capturing the entire subscriber base. Thus, by selling a la carte only and not listing on subscription, content creators can realize greater profit because they can charge a higher per unit a la carte price (indicative of their type) and/or they can retain a larger portion of a la carte sales revenue.[1]

This means that to get creators to list on subscription (and, in turn, to get consumers to pay for the service), the platform must offer $\phi_S \geq \phi_A$. If the platform sets $\beta\phi_A > \phi_S \geq \phi_A$, it encourages the L creator to list on subscription; if it sets $\phi_S \geq \beta\phi_A$, both creators list on subscription. Here, $\beta > 1$ represents the reciprocal of the earlier term discussed following equation (2): β is the ratio between the H creator's fraction of total consumer utility and her fraction of total consumption quantity. Because she contributes more to consumer utility than she does to consumption quantity, this value is always more than one. Numerically, we observe that this value falls somewhere between 1 and slightly over 1.2. This means that if the platform wants to induce both creator types to participate in the subscription service, it will have to, depending on the relative qualities of the L and H type and the level of taste disparity among consumers, share up to 20% more revenue with creators; see Figure 2. In other words, while it is "easy" for the platform to induce the L creator to list on the subscription service (it need only match the revenue share of the a la carte channel, i.e., it can set $\phi_S = \phi_A$), it requires a more substantial concession to induce the H creator to sell via subscription. This additional "boost" in revenue share required to induce the high quality creator

[1]We note that when a portion of consumer demand comes from "subscription only" customers, this result is modified somewhat; see §6.

to use the subscription channel can be as much as 20%, and derives from the fact that the platform must compensate the H creator for her "unfair" share of revenue when using fraction of consumption to divide revenues between creators.

This illustrates that inducing high quality content to join the subscription service can be quite costly for the platform; as a result, platforms may be unwilling to concede as much to high quality creators, and the subscription service may be filled with mostly lower quality content. The proposition further implies that, while the platform can induce (AO, AO), (SA, AO), and (SA, SA), it cannot induce (AO, SA), i.e., it cannot induce the low quality creator to sell only a la carte while the high quality creator sells via subscription. As a result, the average quality of content on the subscription service cannot exceed the average quality of all content available through any form of selling strategy on the platform, and often quality on the subscription service is lower than on the entire platform. This is consistent with the observation that bestsellers and popular authors rarely appear on the Kindle Unlimited service (Kowalczyk, 2017); because these authors would be contributing an outsized portion of consumer utility to the service relative to the total fraction of page reads they incur, they would not be appropriately compensated, resulting in their choice to sell only a la carte e-books.

5 The Contracting Stage

5.1 The Platform's Optimal Revenue Shares

In the contracting stage, the platform seeks to maximize its profits by appropriately setting the revenue shares ϕ_S and ϕ_A for its two services. We assume that the platform must offer some minimum reservation revenue share to induce creator participation in both subscription and a la carte (conditional on the subsequent selling stage equilibrium from Proposition 2 resulting in at least one creator using the subscription channel), i.e. the platform must set $\phi_S > \underline{\phi_S}$ and $\phi_A \geq \underline{\phi_A}$. However, due to the emergent nature of subscription platforms, in practice there is typically more competition in the a la carte distribution model than in the subscription model; as a result, we assume that the reservation revenue share for a la carte is higher than that for subscription, i.e. $\underline{\phi_A} > \underline{\phi_S}$. Amazon, for example, dominates subscription services for e-books in the US, but faces a much more competitive market for a la carte e-book sales (in which competes not only with other a la carte e-book sellers, but also sellers of physical books; if e-books become too unprofitable, then content creators will abandon e-books for physical books).

Consequently, in the contracting stage, the platform may induce an equilibrium described by Proposition 2 if it sets $\phi_A \geq \underline{\phi_A}$ and $\phi_S \geq \underline{\phi_S}$. If the platform sets $\phi_A < \underline{\phi_A}$, then it effectively "shuts down" its a la carte channel, as no creator will participate. However, it may continue to induce participation in the subscription service for any $\phi_S \geq \underline{\phi_S}$; clearly, in this case, the optimal revenue share given to creators will be $\underline{\phi_S}$.[2] The platform thus broadly has two options: operate only a subscription channel by setting $\phi_A < \underline{\phi_A}$, or operate an a la carte channel (and, potentially, a subscription channel as well, depending on the outcome of the equilibrium in Proposition 2) by setting $\phi_A \geq \underline{\phi_A}$. We assume that if the platform is indifferent between operating a channel and not operating a channel, that it chooses to operate the channel in question.

In the former case (operating only a subscription platform), platform revenue is $\Pi_P = (1 - \underline{\phi_S})N_H(u_L + u_H)$. In the latter case (inducing an equilibrium per Proposition 2), platform revenue is given by the expressions in §4.1. By comparing these expressions, we may derive the following result:

Proposition 3. *When the platform seeks to maximize profit,*
(i) If $\frac{N_A}{N_H+N_A} \geq \frac{\phi_A-\phi_S}{1-\underline{\phi_S}}$, *it sets* $\phi_A = \underline{\phi_A}$ *and* $\phi_S = \underline{\phi_A}$, *resulting in the* (SA, AO) *equilibrium.*
(ii) Otherwise, it sets $\phi_A = 0$ *and* $\phi_S = \underline{\phi_S}$, *operating only the subscription channel.*

As the proposition shows, to maximize profit, the platform always sets the a la carte and subscription revenue shares to be equal. It either induces the low quality creator to list on the subscription service while inducing both to sell a la carte (by setting $\phi_A = \phi_S = \underline{\phi_A}$) or induces both creators to sell only via subscription while shutting down the a la carte channel ($\phi_A = 0$). The choice between these two strategies does not depend on consumer utilities: it is only a function of the relative sizes of the a la carte only and hybrid consumer populations N_A and N_H, and the minimum a la carte revenue share $\underline{\phi_A}$. If there are many a la carte only consumers, the platform induces (SA, AO); if not, it induces only subscription sales.[3] The proposition also illustrates that

[2]Note that (SO, SO) is not a viable equilibrium per Proposition 1 when $\phi_A = 0$. However, Proposition 1 assumes creator participation for any ϕ_A. If creators do not consider the a la carte channel for $\phi_A < \underline{\phi_A}$, then in this region, the only decision for creators is whether to join the subscription service, which we assume they will do for any $\phi_S \geq \underline{\phi_S}$. Consequently, by setting $\phi_S = \underline{\phi_S}$ and $\phi_A < \underline{\phi_A}$, the platform may induce both creators to sell via the subscription service only.

[3]Technically, in case (i) of the proposition, the platform is indifferent between operating the subscription channel and not operating it. In other words, the platform achieves the same profit if $\phi_A = \underline{\phi_A}$ and $\phi_S = 0$. However, in practice, there are many reasons why the platform may seek to operate the subscription channel in the long run that are not included in our model, including the before mentioned "virtuous cycle" from attracting more consumers and more creators to list on the service. Hence, we assume, as noted above, that if the platform is indifferent between operating a channel and not, it chooses to operate the channel; this means that (SA, AO) is the optimal equilibrium for the platform to induce.

the platform never induces both types to list on a la carte and subscription simultaneously. Doing so would require the platform to give up an even higher portion of profits than what it offers the content creators for a la carte sales ($\underline{\phi_A}$), i.e., it would have to set $\phi_S = \beta\underline{\phi_A}$ (where $\beta > 1$). This is never profitable for the platform, since the market for the H creator's content is already fully covered at a smaller revenue share via a la carte sales.

Nevertheless, in an effort to grow their subscription service (and feed the "virtuous cycle" described earlier), it is possible that platforms may not myopically seek to maximize immediate profits, but may instead seek to induce high quality content creators to sell via subscription while also maintaining a la carte sales, i.e., induce an (SA, SA) equilibrium. Thus, it is also interesting to consider precisely how much revenue share and profit the platform must give up in order to achieve this. The following proposition analyzes this question:

Proposition 4. *Suppose* $\frac{N_A}{N_H+N_A} \geq \underline{\phi_A}$ *and the platform seeks to induce* (SA, SA) *to enhance the quality of the subscription offerings. Then it must offer* $\phi_A = \underline{\phi_A}$ *and* $\phi_S = \beta\underline{\phi_A}$*, yielding a profit of*

$$\Pi_P^{(SA,SA)} = \left[(1-\underline{\phi_A})N_A + (1-\beta\underline{\phi_A})N_H\right](u_L + u_H).$$

Compared to the optimal strategy in this region of inducing (SA, AO)*, this results in a profit loss of*

$$\Pi_P^{(SA,AO)} - \Pi_P^{(SA,SA)} = \frac{(l+v_L)(v_H-v_L)}{2\ell}\underline{\phi_A}N_H \geq 0.$$

To improve the quality of the subscription service, the platform has to give up some immediate profit. Inducing the L type creator to list on the subscription is simple: the platform need only match the revenue share of the a la carte offering. However, at such a revenue share, the H type will still be better off selling only a la carte. In order to induce the H type to also list on subscription, the platform has to given up an even higher share of profits, i.e., it must set $\phi_S = \beta\underline{\phi_A}$, where, recall, $\beta = \frac{(\ell+v_L)(\ell+v_H)+(\ell+v_H)^2}{(\ell+v_L)^2+(\ell+v_H)^2} > 1$. This leads to several observations. Note that the platform's profit loss from inducing (SA, SA) increases in the reservation revenue share $\underline{\phi_A}$ and the number of hybrid consumers, N_H. This means that in a highly competitive market for a la carte sales, it can be very expensive to promote a subscription service where both high quality (H type) and low quality (L type) creators list instead of only low quality creators. It also helps explain the phenomenon of more lower quality creators listing on subscription than higher quality ones. In addition, holding all else constant, the profit loss is increasing in v_H; consequently, very popular creators—e.g., the most popular authors or musicians—are extremely costly to lure on to the subscription service.

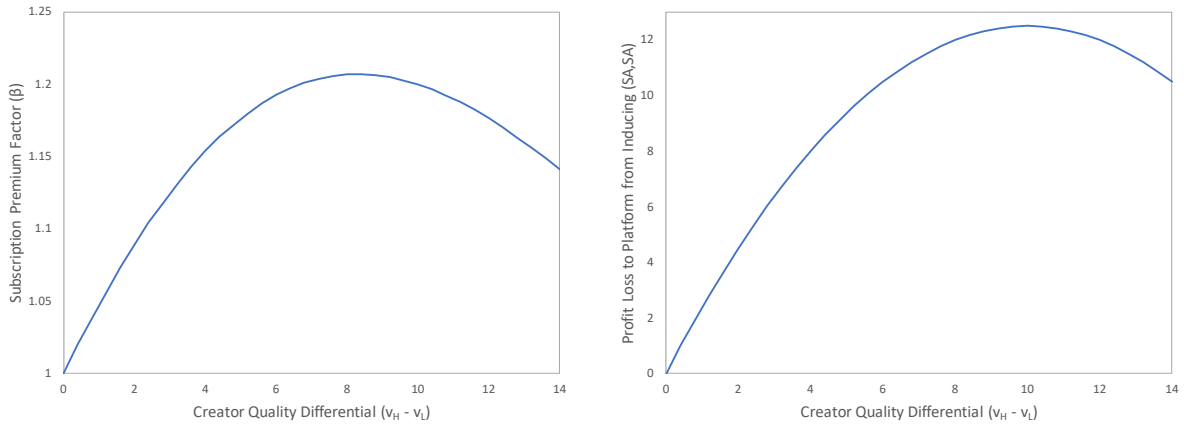

Figure 3. The impact of creator quality differential $(v_H - v_L)$ on the subscription premium factor (β) and platform cost of inducing (SA, SA). In both figures, $(v_H + v_L)/2$ is held constant and equal to 9, $\ell = 1$, $N_H = 1$, and $\underline{\phi_A} = 0.5$.

On the other hand, note that holding average quality $((v_H + v_L)/2)$ constant, as the disparity between the H and L type qualities $(v_H - v_L)$ grows, the platform's profit loss is non-monotonic. Considering the impact of this value on β, which we can think of as the subscription participation premium factor, illustrates the driving forces behind this observation (see Figure 3). The figure shows that β is concave in $v_H - v_L$, first increasing then decreasing. The intuition behind this behavior that when then the H type is slightly higher quality than the L type, the platform has to compensate her significantly to participate in the subscription platform, because, while she is higher quality than the L type, her quality is not great enough to capture a significant portion of consumption on the subscription service. However, as the H type's quality advantage over the L type continues to increase, she captures a larger and larger share of the total consumption, meaning the platform can compensate her less (in the form of a smaller β). Hence, the premium necessary to induce (SA, SA)—and hence the cost of inducing this outcome—is greatest for moderate differences in quality between the low and high quality creators.

Lastly, note that the platform's profit loss is also increasing in ℓ, the dispersion of consumer tastes. If consumers are very homogenous in tastes, the cost of inducing (SA, SA) is small, but if they have widely dispersed tastes, it is large. This further illustrates that it can be very costly to induce high quality on a subscription service if consumers have highly idiosyncratic tastes for content.

5.2 Supply Chain Optimal Decisions

In this section, we consider what revenue sharing parameters maximize the overall supply chain profit (defined to be the sum of platform and creator profits), and compare this to the optimal decisions of the platform derived in Proposition 3. The following proposition summarizes these results:

Proposition 5. *Supply chain profit is maximized by inducing any equilibrium that results in both creators selling a la carte (and zero, one, or both selling via subscription). Hence, the platform chooses a strictly suboptimal selling strategy for the supply chain when* $\frac{N_A}{N_H+N_A} < \underline{\phi_A}$.

Any outcome that results in both creators selling a la carte maximizes supply chain profits. This is because, in equilibrium, both consumer segments always consume both books, and all surplus from that consumption is extracted by optimal price. Thus, the market is fully covered in all cases, and supply chain profit is the same in all equilibria that survive, although the different equilibria result in different allocations of that profit between the platform and the creators. This implies that when the platform prefers to shut down a la carte sales and induce both creators to list on the subscription service (i.e., when $\frac{N_A}{N_H+N_A} < \underline{\phi_A}$), it necessarily results in an inefficient supply chain outcome: a la carte only consumers are no longer covered in the market, meaning total supply chain profits are reduced. In addition, when this happens, the platform extracts all surplus from creators as well as consumers; hence, the platform sacrifices supply chain efficiency in order to extract a larger share of the supply chain surplus.

We note here that one reason we see total market coverage whenever a la carte sales are induce comes from our model assumptions. Specifically, we assumed discrete types of consumers and content creators, which in turn leads to total market coverage under all of the realizable pure strategy equilibria. If consumer or creator types were continuous, it is likely that the result in Proposition 5 that supply chain profit is maximized for any $\frac{N_A}{N_H+N_A} \geq \underline{\phi_A}$ will no longer hold. Nevertheless, the proposition illustrates that the platform may sacrifice supply chain profit in order to maximize its own share, an observation that will likely continue to be true even under more complicated distributions of creator and consumer types.

6 Extension: Subscription Only Consumers

Many consumers—particularly younger ones—prefer the ease and convenience of subscription services to a la carte purchases (Statista, 2017c). As more consumers choose subscription services, it is reasonable to expect those that do subscribe will decrease their a la carte consumption, perhaps to zero. This is particularly true for younger consumers, who are the largest segment for subscription service usage (e.g., 40% of millennials in the US use a music subscription service, compared to 20% or less of all other age groups; Statista 2017b), and for budget constrained consumers who limit their spending on a particular category of items to a fixed amount (e.g., consumers who only wish to spend X dollars per month on books may spend the majority of that on a subscription fee, leaving little or no remainder to spend on a la carte purchases). Hence, creators may only be able to access a segment of the population by selling via the subscription platform, and this in turn may alter their optimal selling strategy as well as the platform's optimal decisions. To consider the consequence of such a "subscription only" consumer segment, in this section we extend our model to include a consumer segment of size N_S that will only read books on a subscription service, i.e., they never consider a la carte purchases. In §6.1, we consider the impact of this consumer segment on the selling stage of the game. In §6.2, we discuss their impact on the contracting stage.

6.1 Subscription Only Consumers and the Selling Stage Equilibrium

In the appendix, we derive the profit functions of the creators and the platform in each of the nine possible selling strategies introduced in §4.1. A comparison of these profit functions leads to the following result:

Proposition 6. *In the presence of a subscription only consumer segment, for both creator types, strategy SA dominates strategy SO, regardless of the other creator's strategy.*

This result is identical to that found in Proposition 1. It continues to hold with subscription only customers because, in strategy SO, a la carte consumers are still excluded; the creator could simply add a la carte sales to capture these customers with no negative repercussions on her profit (since hybrid customers consume in the same way, via subscription, in both the SA and SO strategies). AO is not necessarily dominated, however, even with a subscription only consumer segment, because depending on the revenue sharing rates and the revenue allocation between creators on the subscription platform, it may or may not be worth the tradeoff of excluding subscription only

consumers in exchange for all hybrid consumers paying for content a la carte. This allows us, like in the main model, to focus our analysis on the choice between strategies AO and SA.

Given this, we next present the equilibrium to the selling stage with subscription only consumers, in an analogue to Proposition 2:

Proposition 7. *Define β as in Proposition 2. Then, in the presence of a subscription only consumer segment, the equilibrium to the selling stage exists and is unique, and is characterized as follows:*
(i) If $\phi_S \geq \beta \frac{N_H}{N_S+N_H}\phi_A$, both creators sell via both distribution channels.
(ii) If $\beta \frac{N_H}{N_S+N_H}\phi_A > \phi_S \geq \frac{N_H}{N_S+N_H}\phi_A$, the low quality creator sells via both channels, while the high quality creator sells only via the a la carte channel.
(iii) If $\phi_S < \frac{N_H}{N_S+N_H}\phi_A$, both creators sell only via the a la carte channel.

This result is very similar to Proposition 2, except that with the addition of a subscription only consumer base, selling via a la carte only now means losing out on a segment of the consumer population. Thus, it becomes important to consider the relative sizes of the hybrid and subscription only consumer segments. If the ratio $\frac{N_H}{N_S+N_H}$ is very high (close to 1), then it means that the decision on whether to sell a la carte only or via subscription and a la carte rests mostly on the revenue sharing rates offered by the platform. Otherwise, even if more favorable rates are offered for a la carte than subscription, if selling a la carte only meant excluding a comparatively large number of consumers (because they only consume via subscription), then it may still be more profitable to sell via both channels rather than a la carte only. Part (iii) can also be written as $\phi_S < \frac{N_H}{N_H+N_S}\phi_A$ which means that even if the platform offers a *lower* revenue share rate for subscription sales than a la carte sales, one or both creators may still elect to sell via both subscription and a la carte. However, if the difference is large, i.e., such that the condition in case (iii) is satisfied, then it is important to note that if one content creator chooses not to sell on subscription, it does not mean that the other creator chooses to list on subscription, even though she could capture the entire consumption of the subscription market. In other words, by selling a la carte only and not listing on subscription, content creators can realize greater profit because they can charge a higher per unit price, as long as subscription only consumers are not a substantial portion of the consumer base since they will be excluded from a la carte only sales. Note that, like in the base model, the platform, through changing the revenue sharing rates, can induce (AO, AO), (SA, AO), and (SA, SA), but still cannot induce (AO, SA)—thus, even with a subscription only consumer segment, the quality of books on the subscription service still cannot exceed the average quality of all books sold on the platform.

6.2 Subscription Only Consumers and the Contracting Stage Equilibrium

A consequence of Proposition 7 is that, from the platform's perspective, with the presence of subscription only consumers, it is less expensive to induce creators to list on the subscription service, and the platform no longer needs to offer $\phi_S > \phi_A$. If the platform sets $\phi_S = \frac{N_H}{N_S+N_H}\phi_A$, it can induce the L creator to sell on subscription and a la carte. Similarly, if the platform sets $\phi_S = \beta\frac{N_H}{N_S+N_H}\phi_A$, it can induce both creators to sell via subscription. Contrasting this with in the base model, where we did not have a population of subscription only consumers, shows that the platform can now induce the both creator to sell on subscription at a *lower* revenue share rate, since $\frac{N_H}{N_S+N_H} < 1$ if $N_S > 0$. In particular, inducing the L creator alone to sell via subscription can be done by offering a lower revenue sharing rate than a la carte; inducing both creators to sell via subscription can be accomplished at a smaller revenue sharing than in the absence of subscription only consumers, and can possibly be done with a smaller revenue share than the a la carte service, depending on whether the product $\frac{N_H}{N_S+N_H}\beta$ is more or less than one.

This means that if a sufficiently large portion of consumers are subscription only versus hybrid, then the platform can more easily induce both the L and H creators to participate in the subscription service. Thus, the presence of a subscription only segment can have a significant impact on the platform's decisions, even if the impact on the creators' decisions is minimal. To that end, in this section, we analyze what optimal revenue shares ϕ_A and ϕ_S the platform should set when seeking to maximize its profits. We will compare this to the optimal revenue share rates in the base model and also compare to see if, like in the base model, profit maximizing choices are still suboptimal for inducing participation by creators in the subscription service. As in the base model, we assume that participation in a la carte and subscription sales both require a minimum revenue share, $\underline{\phi_A}$ and $\underline{\phi_S}$, respectively; however, for simplicity (given the more complex profit expressions that occur due to the presence of a subscription only segment), we assume that $\underline{\phi_S} = 0$, i.e., the platform has a very powerful position with regards to the subscription service and is capable of extracting all revenue from creators while still inducing participation.

Given these assumptions, we have the following result:

Proposition 8. *When the platform seeks to maximize profit,*
(i) If $\frac{N_S}{N_H}\frac{u_H}{u_H+u_L} \geq \underline{\phi_A}(\beta-1)$ *and* $\frac{N_A}{N_H\beta+N_A} \geq \underline{\phi_A}$*, it sets* $\phi_A = \underline{\phi_A}$ *and* $\phi_S = \frac{N_H}{N_S+N_H}\beta\underline{\phi_A}$*, resulting in the* (SA, SA) *equilibrium.*
(ii) If $\frac{N_S}{N_H}\frac{u_H}{u_H+u_L} < \underline{\phi_A}(\beta-1)$ *and* $\frac{N_A}{N_H+N_A} \geq N_S\frac{u_H}{(u_H+u_L)}+\underline{\phi_A}$*, it sets* $\phi_A = \underline{\phi_A}$ *and* $\phi_S = \frac{N_H}{N_S+N_H}\underline{\phi_A}$*,*

resulting in the (SA, AO) *equilibrium.*
(iii) Otherwise, the platform sets $\phi_A = 0$ *and* $\phi_S = \underline{\phi_S} = 0$*, and operates only the subscription channel.*

Contrasting this result to Propositions 3 and 4, we see that in the presence of a subscription only consumer group, maximizing profit and growing the subscription service may no longer be conflicting objectives. In the base model, selling *AO* did not lead to excluding any consumers, so since the H and L creators did not receive shares of subscription consumption commensurate with their contributions to quality, it made sense for the H type to not sell on subscription unless induced so by more favorable revenue sharing terms. When there is a subscription only segment, it is costly for creators to sell *AO* because it means excluding a population of subscription only consumers. As the size of this population grows relative to the hybrid consumer population, it becomes more and more costly to exclude them. Thus, the creators do not need a significantly higher subscription revenue share rate (compared to a la carte share rate) to induce sales via subscription. This means that the platform can induce both creators to sell via subscription at a lower cost than in the absence of a subscription only segment, making it profitable (in case (i) of Proposition 8) to induce the (SA, SA) outcome. Since this outcome both maximizes creator participation in the subscription service and profit, Proposition 8 shows that the presence of a sufficiently large subscription only consumer segment can help align these disparate (in the base model) goals of the platform.

7 Conclusion

In this paper, we have studied the problem of subscription and a la carte digital content distribution between a platform and two content creators: one high quality (e.g., an established and well-known author) and one low quality (e.g., lesser-known or new author). We showed that depending on the revenue sharing parameters set by the platform, content creators will choose different strategies. If the revenue share given to content creators for subscription reads is lower than that for a la carte sales, then no content creator will want to list on subscription, regardless of what the other content creator does. If the revenue share for subscription is weakly greater than the share for a la carte sales, then it is possible to induce the low quality creator or both creators to sell via subscription, while it is never possible to induce the high quality creator alone to do so.

These results lead to several important managerial insights. If the platform were to focus on only maximizing immediate profits, then it should never induce the high quality creator to sell via

subscription; doing so is too costly and requires too much subscription revenue given to the creators, since the H creator makes an outsize contribution to consumer utility but not to the quantity of consumption. This means that the average quality of content on subscription is lower than the average quality of content creators (selling through the platform in general). The platform cannot, through changing revenue sharing rates on subscription or a la carte sales, induce only the H type to list on subscription. This means that the highest quality the subscription content can be is no better than the average content quality on the general platform. This could also explain why we frequently observe that most books listed on services like Kindle Unlimited are by lesser-known or new authors and not bestselling authors.

However, given that the subscription service may have value in the future for the platform, such as access to different or new consumers, the platform may want to promote it as a service. In order to induce both types of content creators to list on subscription (in addition to a la carte), the platform will need to give up a significant portion of immediate profits in order to offer a sufficiently high subscription revenue share to content creators that will induce both types to list on subscription. The amount of revenue the platform must relinquish is proportional to the a la carte revenue share, and increases with higher disparity in consumer tastes (denoted by ℓ in our model) and the quality difference between creators ($v_H - v_L$). An important consequence of these results for platforms is that the subscription revenue share rate can be used as a lever to induce content creators into changing their selling behavior: by increasing the rate of subscription revenue sharing, platforms can induce content creators to sell via this channel and raise the overall quality of the service.

In an extension, we added a "subscription only" consumer segment, and found that while our results about creator selling strategies stayed the same, the platform could achieve profit maximization by inducing both creators to sell on both subscription and a la carte. The rationale behind this result is that, in the presence of a "subscription only" segment, especially a comparatively large one, it is possible to induce both creators to sell on subscription and a la carte at a much lower revenue share, because selling a la carte only (and thus excluding the subscription only consumers) is too costly for creators. Thus, the creators, for a sufficiently large "subscription only" consumer segment, will sell on both channels even if the subscription revenue share rate is lower than that offered by the platform for a la carte sales—this means the platform may find it optimal to induce both creators to sell on subscription at the same time. As acceptance of subscription services grows amongst consumers, it is thus likely that platforms will find it easier to induce creators to join such services, and in particular, quality should increase on subscription platforms as platforms find it

less costly to induce high quality creators to participate.

To summarize, in this paper, we've shown that by choosing contract terms for a la carte and subscription sales, platforms can influence who, if anyone, participates in the subscription platform; however, this influence is not without limitations, and inducing high quality content on a subscription platform is challenging and costly, due to the way that high quality creators make an outsized contribution to consumer utility relative to the quantity of consumption. Our work thus helps to develop a more thorough understanding of the new e-commerce landscape for digital information goods, especially the growing market of subscription services. Our insights can help both platforms and the content creators understand the tradeoffs between selling via subscription and selling a la carte, and can also explain some of the most common practical observations regarding the number and quality of creators that list on these platforms.

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A Proofs

Proof of Proposition 1. From the enumeration in §4.1, we see that for both creator types, profit is always higher under strategy SA compared to under strategy SO regardless of the other creator's strategy. □

Proof of Proposition 2. (i) Suppose $\phi_S \geq \phi_A$ and $(1-\alpha)\frac{u_L+u_H}{u_H} \geq \frac{\phi_A}{\phi_S}$. Per the discussion in §4.2, the dominant action of the H creator is SA. If the H creator plays SA, the L creator responds with SA if and only if $\alpha\frac{u_L+u_H}{u_L} \geq \frac{\phi_A}{\phi_S}$. Since $\alpha\frac{u_L+u_H}{u_L} > 1 > (1-\alpha)\frac{u_L+u_H}{u_H} \geq \frac{\phi_A}{\phi_S}$, this is always true. Hence, in this case, (SA, SA) is the unique equilibrium.

(ii) Suppose $\phi_S \geq \phi_A$ and $(1-\alpha)\frac{u_L+u_H}{u_H} < \frac{\phi_A}{\phi_S}$. From §4.2, the L creator will play SA if the H creator plays AO. Conditional on the L creator playing SA, AO is optimal for the H creator if $(1-\alpha)\frac{u_L+u_H}{u_H} < \frac{\phi_A}{\phi_S}$; hence, (SA, AO) is an equilibrium in these conditions. The only other possible equilibrium is (AO, SA). For this to hold, it must be true that AO for the L creator is a best response to SA from the H creator. Per §4.2, this is true if and only if $\alpha\frac{u_L+u_H}{u_L} < \frac{\phi_A}{\phi_S}$. However,

since $\alpha\frac{u_L+u_H}{u_L} > 1$ and $\frac{\phi_A}{\phi_S} < 1$ if $\phi_S \geq \phi_A$, this cannot hold. Hence, (AO, SA) cannot be an equilibrium, and (SA, AO) is the unique equilibrium in this region.

(iii) Suppose $\phi_S < \phi_A$. Then, (AO, AO) is clearly an equilibrium, per the discussion in §4.2. From equation (2), if the L creator plays SA, the H creator will play AO. However, if the H creator plays AO and $\phi_S < \phi_A$, the L creator's best response is also AO. Hence, (AO, AO) is the unique equilibrium when $\phi_S < \phi_A$.

The remainder of the proposition follows by defining $\beta \equiv \left((1-\alpha)\frac{u_L+u_H}{u_H}\right)^{-1} = \frac{(\ell+v_L)(\ell+v_H)+(\ell+v_H)^2}{(\ell+v_L)^2+(\ell+v_H)^2} > 1$ and reframing each of the above regions. □

Proof of Proposition 3. As noted in the text, $\Pi_P = (1-\underline{\phi_S})N_H(u_L+u_H)$ when inducing only subscription distribution. When inducing a la carte distribution (setting $\phi_A \geq \underline{\phi_A} > \underline{\phi_S}$), platform profit is as follows:

$$\Pi_P = \begin{cases} (1-\phi_A)(N_H+N_A)(u_L+u_H) & \phi_A > \phi_S \\ (1-\phi_A)(N_H+N_A)u_H + (1-\phi_A)N_A u_L + (1-\phi_S)N_H u_L & \beta\phi_A > \phi_S \geq \phi_A \\ (1-\phi_A)N_A(u_H+u_L) + (1-\phi_S)N_H(u_L+u_H) & \phi_S \geq \beta\phi_A \end{cases}$$

It is clear that the optimal $\phi_A = \underline{\phi_A}$, and moreover, conditional on inducing participation in the subscription platform, the optimal ϕ_S is any $\phi_S \geq \underline{\phi_S}$ that satisfies the desired equilibrium outcome. Thus, optimal profits when inducing a la carte sales are $\Pi_P = (1-\underline{\phi_A})(N_H+N_A)(u_L+u_H)$, and this includes outcomes when only a la carte sales are induced ($\phi_S < \underline{\phi_A}$) and outcomes when (SA, AO) is induced ($\phi_S = \underline{\phi_A}$). Because we assume that the platform chooses to operate a channel when it is indifferent about doing so, this means that $\phi_S = \underline{\phi_A}$ is optimal conditional on $\phi_A \geq \underline{\phi_A}$. Comparing profits, we see that inducing (SA, AO) is preferred to inducing subscription only sales if $\frac{N_A}{N_H+N_A} \geq \frac{\underline{\phi_A}-\underline{\phi_S}}{1-\underline{\phi_S}}$. □

Proof of Proposition 4. The first part of the proposition follows from the proof of Proposition 3. Noting that

$$\Pi_P^{(SA,SA)} = \left[(1-\underline{\phi_A})N_A + (1-\beta\underline{\phi_A})N_H\right](u_L+u_H)$$

and

$$\Pi_P^{(SA,AO)} = (1-\underline{\phi_A})(N_H+N_A)(u_L+u_H),$$

it follows that

$$\begin{aligned}\Pi_P^{(SA,AO)} - \Pi_P^{(SA,SA)} &= (1-\underline{\phi_A})(N_H+N_A)(u_L+u_H) - \left[(1-\underline{\phi_A})N_A + (1-\beta\underline{\phi_A})N_H\right](u_L+u_H) \\ &= (\beta-1)\underline{\phi_A}N_H(u_L+u_H) \\ &= \frac{(\ell+v_L)(v_H-v_L)}{2\ell}\underline{\phi_A}N_H \geq 0.\end{aligned}$$

This proves the result. □

Proof of Proposition 5. Define $\Pi_{SC} \equiv \Pi_P + \Pi_L + \Pi_H$. Whenever an equilibrium results in both creators selling a la carte (i.e., in (AO, AO), (SA, AO), and (SA, SA)), $\Pi_{SC} = (N_A + N_H)(u_L + u_H)$. However, when the platform shuts down a la carte sales, $\Pi_{SC} = N_H(u_L + u_H)$, which is strictly lower than inducing a la carte sales if $N_A > 0$. □

Proof of Proposition 6. Profits under each selling strategy are given in Table 3. From the enumeration in Table 3, we see that for both creator types, profit is always higher under strategy SA compared to under strategy SO regardless of the other creator's strategy. □

Proof of Proposition 7. Comparing the profits in Table 3 leads to the following observations. First, considering the incentives for the H creator, whose payoffs are given in Table 4, we see that conditional on the L creator playing AO, the H creator plays SA if and only if $1 > \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$. Otherwise, the H creator plays AO. Conditional on the L creator playing SA, the H creator plays SA if and only if:

$$(1-\alpha)\frac{u_L+u_H}{u_H} > \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}, \tag{4}$$

which we may rewrite in the same fashion as in §4.2 as

$$1 > \frac{1}{\beta} > \frac{N_H}{N_H+N_S}\frac{\phi_A}{\phi_S}.$$

Otherwise, the H creator plays AO. Next, we analyze the best response of the L creator, whose payoffs are in Table 5. Conditional on the H creator playing AO, the L creator prefers SA if and only if $1 > \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$. Otherwise, the L creator prefers to play AO. Conditional on the H type playing SA, the L creator prefers SA if and only if $\alpha\frac{u_L+u_H}{u_L} > \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$, which can be rewritten as

$$\frac{(\ell+v_L)^2+(\ell+v_H)^2}{(\ell+v_H)(\ell+v_L)+(\ell+v_L)^2} > \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$$

where $\frac{(\ell+v_L)^2+(\ell+v_H)^2}{(\ell+v_H)(\ell+v_L)+(\ell+v_L)^2} > 1$. Otherwise, the L creator prefers to play AO. This leads to the

	H Creator - AO
L Creator - AO	$\Pi_P = (1-\phi_A)(N_H+N_A)(u_L+u_H)$
	$\Pi_L = \phi_A(N_H+N_A)u_L$
	$\Pi_H = \phi_A(N_H+N_A)u_H$
L Creator - SO	$\Pi_P = (1-\phi_A)(N_H+N_A)u_H + (1-\phi_S)(N_H+N_S)u_L$
	$\Pi_L = \phi_S(N_H+N_S)u_L$
	$\Pi_H = \phi_A(N_H+N_A)u_H$
L Creator - SA	$\Pi_P = (1-\phi_A)(N_H+N_A)u_H + (1-\phi_A)N_Au_L + (1-\phi_S)(N_H+N_S)u_L$
	$\Pi_L = \phi_S(N_H+N_S)u_L + \phi_AN_Au_L$
	$\Pi_H = \phi_A(N_H+N_A)u_H$

(a) H Creator - AO

	H Creator - SO
L Creator - AO	$\Pi_P = (1-\phi_A)(N_H+N_A)u_L + (1-\phi_S)(N_H+N_S)u_H$
	$\Pi_L = \phi_A(N_H+N_A)u_L$
	$\Pi_H = \phi_S(N_H+N_S)u_H$
L Creator - SO	$\Pi_P = (1-\phi_S)(N_H+N_S)(u_L+u_H)$
	$\Pi_L = \alpha\phi_S(N_H+N_S)(u_L+u_H)$
	$\Pi_H = (1-\alpha)\phi_S(N_H+N_S)(u_L+u_H)$
L Creator - SA	$\Pi_P = (1-\phi_A)N_Au_L + (1-\phi_S)(N_H+N_S)(u_L+u_H)$
	$\Pi_L = \alpha\phi_S(N_H+N_S)(u_L+u_H) + \phi_AN_Au_L$
	$\Pi_H = (1-\alpha)\phi_S(N_H+N_S)(u_L+u_H)$

(b) H Creator - SO

	H Creator - SA
L Creator - AO	$\Pi_P = (1-\phi_A)(N_H+N_A)u_L + (1-\phi_A)N_Au_H + (1-\phi_S)(N_H+N_S)u_H$
	$\Pi_L = \phi_A(N_H+N_A)u_L$
	$\Pi_H = \phi_S(N_H+N_S)u_H + \phi_AN_Au_H$
L Creator - SO	$\Pi_P = (1-\phi_A)N_Au_H + (1-\phi_S)(N_H+N_S)(u_L+u_H)$
	$\Pi_L = \alpha\phi_S(N_H+N_S)(u_L+u_H)$
	$\Pi_H = (1-\alpha)\phi_S(N_H+N_S)(u_L+u_H) + \phi_AN_Au_H$
L Creator - SA	$\Pi_P = (1-\phi_A)N_A(u_H+u_L) + (1-\phi_S)(N_H+N_S)(u_L+u_H)$
	$\Pi_L = \alpha\phi_S(N_H+N_S)(u_L+u_H) + \phi_AN_Au_L$
	$\Pi_H = (1-\alpha)\phi_S(N_H+N_S)(u_L+u_H) + \phi_AN_Au_H$

(c) H Creator - SA

Table 3. Profits under the various combinations of selling strategies with a subscription only segment of size N_S.

		H Creator	
		AO	SA
L creator	AO	$\phi_A(N_H+N_A)u_H$	$\phi_S(N_H+N_S)u_H + \phi_AN_Au_H$
	SA	$\phi_A(N_H+N_A)u_H$	$(1-\alpha)\phi_S(N_H+N_S)(u_L+u_H) + \phi_AN_Au_H$

Table 4. Payoffs for the H creator in the selling stage game.

		H Creator	
		AO	SA
L creator	AO	$\phi_A(N_H+N_A)u_L$	$\phi_A(N_H+N_A)u_L$
	SA	$\phi_S(N_H+N_S)u_L+\phi_A N_A u_L$	$\alpha\phi_S(N_H+N_S)(u_L+u_H)+\phi_A N_A u_L$

Table 5. Payoffs for L creator in the selling stage game.

following result:

(i) Suppose $\frac{1}{\beta} \geq \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$. Per the discussion above, the dominant action of the H creator is SA. If the H creator plays SA, the L creator responds with SA if and only if $\alpha\frac{u_L+u_H}{u_L} \geq \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$. Since $\alpha\frac{u_L+u_H}{u_L} > 1 > (1-\alpha)\frac{u_L+u_H}{u_H} \geq \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$, this is always true. Hence, in this case, (SA, SA) is the unique equilibrium.

(ii) Suppose $1 > \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S} > \frac{1}{\beta}$. From Table 3, the H creator will play AO if the L creator plays SA. Conditional on the H creator playing AO, SA is optimal for the L creator if $1 > \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$; hence, (SA, AO) is an equilibrium in these conditions. The only other possible equilibrium is (AO, SA). For this to hold, it must be true that AO for the L creator is a best response to SA from the H creator. Per §6.1, this is true if and only if $1 > \frac{\phi_A}{\phi_S}\frac{N_H}{N_S+N_H}$ and $\beta < \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_s}$ hold simultaneously, which is impossible because $1 < \beta$. Hence, (AO, SA) cannot be an equilibrium, and (SA, AO) is the unique equilibrium in this region.

(iii) Suppose $1 < \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$. Then, (AO, AO) is clearly an equilibrium, per the discussion in §6.1. From equation (4), if the L creator plays SA, the H creator will play AO. However, if the H creator plays AO and $1 < \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$, the L creator's best response is also AO. Hence, (AO, AO) is the unique equilibrium when $1 < \frac{N_H}{N_S+N_H}\frac{\phi_A}{\phi_S}$. □

Proof of Proposition 8. We begin by noting that, from Proposition 7, the platform can induce the following outcomes by adjusting the revenue sharing parameters:

1. By setting $\phi_A = \underline{\phi_A}$ and $\phi_S = \frac{N_H}{N_S+N_H}\beta\underline{\phi_A}$, the platform induces (SA, SA) and realizes a profit of $\Pi_P^{(SA,SA)} = (1-\underline{\phi_A})N_A(u_L+u_H) + (1-\frac{N_H}{N_S+N_H}\beta\underline{\phi_A})(N_S+N_H)(u_L+u_H)$.

2. By setting $\phi_A = \underline{\phi_A}$ and $\phi_S = \frac{N_H}{N_S+N_H}\underline{\phi_A}$, the platform induces (SA, AO) and realizes a profit of $\Pi_P^{(SA,AO)} = (1-\underline{\phi_A})(N_A+N_H)u_H + (1-\underline{\phi_A})N_A u_L + (1-\frac{N_H}{N_S+N_H}\underline{\phi_A})(N_H+N_S)u_L$.

3. By setting $\phi_A = \underline{\phi_A}$ and $\phi_S = 0$, the platform "shuts down" the subscription service and induces (AO, AO), and realizes a profit of $\Pi_P^{(AO,AO)} = (1-\underline{\phi_A})(N_A+N_H)(u_L+u_H)$.

4. By setting $\phi_A = 0$ and $\phi_S = \underline{\phi_S}$, the platform "shuts down" the a la carte service and induces (SO, SO), and realizes a profit of $\Pi_P^{(SO,SO)} = (1-\underline{\phi_S})(N_S+N_H)(u_L+u_H)$.

Comparing the first two cases, platform profit under (SA, SA) is higher than under (SA, AO) if

$$(1 - \frac{N_H}{N_S + N_H}\beta\underline{\phi_A})(u_L + u_H) \geq (1 - \underline{\phi_A})\frac{N_H}{N_S + N_H}u_H + (1 - \frac{N_H}{N_S + N_H}\underline{\phi_A})u_L.$$

This reduces to

$$\frac{N_S}{N_H}\frac{u_H}{u_H + u_L} \geq \underline{\phi_A}\,(\beta - 1)\,. \tag{5}$$

Next, note that platform profit under (SA, SA) is higher than under (AO, AO) if $\frac{N_S}{N_H} \geq \underline{\phi_A}(\beta - 1)$. This condition clearly holds if (5) holds, meaning (SA, SA) is optimal if (5) holds. If (5) is violated, then the platform chooses between (SA, AO) and (AO, AO), preferring the former if $1 - \frac{N_H}{N_S + N_H}\underline{\phi_A} \geq (1 - \underline{\phi_A})\frac{N_H}{N_H + N_S}$. This condition always holds, hence the platform never prefers to shut down the subscription platform. It is thus left to compare the profit under (SA, SA) and (SA, AO) to the profit under (SO, SO). In the special case when $\underline{\phi_S} = 0$, (SA, SA) is preferred to (SO, SO) if $\frac{N_A}{N_H\beta + N_A} \geq \underline{\phi_A}$ while (SA, AO) is preferred to (SO, SO) if $\frac{N_A}{N_H + N_A} \geq N_S\frac{u_H}{(u_H + u_L)} + \underline{\phi_A}$. These conditions lead to the result in the proposition. $\square$