Self versus delegated distribution in digital platforms: The case of Amazon*

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Abstract

Within the e-book market, authors face two alternatives: either to make use of a traditional publisher or to self-publish their works. The self-publishing model has experienced an unquestionable success since the launch of Kindle Direct Publishing (KDP) by Amazon. While self-publishing conveys advantages both for authors and consumers, it also raises concerns related to an accrued market dominance by Amazon. This paper analyzes the pros and the cons of this emerging business by delving into the internal organization of digital platforms. The results indicate that both the platform and the content providers (authors) adopt a self-distribution (self-publishing) structure for low values of product differentiation because competition among content providers is fierce and a distribution intermediary (publisher) does not provide much value. Instead, for high values of product differentiation, the intermediation of a distribution company is preferred because it allows coordinating content prices that would be very high otherwise. An increase in the bargaining power of content providers favors the adoption of delegated distribution. These results help to understand why emerging authors tend to switch to self-publishing, while best-sellers stay with traditional publishers. From a welfare perspective, consumer interests are misaligned with those of the platform and content providers for intermediate values of product differentiation. This is because the platform and the content providers choose self-distribution even though content prices are higher.

Keywords: e-book industry; self-distribution; delegated distribution; market power; digital platforms.

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1 Introduction

The importance of two-sided digital platforms has been increasing during the last decade and they have become dominant in many sectors such as Internet browsers (Google), social networks (Facebook), books and retail (Amazon), mobile apps (Apple), video streaming (Netflix), music streaming (Spotify), etc. A major concern about these markets of digital services is that they tend to be dominated by a single large platform (Ducci, 2020). More precisely, in the e-book industry, Amazon has undoubtedly become the leading platform. In 2017, e-books represented 30% of all books sold in the US and a worldwide revenue of $\$13,436$ million (Statista, 2021). Amazon has enjoyed near-monopoly status over this industry since it launched the Kindle e-book reader in 2007, controlling between 60 and 80 percent of all e-book sales.[1] While such monopolization has the advantage of yielding clear positive network externalities for consumers who can virtually find any available content on a single platform (that becomes a true marketplace), it also gives rise to concerns related to potential abuse of market power such as tying practices or foreclosure (Ciriani & Lebourges, 2018; Iacobucci & Ducci, 2019; Peitz, 2008).[2] This paper provides an overall assessment on the welfare implications of such monopolized two-sided digital platforms by delving into their internal organization.

Within the e-book market, two publishing models coexist: the traditional model and self-publishing. Under the traditional model, authors sell their rights to a publishing company that, in turn, *i*) helps consumers finding a convenient book taking into account their tastes and interests, and *ii*) negotiates with the platform the economic conditions for the distribution. The self-publishing model, enabled by the digitalization, establishes a direct interaction author-platform. This model has experienced an unquestionable success, as 300 million self-published e-books (worth $1.25 billion) are sold each year, which represented around one third of all e-books sold in 2022. The number of self-published books has increased by 264% over the period 2018-2022. Moreover, while the global publishing market is expected to grow at a 1% compound annual growth rate per year, the self-publishing e-book market is expected to grow at 17% (Rizzo, 2023).[3] Since the launch of Kindle Direct Publishing (KDP), Amazon has become the dominant self-publishing platform.[4] On the one hand, self-publishing circumvents distribution intermediaries, which conveys advantages both for authors and consumers.[5] On the other hand, it also raises concerns re-

[1] Amazon does not provide detailed information on its sales data. According to Magnolia Media Network, Amazon's market share would be 67%. However, other independent analysts provide estimations suggesting a larger figure reaching 80% (BookSliced, 2021).

[2] Despite its reputation for low prices, Amazon rose prices in 2018 by almost 5% in the US retail toy market following the shut down of Toys R Us, which was a major competitor (see He, Reimers & Shiller, 2021).

[3] This trend started at the beginning of the 2000s. Waldfogel & Reimers (2015) report a rise in self-published works by almost 300% between 2006 and 2014.

[4] For example, the number of titles sold by Amazon in the US during 2018 reached 1.4 million units while its closest competitor (Smashwords) sold about $70,000$.

[5] KDP allows authors to sell their works through Amazon receiving (typically) 70% of the sales price as a royalty (authors also pay Amazon some delivery fees).

lated to an accrued market dominance by Amazon.[6] The future consequences of Amazon's immense dominance in this market remains an open question.

More precisely, the following *questions* arise: *i*) Is Amazon's self-publishing business model (KDP) beneficial or detrimental to consumer welfare?, *ii*) Is there a risk for traditional publishing companies to be driven out of the e-book market by Amazon?, and *iii*) Should Amazon's dominance over traditional publishing companies in the e-book market be a concern for policy makers? The answer to these questions must lie in unraveling the implications of the traditional and the self-publishing models on price formation (both for e-readers and e-books).

Inspired by this reality, this study focuses on a monopoly platform that sells a core good (e.g., Kindle e-reader) to final users, which allows them to get access to a side good or content (e.g., e-books) provided by third-party firms. In this ecosystem, content providers can be either independent agents (*self-distribution*) or, alternatively, distribution companies *(delegated distribution)*. More precisely, we propose a baseline platform model where users are ex ante uncertain about their true preferences on the content and each content provider sells a differentiated product variety and determines its price around a Salop circle under the aforementioned two market structures: self-distribution and delegated distribution. In the first case, content providers behave competitively (capturing the situation in which authors publish their books directly using Amazon's KDP). Instead, in the second case, authors transfer their copyright to a publisher (such as Penguin Random House, Harper Collins, Macmillan, Hachette or Simon & Shuster) that bargains with Amazon on the final terms of the distribution. Contract structures are based on ad valorem fees (i.e., proportional fees), given that digital platforms such as Amazon rely predominantly on this pricing instruments (see Wang & Wright, 2017 and 2018; Gaudin & White, 2021).

In terms of modeling, under self-distribution, each content provider offers a specific variety and chooses its price without affecting the general demand for the bundle. Instead, under delegated distribution, the distribution company behaves as a multiproduct monopolist that provides all varieties and determines their price, thereby affecting the general demand for the bundle. The model is structured as a three-stage game. In stage 1, both platform and content providers decide whether to self-distribute the products or to keep on making use of the intermediation of the distribution company. In stage 2, ad valorem fees are determined as a result of a bargaining process. In stage 3, the prices of the core and the side good are chosen simultaneously. Having understood the optimal decision on whether to adopt either a self or a delegated distribution market structure, a welfare analysis comparing both market structures is also provided.

The key difference between the two market structures has to do with the advantages and drawbacks derived from the intermediation of the distribution company. The drawback for the platform and content providers has to do with having to share their surplus with a third player. Instead, there are two advantages. First, the distribution company helps consumers finding their preferred variety by eliminating their mismatching cost and boosting demand.

[6] As Paul Krugman puts it himself, Amazon has not been exploiting its monopoly power so far. Instead, it has used its monopsony power to put a squeeze on publishers, in effect driving down the price for e-books (Krugman, 2014).

Second, it behaves as a multiproduct monopolist, thereby internalizing the effect of content pricing decisions on the general demand. Whether the advantages overcome the drawbacks depends on the degree of product differentiation and the relative bargaining power of the three type of players.

Our main results on the adoption of either a self or a delegated distribution market structure can be summarized as follows. For low values of product differentiation, both platform and content providers decide to adopt a self-distribution market structure. The explanation is twofold. First, the mismatching cost is low and, therefore, the intermediation of the distribution company does not provide much value to consumers. Second, content providers have low market power such that the externality they generate by setting prices independently is modest. Consequently, the advantages that the platform and content providers would perceive from the intermediation of the distribution company do not compensate having to share profits with an additional player. For large values of product differentiation, the mismatching cost is high and the externality generated by independent pricing of content providers is also high. In this situation, the added value of the distribution company is relevant, so that the platform and the content providers agree on sharing profits with it. As regards to the effect of the relative bargaining power of the three players, our analysis concludes that the higher the bargaining power of content providers, the more likely a delegated market structure will be adopted. This result explains the fact that emerging authors (with low bargaining power) mostly publish their e-books under self-distribution, while well-known authors (best sellers with high bargaining power) mostly publish their e-books with a publishing company.

The welfare analysis reveals that consumer interests are aligned with those of the platform and content providers for either low or high values of product differentiation. When product differentiation is low, competition among content providers is intense and content prices are low. In this situation, a distribution company behaving as a multiproduct monopolist would raise content prices. Instead, when product differentiation is high, competition among content providers is low. In this situation, a distribution company would set lower prices by internalizing the effect of content pricing on general demand.[7] Consequently, in both situations the market structure adopted by the platform and content providers also benefits consumers through lower prices. Instead, there is a misalignment between the interests of platform and content providers and those of consumers for intermediate values of product differentiation. This is because the platform and the content providers adopt a self-distribution market structure to circumvent the intermediation of a distribution company (thereby avoiding sharing profits with a third party) despite the fact that prices are lower under delegated distribution, as the distribution company boosts demand by eliminating any mismatching cost.

Our results give rise to the following implications on Amazon's business model in response to the *research questions* formulated above. Regarding the question on whether Amazon's self-publishing business model (KDP) is beneficial or detrimental to consumer welfare, our results show that Amazon can use KDP to circumvent publishing companies

[7] This mechanism recalls to some extent the *double marginalization externality* that is internalized after a merger of firms producing complentary goods.

under certain circumstances, which would result into higher e-book prices for consumers. On whether there is a risk for publishing companies to be driven out of the e-book market by Amazon, our results indicate that they face the risk of being circumvented in the segment of non-specialized books or novels written by emerging authors (i.e., for low values of product differentiation). This trend can be clearly observed in the segment of romance novels (or romantic fiction), as pointed out in Peukert & Reimers (2022) and Waldfogel & Reimers (2015). Finally, regarding the question on whether Amazon's dominance over traditional publishing companies in the e-book market should be a concern for policy makers, our analysis indicates that this dominance causes damage to final consumers for intermediate values of product differentiation, which would suggest undertaking certain regulatory measures to limit the expansion of KDP.

Our paper relates to the literature on two-sided markets started by Rochet & Tirole (2003) and Armstrong (2006). Within this rather wide literature on platform economics, our analysis relates closest to two strands.

The first literature strand focuses on the strategic decision of platforms on whether functioning as a marketplace (in which sellers directly interact with buyers) or as a reseller (purchasing from suppliers and selling to buyers).[8] This literature starts with Hagiu (2007), who shows that the reseller mode yields higher platform profits when indirect network effects are strong and when the demand of products from different sellers is interrelated. Instead, the marketplace mode is preferred by the platform when seller investment incentives are important or when there is asymmetric information regarding seller product quality. Hagiu & Wright (2015a) focuses on the difference between the two modes with respect to the allocation of residual control rights over a non-contractible decision variable (the choice of some marketing activity). Whether the marketplace or the reseller mode is preferred depends on the information of the platform and independent sellers about the optimal tailoring of marketing activities for each product. Finally, Hagiu, Teh & Wright (2022) consider the possibility of a platform that operates both as a marketplace and as a seller (dual mode) meaning that it competes with third-party sellers on its marketplace. Their results raise concerns against an outright ban of the dual mode. Differently, our model considers the complementarity between a core good that is directly provided by the platform and a side good (content) that is sold on the marketplace either directly by content providers (self-distribution) or through the intermediation of a distribution company (delegated distribution). Therefore, the provision of a core good and the fact that the reseller is a third party (which captures the characteristics of the e-book market) constitute the main differences with respect to the aforementioned literature.

The second literature strand related to our study focuses on the fee structure. With respect to the use of ad valorem fees, our modeling approach relies on the classical results from the taxation literature on the advantages of ad valorem commodity tax regimes as compared to per-unit schemes (Suits & Musgrave, 1953; Bishop, 1968). In the context of platforms, Wang & Wright (2017) show that the optimal fee schedule encompasses a per-unit component (proportional to the operating cost) along with an ad valorem component.

[8] From a different perspective, there are other studies focusing on the decision of platforms to act as either as a marketplace or as a vertically integrated firm (e.g., Hagiu & Wright, 2015b, 2019).

Building on this result and taking into account that prices in our model denote markups (as operating costs are normalized to zero), contracts in our analysis are based on ad valorem fees. In a subsequent paper, Wang & Wright (2018) show that ad valorem fees, in addition to being optimal for platforms, also increase welfare. Consequently, they should be allowed by regulatory authorities. Finally, Gaudin & White (2021) compare per unit and ad valorem platform fees, showing that ad valorem fees are typically more efficient than per unit fees. However, per unit fees become more efficient when user access becomes relevant. In our analysis, user access (i.e., access of content providers to the platform) is not an issue, so that ad valorem fees are the optimal scheme for the platform. Similarly, Johnson (2017) compares revenue-sharing agreements (agency model) and independent pricing (wholesale model) as regards to their effects on retail prices. He also concludes that upstream firms are better off using ad valorem fees (revenue sharing) while downstream firms are worse off.

There is another strand of the literature studying countervailing power in vertical relations (see, e.g., Von Ungern-Sternberg, 1996; Dobson & Waterson, 1997). A study within this literature that is related to our paper is Iozzi & Valletti (2014), who use a Nash bargaining between one upstream and several downstream firms to show that pricing depends on the respective outside options of each player. In our model, the platform and the content providers decide whether or not to use the intermediation of a distribution company. Therefore, whenever the distribution company does not generate enough value, platform and content providers circumvent it by adopting a bilateral (self-distribution) market structure.

There are some other papers that have studied different issues directly related to Amazon's business model. Zhu & Liu (2018) analyze Amazon's incentives to compete directly with content providers (i.e., acting both as a marketplace and as a reseller). While Amazon's entry discourages future investment and growth by third-parties on the platform, it has the advantage of boosting demand and reducing shipping costs for consumers. Wang & Miller (2020) compare the incentives of publishing companies to provide content either as e-books or printed books. They find that publishers offer high demand products as e-books on Kindle, while excluding some of their greatest revenue-generating books. Finally, De los Santos & Wildenbeest (2017) and De los Santos, O'Brien & Wildenbeest (2021) examine the transition from wholesale to agency contracts in the e-book industry before and after a ban on agency contracting (imposed in the antitrust settlement between US Department of Justice and the major publishers), concluding that the agency contracts led to publisher collusion.

The paper is organized as follows. Section 2 presents the model and Sections 3 and 4 carry out the equilibrium analysis under self-distribution and delegated distribution, respectively. The adoption of organizational structures is studied in Section 5. Section 6 analyzes the welfare implications of each organizational structure and compares private and social incentives. A discussion of the implications of our results on the e-book market is contemplated in Section 7. Finally, Section 8 concludes the paper. Appendix A contains all proofs and Appendices B, C, D, and E provide supplementary material with extensions of the model.

2 Model

Consumers. Consumers purchase a bundle $\Omega \equiv \{A + B\}$ at a single platform (e.g., Amazon), which is composed of a core good A (e.g., Kindle e-reader) and a side good B (e.g., e-books). The core good is directly provided by the platform. Instead, the side good can be provided under two different market structures: delegated distribution (denoted by D) and self-distribution (denoted by S). Under delegated distribution, content providers make use of a distribution company (e.g., Penguin Random House or Harper Collins) to deal with the platform. Under self-distribution, independent content providers (e.g., authors) deal with the platform directly.[9]

Each consumer i has willingness to pay for the bundle $v_i \in [0, \bar{v}]$ and is characterized by a side-service taste parameter θ_i, which is uniformly distributed over the unit-length Salop circle.[10] More precisely, they make their purchase decision according to the following expected utility function:

$$\mathbb{E}_\theta[V_i(p_A, p_B^e; \theta)] = v_i - p_A - p_B^e - \lambda \int_0^{\frac{1}{2n}} t\theta d\theta = v_i - p_A - p_B^e - \frac{\lambda t}{8n^2}, \quad (1)$$

where p_A is the price of the core good; p_B^e is the expected price of the side good; $n \geq 2$ is the number of existing varieties of the side good which are equidistantly spaced around the Salop circle; t stands for the degree of product differentiation among varieties with $t/(8n^2)$ capturing consumers' average *mismatching cost*; and $\lambda \in \{0, 1\}$ is the extent of the mismatching cost. Under delegated distribution $\lambda = 0$ is assumed, meaning that the intermediation of the distribution company allows consumers finding their preferred variety. Instead, under self-distribution $\lambda = 1$ as there is no intermediation and consumers have to bear the mismatching cost.[11,12] The degree of product differentiation is assumed to be positive and bounded from above, i.e., $t \in (0, \bar{t})$ with $\bar{t} \equiv 8\bar{v}n^2$.[13]

Consumers' purchase decision regarding the side good is as follows. First, they decide whether or not to purchase depending on their willingness to pay but being unaware of their actual taste for the side good (i.e., their location on the Salop circle). This decision is based on the expected side-good price p_B^e, as shown in equation (1). Second, they decide which variety to purchase once they learn their actual taste at the moment in which side-good sellers determine their equilibrium price p_B. The solution concept is *rational expectations equilibrium* (see Gans, 2012), under which the consumer's expectation of the

[9] Appendix E presents an extention of the model that allows for coexistence of the two market structures.

[10] See Salop (1979).

[11] Considering the two polar cases $\lambda = 0$ and $\lambda = 1$ is without loss of generality but simplifies the exposition of the results.

[12] It could be argued that Amazon KDP makes use of big data techniques to learn from consumer preferences which also allows reducing consumers' mismatching cost. However, as long as the mismaching cost is larger under self-publishing as compared to traditional publishing, our modeling choice would remain valid.

[13] The condition $t < \bar{t}$ guarantees that equilibrium quantities and bundle prices are always positive, as it can be observed from (22), (23), (37), and (38).

side-good price p_B^e in equilibrium equals the chosen price of side-good sellers contingent on those expectations.

To understand this purchasing-decision process, it is important to have in mind that the degree of product differentiation refers to varieties within a certain product category (in the case of e-books, categories would refer to textbooks, comics, mystery, romance novels, etc.). In this context, having consumers that are ex ante unaware of their taste refers to a situation in which they cannot anticipate which particular variety they will like to purchase within a given product category, i.e., for a given degree of product differentiation (in the case of e-books, e.g., this would refer to which textbook manual they would like to purchase within the category of Intermediate Microeconomics).[14,15]

Moreover, consumers have a zero outside option and their willingness to pay for the bundle v is uniformly distributed over the support $[0, \bar{v}]$ and has a density function $f(v) = 1/\bar{v}$. Denoting $\hat{v} = p_A + p_B^e + \lambda t/(8n^2)$ the willingness to pay of the marginal consumer, the demand for the bundle is given by

$$Q(p_A, p_B^e) = \int_{\hat{v}}^{\bar{v}} f(v)dv = \frac{1}{\bar{v}} \left(\bar{v} - p_A - p_B^e - \frac{\lambda t}{8n^2} \right). \tag{2}$$

Content providers. Content providers supply a horizontally differentiated side good, being unaware of consumers' willingness to pay v_i, so that they cannot price discriminate.[16,17] At this point, content providers assume that an individual consumer located in θ_i is associated with a willingness to pay $v_i \in [\hat{v}, \bar{v}]$ with the same probability.[18] As a consequence, content providers expect any consumer to have an average willingness to pay given by $\mathbb{E}v \equiv \int_{\hat{v}}^{\bar{v}} v \cdot f(v)\, dv$. Thus, content providers expect that a consumer located at θ_i and purchasing side-good variety $k \in \{1, ..., n\}$ would obtain a utility of

$$\mathbb{E}_v \left[V_i(p_A, p_{B_k}; \theta_i) \right] = \mathbb{E}v - p_A - p_{B_k} - \lambda t|\theta_i - \theta_k|, \tag{3}$$

where p_{B_k} is the price set by the k^{th} side-good seller. The indifferent consumer between firm k and its nearest rival, say firm j, is

$$\widehat{\theta}_i = \frac{1}{2} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{\lambda t} \right), \tag{4}$$

[14] In reality, consumers purchase many e-books to read on a single e-reader. A simple way to include this feature in our model would be to imagine several Salop circles, each one for a particular e-book category.

[15] In behavioral economics, there are models where uninformed consumers do not know their ideal taste ex ante and, therefore, they are uncertain about the product they will finally purchase (Heidhues & Kőszegi, 2010; Karle & Peitz, 2014). Our model is more related to Heidhues & Kőszegi (2008), as they also depart from a Salop model of price competition with differentiated products.

[16] In the analysis that follows, side-good sellers and content providers are used interchangeably.

[17] There is no *hold-up problem* as content providers do not take into account consumers' platform adoption in their pricing decisions.

[18] A similar theoretical framework has been used in Katz & Shapiro (1985), where sellers cannot price-discriminate, but they can perfectly predict the aggregate consumer behavior.

such that the demand of side-good seller k is given by

$$Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e) = \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{\lambda t}\right) Q(p_A, p_B^e), \tag{5}$$

where the first term denotes k's market share. Without loss of generality, all operating costs are assumed to be zero so that prices denote mark-ups.[19]

Payoffs. Under market structure D, the distribution company pays the platform an ad valorem fee η. In turn, content providers give up copyrights in favor of the distribution company by means of a revenue-sharing agreement consisting of another ad valorem fee φ. Accordingly, the payoffs of the platform, the distribution company, and content providers are given by

$$\pi_A = p_A Q(p_A, p_B^e) + \eta \sum_{k=1}^{K} p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e), \tag{6}$$

$$\pi_B = \varphi (1-\eta) \sum_{k=1}^{K} p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e), \text{ and} \tag{7}$$

$$\pi_{B_k} = (1-\varphi)(1-\eta)\, p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e), \tag{8}$$

respectively, where K denotes the number of content providers. Each variety located at a certain point in the Salop circle is provided by a content provider located at the same point (i.e., $K = n$).

Under market structure S, content providers sign a revenue-sharing agreement directly with the platform consisting of an ad valorem fee μ.[20] The payoffs of the platform and content providers are now given by

$$\pi_A = p_A Q(p_A, p_B^e) + \mu \sum_{k=1}^{K} p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e), \text{ and} \tag{9}$$

$$\pi_{B_k} = (1-\mu)\, p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p_B^e). \tag{10}$$

The determination of the fees is modeled via the alternating-offer framework of Rubinstein (1982). The platform (distribution company) offers each content provider a share of the total profits that is generated in the bilateral relationship. If the content provider accepts the offer, the process ends. Otherwise, the content provider makes a counter offer, which the platform (distribution company) can either accept or reject, where the process ends in the former case and proceeds to the next bargaining stage in the latter. Binmore,

[19] It could be argued that operation costs under self-distribution are actually higher than under delegated distribution, as independent content providers may lack experience in publishing and would probably incur higher costs in marketing their work. Introducing asymmetric costs between both organizational structures would rescale our results without affecting qualitatively our main findings.

[20] Wang and Wright (2017) show that an ad valorem fee schedule is optimal for platforms when there are no operating costs.

Rubinstein & Wolinsky (1986) have shown that Rubinstein's (1982) alternating-offer model approximates the Nash bargaining solution where the bargaining powers can be related, for example, to the discount rate.

Under scenario S, content providers bargain directly with the platform on the ad valorem fee μ. Under scenario D, content providers, the distribution company, and the platform bargain on the ad valorem fees η and φ. Let us denote γ_A, γ_B, and γ_k the bargaining power of the platform, the distribution company, and content providers, respectively. The outside options of all agents (platform, distribution company, and content providers) are normalized to zero.

Timing of the game. The timing of events is as follows. In stage 1, both platform and content providers decide whether to self-distribute the products (market structure S) or to make use of the distribution company (market structure D).[21,22] In stage 2, ad valorem fees are determined as a result of a bargaining process.[23] In stage 3, the prices of the core and the side good are chosen simultaneously.[24] As usual, the game is solved by backwards induction.

3 Prices and fees under self-distribution

In the material that follows, stages 2 and 3 under self-distribution are solved. First, optimal prices for the core and side good are derived (stage 3). Second, optimal ad valorem fees are determined as a result of a bargaining process (stage 2).

3.1 Prices under self-distribution (stage 3)

Under market structure S, in stage 3, each of the $K = n$ content providers sells a specific variety k and chooses p_{B_k} and the platform determines p_A. Content providers pricing decisions cannot affect consumers' general demand for the bundle $Q(p_A, p_B^e)$ because it depends on consumer's prior expectations on the side-good prices p_B^e, so that $\partial p_B^e / \partial p_{B_k} =$

[21] An extention in which the distribution company can offer side-payments to the platform and the content providers in order to prevent them adopting a self-distribution business model, is presented in Appendix C.

[22] Appendix E presents the mixed case that accommodates content providers both under self and delegated distribution, where the size of each group is endogenously determined.

[23] It is also true that many digital platforms make use of fixed (subscription) fees, such as streaming platforms for movies (e.g., Netflix, Amazon Prime Video, HBO, Disney Plus, etc.), for music (e.g., Spotify, Apple Music, Deezer, Pandora, etc.) or for audiobooks (e.g., Audible, Scribd, Audiobooks, Libro.fm, etc.). An extention of the model with fixed fees is provided in Appendix D.

[24] There is no apparent reason to consider a sequential choice in this stage, as the determination of the core-good price and the side-good price is similar from an strategic viewpoint (as it is observed in the case of e-readers and e-books). Nevertheless, to show that the timing choice of simultaneous price setting in stage 3 is innocuous, the sequential price setting (under which the platform enjoys a first-mover advantage and chooses the core-good price before the distribution company chooses the side-good price) is analyzed in Appendix B.

0.[25] Under self-distribution, there are no efficiency gains from the intermediation of any distribution company, so that $\lambda = 1$. Therefore, the platform and the content providers solve

$$\max_{p_A} \pi_A = p_A Q(p_A, p_B^e) + \mu \sum_{k=1}^{K} p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) Q(p_A, p_B^e), \tag{11}$$

$$\max_{p_{B_k}} \pi_{B_k} = (1-\mu)\, p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) Q(p_A, p_B^e), \tag{12}$$

yielding the following reaction functions:

$$p_A = \frac{1}{2}\left(\bar{v} - \frac{t}{8n^2} - p_B^e - \mu \sum_{k=1}^{K} p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) \right), \tag{13}$$

$$p_{B_k} = \frac{1}{2}\left(p_{B_j} + \frac{t}{n} \right), \tag{14}$$

for $\forall k, j \neq k$, which show that content providers choose their optimal prices independently of the platform pricing decision, while the platform optimal price decreases with consumer's prior expectations on the side-good prices p_B^e. Expressions in (13) and (14) show that p_A decreases with t through consumers' average mismatching cost $(t/(8n^2))$, whereas p_{B_k} increases with t as higher product differentiation translates into an accrued local-monopoly power.

Under rational expectations, the consumer's expectation of the side-good price p_B^e in equilibrium is the price determined by content providers contingent on those expectations, i.e., $p_B^e = p_{B_k}^S(p_B^e)$. Therefore, stage-3 equilibrium prices for the side and the core good are

$$p_A^S = \frac{1}{2}\left(\bar{v} - \frac{t}{8n^2} - (1+\mu)\frac{t}{n} \right), \tag{15}$$

$$p_B^S = p_{B_k}^S = \frac{t}{n} \quad \text{for } \forall k, \tag{16}$$

where p_B^S is the standard Salop price and p_A^S is the platform monopoly price discounted by consumers' average mismatching cost and side-good expenditures, which are accrued by the amount of the ad valorem fee.[26] Substituting equations (16) and (15) into (2), we obtain the equilibrium quantity

$$Q^S = \frac{1}{2\bar{v}}\left(\bar{v} - \frac{t}{8n^2} - (1-\mu)\frac{t}{n} \right), \tag{17}$$

[25] The modeling assumption $\partial p_B^e / \partial p_{B_k} = 0$ under scenario S means that content providers do not internalize at all the negative externality they generate on the platform (as they do not take into account the effect of their pricing decisions on the general demand). However, the results would not change qualitatively as long as $\partial p_B^e / \partial p_{B_k} << 1$.

[26] In the case of Amazon's KDP, authors obtain a higher fee whenever they charge lower prices for their e-books. Departing from our model and incorporating a positive per unit cost c for content providers, (12) becomes

$$\max_{p_{B_k}} \pi_{B_k} = [(1-\mu)\, p_{B_k} - c] \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) Q(p_A, p_B^e),$$

which can be used to write the stage-3 equilibrium profits as follows:

$$\pi_A^S = \left(p_A^S + \mu p_B^S\right) Q^S = \bar{v} \left(Q^S\right)^2, \tag{18}$$

$$\pi_{B_k}^S = (1-\mu) \frac{p_B^S}{n} Q^S = (1-\mu) \frac{t}{n^2} Q^S, \tag{19}$$

where the profits of content providers are naturally decreased by the amount of the ad valorem fee.

3.2 Ad valorem fee under self-distribution (stage 2)

In stage 2, the ad valorem fee μ is determined as the result of the following bargaining problem between the platform and each content provider:

$$\max_{\mu} \left(\underbrace{\frac{\bar{v}}{n} \left(Q^S\right)^2}_{\pi_A^S/n} \right)^{\gamma_A} \left(\underbrace{(1-\mu) \frac{t}{n^2} Q^S}_{\pi_{B_k}^S} \right)^{\gamma_k}, \tag{20}$$

where the first term stands for the platform's profit generated by each content provider. The optimal fee is encapsulated in the lemma that follows.

Lemma 1 *Under self-distribution, the optimal fee is*

$$\mu^{S^*} = 1 - \frac{\gamma_k}{\gamma_A + \gamma_k} \left(\bar{v} - \frac{t}{8n^2}\right) \frac{n}{2t}, \tag{21}$$

which is decreasing with the bargaining power of the content providers and increasing with the bargaining power of the platform.

Taking into account this optimal fee, yields the following equilibrium prices and quantity under market structure S:

$$p_A^{S^*} = \frac{1}{2} \left(1 + \frac{\gamma_k}{2(\gamma_A + \gamma_k)}\right) \left(\bar{v} - \frac{t}{8n^2}\right) - \frac{t}{n},\ p_{B_k}^{S^*} = p_B^{S^*} = \frac{t}{n}, \tag{22}$$

and

$$Q^{S^*} = \frac{1}{2\bar{v}} \left(1 - \frac{\gamma_k}{2(\gamma_A + \gamma_k)}\right) \left(\bar{v} - \frac{t}{8n^2}\right). \tag{23}$$

---

which yields a stage-3 equilibrium price given by

$$p_{B_k} = \frac{t}{n} + \frac{c}{1-\mu},$$

thereby capturing the aforementioned tradeoff between fees received by authors (i.e., $1-\mu$) and e-book prices.

From (22) and (23), it can be observed that the price of the side-good is the standard Salop price that increases with the degree of product differentiation. The platform adjusts the price of the core good in response to variations of the side-good price in such a way that the price of the bundle (i.e., $p_A^{S^*} + p_B^{S^*}$) is not altered by the pricing decision of content providers.[27] Consequently, both the price of the bundle and its quantity only depend on the degree of product differentiation through the average mismatching cost $(t/(8n^2))$. Looking at the effect of the bargaining strength of platform and content providers, it follows that the price of the bundle decreases (increases) with the bargaining power of the platform (content providers), whereas the opposite is observed for the equilibrium quantity. The reason is that the platform optimally adopts its pricing strategy in the core good market to changes in bargaining powers. More precisely, when its bargaining power increases, it obtains a higher fee μ resulting from the bargaining process with content providers and, consequently, it reduces its price for the core good with the purpose of boosting the demand for the bundle.

From (22) and (23), the stage-2 profits obtained by the platform and each content provider are given by

$$\pi_A^{S^*} = \bar{v}\left(Q^{S^*}\right)^2, \tag{24}$$

$$\pi_{B_k}^{S^*} = \frac{2\gamma_k}{2\gamma_A + \gamma_k} \frac{\bar{v}\left(Q^{S^*}\right)^2}{n}, \tag{25}$$

where, naturally, the profit of both the platform and the content providers is increasing (decreasing) with its own (the other agent's) bargaining power.

4 Prices and fees under delegated distribution

Let us consider now the delegated distribution market structure by deriving, first, optimal prices for the core and the side good (stage 3) and, then, the optimal ad valorem fees (stage 2).

4.1 Prices under delegated distribution (stage 3)

Under market structure D, in stage 3, a single distribution company provides all n varieties and determines the price of every variety p_{B_k}. As varieties are equidistantly spaced around the Salop circle, the multiproduct monopolist avoids competition among varieties and determines a unique price for side goods, i.e., $p_{B_k} = p_B$, so that $p_B^e = p_B$ under rational expectations. Consequently and differently to scenario S, the multiproduct monopolist can affect consumers' general demand for the bundle $Q(p_A, p_B^e)$ because $\partial p_B^e / \partial p_B = 1$.

[27] The inspection of expressions (15) and (22) reveals that the platform can decide to sell the core good (e.g., e-reader) below marginal cost (so that $p_A^{S^*} < 0$) to boost its revenues from the sales of the side good (e.g., e-books).

Taking these conditions into account along with the profit functions in (6) and (7), the maximization problem of the platform and the distribution company becomes

$$\max_{p_A} \pi_A = (p_A + \eta p_B)\, Q(p_A, p_B), \tag{26}$$

$$\max_{p_B} \pi_B = \varphi\,(1-\eta)\, p_B Q(p_A, p_B), \tag{27}$$

where η is the ad valorem fee charged by the platform to the distribution company and φ is the ad valorem fee charged by the distribution company to each of the K content providers. Under delegated distribution, the intermediation of the distribution company enables consumers to identify their preferred variety, so that they do not incur any mismatching cost and $\lambda = 0$. Under simultaneous price setting, profit maximization yields the following reaction functions:[28]

$$p_A = \frac{1}{2}\left(\bar{v} - (1+\eta)\, p_B\right) \text{ and } p_B = \frac{1}{2}\left(\bar{v} - p_A\right), \tag{28}$$

which show that optimal prices are strategic substitutes.[29] It should be noticed that the second reaction function is markedly different as compared to market structure S because it now depends on the price of the core good p_A. The rationale explaining this relevant difference between both market structures has to do with the fact that: *i*) under market structure S, content providers only care about their local-monopoly power, while *ii*) under market structure D, the distribution company internalizes the consequences of its pricing decisions (in the side-good market) on the general demand for the bundle. This difference is essential in the analysis that follows.

Stage-3 equilibrium prices for the core and the side good are as follows:[30]

$$p_A^D = \frac{1-\eta}{3-\eta}\bar{v},\; p_B^D = \frac{1}{3-\eta}\bar{v}, \tag{29}$$

where both prices depend on the ad valorem fee that is determined in stage 2. Instead, the price of the side good under market structure S is the standard Salop price, which is independent of ad valorem fees. Expression (29) shows that p_A^D is decreasing with the ad valorem fee η, while p_B^D is increasing with η. The reason is that, when the platform receives a larger proportion of revenues from the side-good market, the distribution company increases the price of the side-good. Then, the platform optimally reacts by decreasing the price of the core good.

[28] The case under which the platform has a first-mover advantage and chooses the core-good price before the distribution company chooses the side-good price is analyzed in Appendix B. The analysis shows that, awarding a first-mover advantage to the platform under delegated distribution, yields a similar effect as diminishing the bargaining power of the distribution company, namely, that the area under which market structure S is adopted becomes then larger.

[29] These reaction functions correspond to two duopoly firms selling two complementary products, a specification that recalls Cournot's (1838) model of complementary duopoly. Cournot considered the merger of two monopolists that produce complementary goods (zinc and copper) into a single monopolist that produces the combination of them (brass).

[30] Even though the prices of core and side goods differ in reality (e.g., Kindle e-readers are more expensive than e-books), it should be recalled that prices denote mark-ups as marginal costs are normalized to zero.

Substituting equations (29) into (2), we obtain the equilibrium quantity

$$Q^D = \frac{1}{3-\eta}. \tag{30}$$

The equilibrium quantity Q^D depends on the price of the bundle $p_A^D + p_B^D$. It can be observed that Q^D is increasing with the ad valorem fee, indicating that the effect of η on the core-good price dominates its effect on the side-good price.

Using (30), allows writing the stage-3 equilibrium profits as follows:

$$\pi_A^D = \bar{v}\left(Q^D\right)^2, \tag{31}$$

$$\pi_B^D = \varphi\left(1-\eta\right)\bar{v}\left(Q^D\right)^2, \text{ and} \tag{32}$$

$$\pi_{B_k}^D = \left(1-\varphi\right)\left(1-\eta\right)\frac{\bar{v}\left(Q^D\right)^2}{n}. \tag{33}$$

While content providers under market structure D have no influence on pricing decisions as they give up copyrights in favor of the distribution company by means of a revenue-sharing agreement consisting of an ad valorem fee φ, they actively participate in stage 2 where the ad valorem fees φ and η are determined.

4.2 Ad valorem fees under delegated distribution (stage 2)

In stage 2, content providers, the distribution company, and the platform bargain on the ad valorem fees η and φ, where the bargaining process is modeled via the alternating-offer framework of Rubinstein (1982). Hence, the optimal ad valorem fees are obtained as the solution of

$$\max_{\eta,\varphi}\left(\underbrace{\frac{\bar{v}\left(Q^D\right)^2}{n}}_{\pi_A^D/n}\right)^{\gamma_A}\left(\underbrace{\frac{\varphi\left(1-\eta\right)\bar{v}\left(Q^D\right)^2}{n}}_{\pi_B^D/n}\right)^{\gamma_B}\left(\underbrace{\frac{\left(1-\varphi\right)\left(1-\eta\right)\bar{v}\left(Q^D\right)^2}{n}}_{\pi_{B_k}^D}\right)^{\gamma_k}, \tag{34}$$

which yields the fees that are specified in the lemma that follows.

Lemma 2 *Under delegated distribution, the optimal fees are*

$$\eta^{D*} = \frac{2\gamma_A-\gamma_B-\gamma_k}{2\gamma_A+\gamma_B+\gamma_k}, \tag{35}$$

$$\varphi^{D*} = \frac{\gamma_B}{\gamma_B+\gamma_k}. \tag{36}$$

where η^D increases (decreases) with the bargaining power of the platform (the content providers and the distribution company); and φ^D increases (decreases) with the bargaining power of the distribution company (the content providers).

Consequently, plugging the optimal fee (35) into (29) and (30) yields

$$p_A^{D^*} = \frac{\gamma_B + \gamma_k}{2(\gamma_A + \gamma_B + \gamma_k)}\bar{v},\ p_B^{D^*} = \frac{2\gamma_A + \gamma_B + \gamma_k}{4(\gamma_A + \gamma_B + \gamma_k)}\bar{v}, \tag{37}$$

and

$$Q^{D^*} = \frac{2\gamma_A + \gamma_B + \gamma_k}{4(\gamma_A + \gamma_B + \gamma_k)}. \tag{38}$$

Looking at side-good pricing decisions (i.e., expressions (16) and (29)), it can be observed that the effect of product differentiation across varieties (t) is clearly different. Under self-distribution (market structure S), side-good prices rise when t increases as a standard (local) market-power exploitation in a Salop circle (as already ascertained from inspection of (14)). Instead, under delegated distribution (market structure D), side-good prices are independent of t as the intermediation of the distribution company allows consumers finding their preferred variety so that there is no mismatching cost.

The platform pricing decisions on the core good can be understood as the consequence of the side-market pricing decisions described above. Therefore, the price of the core good under market structure S is decreasing with t. Precisely, the side-good sellers generate a negative externality on the platform as they do not take into account the effect of their pricing decisions on the general demand. In consequence, the platform internalizes this externality when making its pricing decisions in the core-good market and when determining the ad valorem fee μ. Differently, under scenario D, the platform does not need to adjust its pricing decisions in the core-good market because both the distribution company and the platform take into account the effect of their pricing decisions on the general demand. Therefore, Q^{D^*} is also independent of t. Instead, given that the demand depends (negatively) on the sum of core and side-good prices (as it can be seen in (2)) and that the price effect coming from the side-good market is dominant, Q^{S^*} decreases with t as $p_B^{S^*}$ increases with t. This result highlights the strategic and relevant role of the side-good market structure.

Plugging (29) into (31)-(33) yields the following stage-2 equilibrium profits:

$$\pi_A^{D^*} = \bar{v}\left(Q^{D^*}\right)^2, \tag{39}$$

$$\pi_B^{D^*} = \frac{2\gamma_B}{2\gamma_A + \gamma_B + \gamma_k}\bar{v}\left(Q^{D^*}\right)^2, \tag{40}$$

$$\pi_{B_k}^{D^*} = \frac{2\gamma_k}{2\gamma_A + \gamma_B + \gamma_k}\frac{\bar{v}\left(Q^{D^*}\right)^2}{n}, \tag{41}$$

where the profits from the side-good market are shared among the platform, the distribution company, and the content providers according to their respective bargaining powers.

5 Choice of side-good market structure (stage 1)

In stage 1, the platform and the content providers decide whether to adopt a self-distribution market structure or to keep on making use of the intermediation of the distribution company (traditional model). The distribution company always prefers market structure D

because it is driven out of the market under structure S. The final choice depends on which of the two structures is more profitable for the platform and the content providers. The self-distribution market structure is adopted whenever $\Delta\Pi \equiv \pi_A^{S*} + K\pi_{B_k}^{S*} - \left(\pi_A^{D*} + K\pi_{B_k}^{D*}\right) > 0$ holds.[31] Making use of (24), (25), (39) and (41), this condition becomes

$$\Delta\Pi = \left(1 + \frac{2\gamma_k}{2\gamma_A + \gamma_k}\right) \bar{v} \left(Q^{S^*}\right)^2 - \left(1 + \frac{2\gamma_k}{2\gamma_A + \gamma_B + \gamma_k}\right) \bar{v} \left(Q^{D^*}\right)^2 > 0. \quad (42)$$

Analyzing the determinants of the sign of this profit gap allows to derive the following proposition.

Proposition 1 *The self-distribution market structure is adopted when the degree of product differentiation is low ($0 < t < t^*$). Instead, delegated distribution is adopted when the degree of product differentiation is high ($t^* < t < \bar{t}$), where $t^* = 8n^2\bar{v}\left(1 - \sqrt{\gamma}\right)$ and* $\gamma \equiv \frac{(2\gamma_A+\gamma_B+\gamma_k)(2\gamma_A+\gamma_B+3\gamma_k)(\gamma_A+\gamma_k)^2}{(2\gamma_A+\gamma_k)(2\gamma_A+3\gamma_k)(\gamma_A+\gamma_B+\gamma_k)^2}$.

To understand this result, it is useful to take into account the advantages and drawbacks for the platform and content providers associated with the intermediation of the distribution company. A first advantage is that the distribution company gives rise to a better consumer fit by eliminating consumer mismatching cost, thereby boosting demand. A second advantage is that the distribution company behaves as a multiproduct monopolist that coordinates content pricing decisions, so that they do not generate a negative externality on the general demand. The drawback for the platform and content providers is that they must share their surplus with a third player.

For low values of product differentiation, both platform and content providers decide to adopt a self-distribution market structure because the mismatching cost is low and, therefore, the intermediation of the distribution company does not provide much value to consumers. Additionally, content providers have low market power such that they generate a limited externality when setting prices independently. Consequently, the advantages that the platform and content providers would perceive from the intermediation of the distribution company do not compensate having to share profits with a third player. For large values of product differentiation, both the mismatching cost and the externality generated by independent pricing of content providers are high. In this situation the distribution company adds significant value, and, consequently, the platform and the content providers benefit from sharing profits with it.

Carrying out a simple comparative-static exercise to ascertain the effect of γ_B and γ_k over t^*, it is obtained that the range for t under which scenario S is preferred by platform and content providers expands with the bargaining power of the distribution company

[31] Alternatively, the distribution company could offer side-payments to the platform and the content providers in order to prevent them adopting a self-distribution business model, under which the distribution company would obtain zero profits. The distribution company would be willing to offer side-payments up to $\pi_B^{D^*}$. Consequently, whenever the distribution company offers side-payments, the self-distribution model is adopted if $\pi_A^{S^*} + K\pi_{B_k}^{S^*} > \pi_A^{D^*} + \pi_B^{D^*} + K\pi_{B_k}^{D^*}$. As shown in Appendix C, our results remain qualitatively unchanged under this alternative modeling choice.

and shrinks with the bargaining power of content providers, as displayed in Figure 1 and encapsulated in the following corollary.[32]

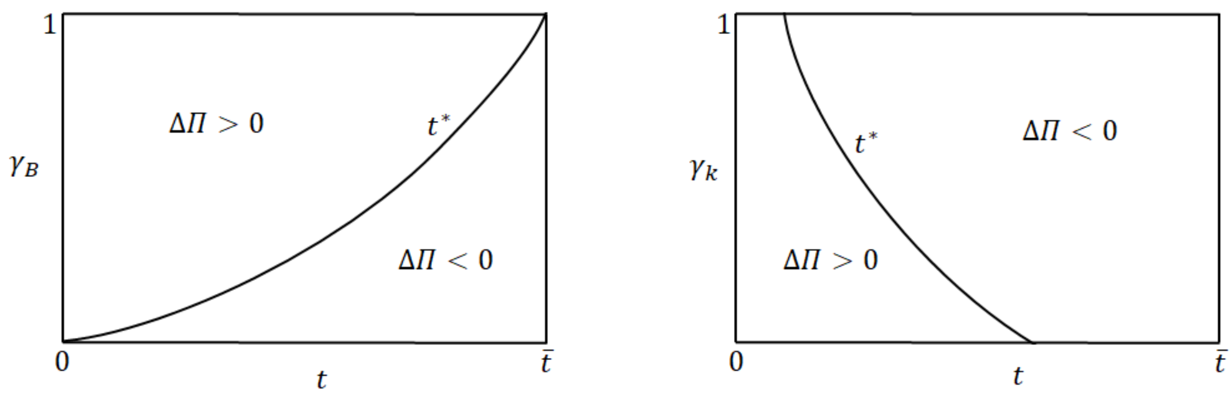

Figure 1: Comparative statics

Corollary 1 *The threshold t^* decreases with the bargaining power of content providers (i.e., $\frac{\partial t^*}{\partial \gamma_k} < 0$), and increases with the bargaining power of the distribution company (i.e., $\frac{\partial t^*}{\partial \gamma_B} > 0$), where $t^*|_{\gamma_B \to 1} = \bar{t}$ and $t^*|_{\gamma_B \to 0} = 0$.*

The reason is that platform and content providers are more inclined: *i*) to circumvent the distribution company when it has a stronger bargaining position, and *ii*) to deal with the distribution company when content providers have a stronger bargaining position vis-à-vis the distribution company. In the case of the e-book industry, the low bargaining power that characterizes emerging authors advises against dealing with a traditional publisher, urging them to self-distribute their e-books. Instead, established well-known authors with a high bargaining power prefer to take advantage of the intermediation of a traditional publisher.[33]

When the platform and the content providers have no bargaining power with respect to the distribution company (i.e., $\gamma_A = \gamma_k = \gamma = 0$), then $t^* = \bar{t}$. Naturally, platform and content providers are not interested in dealing with the distribution company when they do not have any bargaining power. Consequently, they always prefer scenario S. Instead, when the distribution company has no bargaining power (i.e., $\gamma_B = 0$ and $\gamma = 1$), then

[32] It can be observed that $\frac{\partial t^*}{\partial \gamma_B} = \frac{\partial t^*}{\partial \gamma} \frac{\partial \gamma}{\partial \gamma_B}$ and $\frac{\partial t^*}{\partial \gamma_k} = \frac{\partial t^*}{\partial \gamma} \frac{\partial \gamma}{\partial \gamma_k}$, with $\frac{\partial t^*}{\partial \gamma} < 0$ and $\frac{\partial \gamma}{\partial \gamma_B} = \frac{2(\gamma_A+\gamma_k)^2\left(2\gamma_A^2+4\gamma_A\gamma_k+\gamma_B\gamma_A+\gamma_k^2+\gamma_B\gamma_k\right)}{(\gamma_A+\gamma_B+\gamma_k)^3\left(4\gamma_A^2+8\gamma_A\gamma_k+3\gamma_k^2\right)} < 0$, and
$$\frac{\partial \gamma}{\partial \gamma_k} = \frac{2\gamma_B(\gamma_A+\gamma_k)}{(\gamma_A+\gamma_B+\gamma_k)^3\left(4\gamma_A^2+8\gamma_A\gamma_k+3\gamma_k^2\right)^2}\begin{pmatrix} 8\gamma_A^4+4\gamma_A^3\gamma_B+36\gamma_A^3\gamma_k+17\gamma_A^2\gamma_B\gamma_k+50\gamma_A^2\gamma_k^2 \\ +\gamma_A\gamma_B^2\gamma_k+16\gamma_A\gamma_B\gamma_k^2+24\gamma_A\gamma_k^3+3\gamma_B\gamma_k^3+3\gamma_k^4 \end{pmatrix} > 0.$$

[33] Although the model focuses on e-books, the eventual coexistence of e-books and physical books provided by traditional publishers would be captured in our model by an accrued bargaining power of authors (i.e., a higher γ_k). As shown in Figure 1, this coexistence of the two formats would make authors more inclined to use the intermediation of a traditional publisher in the e-book market (i.e., delegated distribution).

$t^* = 0$. This means that platform and content providers always prefer to make use of the intermediation of the distribution company as it adds value at no cost.

6 Welfare analysis

Consumer welfare can be written as

$$\begin{aligned} CS &= 2n \int_{\hat{v}}^{\bar{v}} \int_{0}^{1/2n} \left(v_i - p_A - p_B^e - \lambda t\theta\right) f(v) d\theta dv \\ &= \left(\frac{\bar{v}Q(p_A, p_B^e)}{2} - \frac{\lambda t}{4n} + \frac{\lambda t}{8n^2}\right) \bar{v}Q(p_A, p_B^e), \end{aligned} \tag{43}$$

where $\lambda t/\left(8n^2\right)$ is the consumers' average mismatching cost and $\lambda t/\left(4n\right)$ is the total consumers' mismatching cost (i.e., $2n$ times the average mismatching cost). It should be noticed that the demand in (2) is formed by consumers' ex-ante expectations (as shown in (1)), while the consumer surplus takes into account the realized utility.

With the purpose of comparing consumer welfare under both scenarios, $\Delta CS \equiv CS^S - CS^D$ can be written in the following way using expression (43):

$$\Delta CS = \bar{v}\left(\frac{\bar{v}}{2}\left(Q^{S^*}\right)^2 - \frac{\bar{v}}{2}\left(Q^{D^*}\right)^2 - \left(\frac{t}{4n} - \frac{t}{8n^2}\right)Q^{S^*}\right). \tag{44}$$

Looking at (44), it can be observed that the difference in the first two terms (which ultimately depends on total demand) determines the sign of the expression when product differentiation is small. In this case, $Q^{S^*} > Q^{D^*}$ and $\Delta CS > 0$, so that consumers are better off under market structure S. Instead, for higher levels of product differentiation, $Q^{S^*} < Q^{D^*}$ is observed and $\Delta CS < 0$.[34] The following result is obtained.

Proposition 2 *Consumers are better off under self-distribution when the degree of product differentiation is low ($0 < t < \widetilde{t}$), where $\widetilde{t} < t^*$. Instead, they are better off under delegated distribution when the degree of product differentiation is high ($\widetilde{t} < t < \bar{t}$).*

The larger surplus observed under self-distribution for a low degree of product differentiation ($0 < t < \widetilde{t}$) is consistent with the findings in Waldfogel & Reimers (2015), who estimate a substantial increase in consumer surplus associated to cost-reductions in the distribution of e-books.[35] These cost-reductions are mostly explained by the success of the self-distribution model that has achieved its largest impact in the segment of romance

[34] From inspection of (23) and (38), it can be observed that Q^{S^*} is decreasing in t, while Q^{D^*} is independent of t becasue the distribution company fully eliminates the mismatching cost. As a consequence, the quantity gap $Q^{S^*} - Q^{D^*}$ is decreasing in t with $Q^{S^*} - Q^{D^*} = \frac{\gamma_A \gamma_B}{4(\gamma_A+\gamma_k)(\gamma_A+\gamma_B+\gamma_k)} > 0$ for $t = 0$ and $Q^{S^*} - Q^{D^*} = -\frac{2\gamma_A+\gamma_B+\gamma_k}{4(\gamma_A+\gamma_B+\gamma_k)} < 0$ for $t = \bar{t}$.

[35] Waldfogel & Reimers (2015) estimate an increase in consumer surplus of \$3.5 billion between 2008 and 2012 (and a cumulative increase of \$5.7 billion).

novels (which can be considered as non-specialized e-books having as potential readers the general public) where self-published works account for almost a third.

Taking into account the results from Propositions 1 and 2, Figure 2 below displays a plot of the profit gap $\Delta\Pi$ and the consumer surplus gap ΔCS.

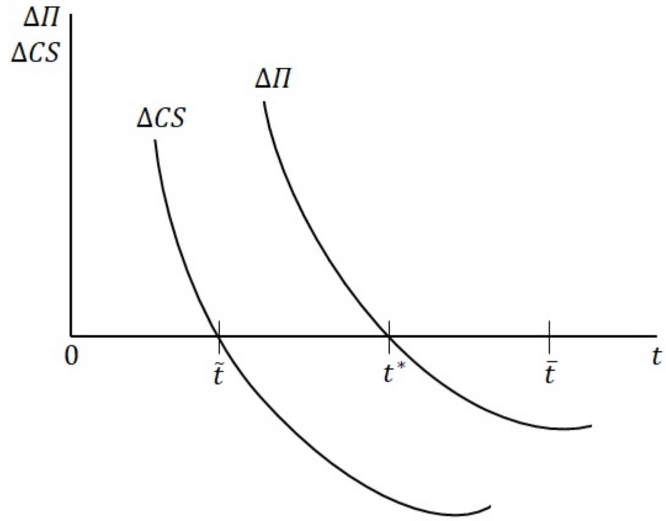

Figure 2: Profit gap and consumer surplus gap

This comparison between private and public interests is summarized in the following Corollary.

Corollary 2 *The adoption of a self-distribution market structure ($\Delta\Pi > 0$) only benefits consumers when the degree of product differentiation is sufficiently low, while the adoption of a delegated distribution market structure ($\Delta\Pi < 0$) is always in the interest of consumers. More precisely:*

$$\begin{array}{ll} i)\ \Delta\Pi > 0;\ \Delta CS > 0 & \text{for } 0 < t < \widetilde{t}, \\ ii)\ \Delta\Pi > 0;\ \Delta CS < 0 & \text{for } \widetilde{t} < t < t^*, \\ iii)\ \Delta\Pi < 0;\ \Delta CS < 0 & \text{for } t^* < t < \bar{t}. \end{array}$$

The intuition behind this result is as follows. For small values of product differentiation ($0 < t < \widetilde{t}$), the local-monopoly power exerted by independent content providers under self-distribution is rather modest and prices are low. Moreover, the mismatching cost is rather modest when t is small, so that the intermediation of a distribution company that would prevent consumers from bearing such a cost does not add much value. Thus, both platform and content providers find it more profitable to adopt a self-distribution market structure. On the other hand, consumers are also better off under self-distribution as they can take advantage of lower bundle prices and, consequently, there is no discrepancy between private and public interests.

Shifting attention to large values of product differentiation ($t^* < t < \bar{t}$), the local-monopoly power exerted by independent content providers under self-distribution is strong, thereby creating an upward pressure on content prices. Moreover, the mismatching cost is rather relevant when t is high, so that the intermediation of a distribution company that prevents consumers from bearing such a cost adds value and boosts demand. Thus, both platform and content providers find it more profitable to adopt a delegated distribution market structure. On the other hand, consumers are also better off under delegated distribution as they can take advantage of lower bundle prices, which is explained by i) the elimination of any mismatching cost due to the intermediation of the distribution company and ii) the internalization of content pricing decisions by the distribution company. Again, in this case there is no discrepancy between private and public interests.

Finally, for intermediate levels of product differentiation ($\widetilde{t} < t < t^*$), platform and consumer interests are misaligned. Consumers prefer to deal with a distribution company while both platform and content providers opt for a self-distribution market structure. The reason is that the added value generated by the intermediation of the distribution company makes consumers be better off under delegated distribution, whereas both platform and content providers are worse off as they have to bargain with a third party.

7 Discussion: Implications for the e-book market

Our results in Propositions 1-2 and Corollary 2, give rise to the following implications on Amazon's business model in response to the research questions formulated in the introduction of this paper.

Regarding the question on whether Amazon's self-publishing business model (Kindle Direct Publishing) is beneficial or detrimental to consumer welfare, the answer derived from our analysis is non-trivial, as pointed out in Proposition 2. We conclude that Kindle Direct Publishing (KDP) benefits consumers through lower content and bundle prices when product differentiation across e-books is low. Therefore, as long as authors do not have much influence over e-book prices, KDP should be beneficial for both consumers and Amazon. Instead, the intermediation of a publishing company allows consumers finding their preferred variety at lower content and bundle prices when product differentiation across e-books is high.

On whether there is a risk for publishing companies to be driven out of the e-book market by Amazon, our results indicate that this is not the case as long as product differentiation among e-books and/or authors' bargaining power are high (as shown in Figure 1). Under such scenario, the intermediation of publishing companies results into lower e-book prices, which is beneficial for Amazon as it can raise the price of Kindle e-readers (as shown in Proposition 1). For instance, in the segment of specialized books (such as academic textbooks) or novels written by well-known authors, our results suggest that publishing companies will continue playing a relevant role in their distribution. Instead, in the segment of non-specialized books or novels written by emerging authors, publishing companies are at risk of being driven out of the e-book market by Amazon. This finding is corroborated by the works of Peukert & Reimers (2022) and Waldfogel & Reimers (2015), who show that the role of publishing companies has declined over the last decade in the segment of romance novels (or romantic fiction) where self-published works account for almost a third.

Regarding the question on whether Amazon's dominance over traditional publishing companies in the e-book market should be a regulatory concern, our analysis indicates that this is the case under certain circumstances. Looking at the three possibilities described in Corollary 2, our results suggest that Amazon's dominance is less detrimental to consumers whenever authors have either modest or substantial influence over e-book prices (see Corollary 2i and 2iii). On the one hand, when authors have modest market power, both producers (Amazon and content providers) and consumers prefer KDP. On the other hand, when authors have substantial market power, both producers (Amazon and content providers) and consumers are interested in making use of the intermediation of a publishing company such as Penguin Random House, Harper Collins, Macmillan, Hachette or Simon & Shuster. Instead, our results suggest that Amazon's dominance is detrimental for consumers whenever authors have a moderate influence over e-book prices (see Corollary 2ii) because consumers would prefer to deal with a traditional publisher whereas Amazon (together with the authors) would use KDP to circumvent any intermediation of publishing companies.

A final caveat should be taken into account. Our analysis derives results on the internal organization of Amazon e-book business (i.e., self-distribution vs. publishing companies) under the actual market structure where Amazon is the sole leading platform. There is a current debate in the US initiated by Khan (2017) suggesting the adoption of a new antitrust law framework based on *common carrier obligations and duties*. Under this view, antitrust recommendations concerning dominant platforms should take into account the potential effects of platform competition and consider innovative regulatory measures such as giving access to Amazon's infrastructure to independent operators at *just and reasonable rates*. This revised antitrust approach based on common carrier obligations would be similar to the one adopted to essential network industries (such as railroads, telecommunications or electric distribution).[36] However, such an antitrust approach seems hard to implement given the extraordinarily and long-lasting low prices of Amazon's books (both physical and e-books), which seems to rule out any possible concern about predatory pricing (Reimers & Waldfogel, 2017).[37] Of course, deriving regulatory implications from our results in the light of this new antitrust perspective would require to consider additional counterfactuals involving platform competition, which most likely would result into a better outcome for final consumers.

8 Conclusion

The proposed model allows providing an overall assessment on the welfare implications associated with the two main organizational structures in digital platforms: self-distribution

[36] See Khan (2018) and Eeckhout (2021) for further discussion on this new approach to antitrust policy.

[37] One may wonder if this low-price startegy can be maintained indefinitely, as it represents a source of surplus for consumers but not for shareholders.

and delegated distribution. Bringing the analysis to the e-book industry helps unraveling some relevant implications regarding Amazon's self-publishing business model (Kindle Direct Publishing). Our results suggest that: *i*) self-publishing can result into higher e-book prices for consumers under certain circumstances; *ii*) publishing companies could be driven out of the e-book market by Amazon in the segment of non-specialized books or novels written by emerging authors; *iii*) Amazon's dominance over traditional publishing companies could cause damage to final consumers, which suggests undertaking certain regulatory measures to limit the expansion of Kindle Direct Publishing.

Although the e-book industry represents the main motivation for our analysis, there are other settings to which the model could be applied. For instance, in the video-game industry there are three main platforms (Nintendo, Sony, and Microsoft) with a considerable degree of monopoly power due to technical incompatibilities and high switching costs. In this industry, consumers purchase consoles (core good) from the platform while video games (side goods) are provided by game developers. These platforms allow developers to provide their video-games directly or, alternatively, making use of a distribution company (e.g., Tencent Games or Activision Blizzard). Therefore, the implications derived from the above analysis would apply to this industry as well.

Instead, there are other industries where multihoming is a generalized practice and platform competition becomes an issue. For instance, in the streaming industry, digital platforms (e.g., Netflix, HBO, Amazon, Disney or Filmin) compete for content (movies and series) provided either by independent studios or distribution companies (e.g., Paramount Pictures, Warner Bros., Universal or 20th Century Fox). An adaptation of our setting to accommodate platform competition could be used to analyze the managerial and welfare implications within this industry. This constitutes an interesting avenue for future research.

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A Appendix: Proofs

Proof of Lemma 1.
Noticing that the objective function of the bargaining problem in (20) can be rewritten as

$$\Lambda = \left(\frac{\bar{v}}{n}\right)^{\gamma_A} \left(\frac{t}{n^2}\right)^{\gamma_k} (1-\mu)^{\gamma_k} \left(Q^S\right)^{2\gamma_A+\gamma_k}, \tag{A1}$$

and that $\frac{\partial Q^S}{\partial \mu} = \frac{t}{2\bar{v}n}$, the first-order condition is

$$\frac{\partial \Lambda}{\partial \mu} = \left(\frac{2\gamma_A+\gamma_k}{Q^S}\frac{\partial Q^S}{\partial \mu} - \frac{\gamma_k}{1-\mu}\right)\Lambda = \left(\frac{2\gamma_A+\gamma_k}{\frac{n\bar{v}}{t} - \frac{1}{8n} - (1-\mu)} - \frac{\gamma_k}{1-\mu}\right)\Lambda = 0. \tag{A2}$$

From this equation, the optimal ad valorem fee in (21) is derived. The second-order derivative is:

$$\frac{\partial^2 \Lambda}{\partial \mu^2} = \left(-\frac{2\gamma_A+\gamma_k}{\left(\frac{n\bar{v}}{t} - \frac{1}{8n} - (1-\mu)\right)^2} - \frac{\gamma_k}{(1-\mu)^2}\right)\Lambda + \left(\frac{2\gamma_A+\gamma_k}{\frac{n\bar{v}}{t} - \frac{1}{8n} - (1-\mu)} - \frac{\gamma_k}{1-\mu}\right)\frac{\partial \Lambda}{\partial \mu}, \tag{A3}$$

which at the optimum is

$$\frac{\partial^2 \Lambda}{\partial \mu^2} = \left(-\frac{2\gamma_A+\gamma_k}{\left(\frac{n\bar{v}}{t} - \frac{1}{8n} - (1-\mu)\right)^2} - \frac{\gamma_k}{(1-\mu)^2}\right)\Lambda < 0, \tag{A4}$$

so that the optimal fee (21) is a maximum. ■

Proof of Lemma 2.
Noticing that the objective function of the bargaining problem in (34) can be rewritten as

$$\Upsilon = \left(\frac{\bar{v}}{n}\right)^{\gamma_A+\gamma_B+\gamma_k} \varphi^{\gamma_B} (1-\varphi)^{\gamma_k} (1-\eta)^{\gamma_B+\gamma_k} (3-\eta)^{-2(\gamma_A+\gamma_B+\gamma_k)}, \tag{A5}$$

the first-order conditions are

$$\frac{\partial \Upsilon}{\partial \eta} = \left[2\frac{\gamma_A+\gamma_B+\gamma_k}{3-\eta} - \frac{\gamma_B+\gamma_k}{1-\eta}\right]\Upsilon = 0, \tag{A6}$$

$$\frac{\partial \Upsilon}{\partial \varphi} = \left[\frac{\gamma_B}{\varphi} - \frac{\gamma_k}{1-\varphi}\right]\Upsilon = 0. \tag{A7}$$

From these equations, the optimal ad valorem fees in (35) and (36) are derived. The second-order derivatives are:

$$\frac{\partial^2 \Upsilon}{\partial \eta^2} = \left[2\frac{\gamma_A+\gamma_B+\gamma_k}{(3-\eta)^2} - \frac{\gamma_B+\gamma_k}{(1-\eta)^2}\right]\Upsilon + \left[2\frac{\gamma_A+\gamma_B+\gamma_k}{3-\eta} - \frac{\gamma_B+\gamma_k}{1-\eta}\right]\frac{\partial \Upsilon}{\partial \eta} \tag{A8}$$

$$\frac{\partial^2 \Upsilon}{\partial \varphi^2} = \left[-\frac{\gamma_B}{\varphi^2} - \frac{\gamma_k}{(1-\varphi)^2}\right]\Upsilon + \left[\frac{\gamma_B}{\varphi} - \frac{\gamma_k}{1-\varphi}\right]\frac{\partial \Upsilon}{\partial \varphi} \tag{A9}$$

$$\frac{\partial^2 \Upsilon}{\partial \varphi \partial \eta} = \left[2\frac{\gamma_A+\gamma_B+\gamma_k}{3-\eta} - \frac{\gamma_B+\gamma_k}{1-\eta}\right]\frac{\partial \Upsilon}{\partial \varphi} \tag{A10}$$

Then, the Hessian matrix at the optimum is:

$$H = \Upsilon \begin{bmatrix} -\frac{1}{8}\frac{(2\gamma_A+\gamma_B+\gamma_k)^3}{(\gamma_B+\gamma_k)(\gamma_A+\gamma_B+\gamma_k)} & 0 \\ 0 & -\frac{(\gamma_B+\gamma_k)^3}{\gamma_B\gamma_k} \end{bmatrix} \tag{A11}$$

with $\det(H_1) < 0$ and $\det(H) > 0$, so that the optimal fees are maxima. ■

Proof of Proposition 1.
After making use of (21) and (35) and substituting (17) and (30) into (42), we observe that $\Delta\Pi > 0$ iff

$$\Psi \equiv \left(\bar{v} - \frac{t}{8n^2}\right)^2 - \gamma\bar{v}^2 = \bar{v}^2(1-\gamma) - 2\bar{v}\left(\frac{t}{8n^2}\right) + \left(\frac{t}{8n^2}\right)^2 > 0, \tag{A12}$$

where $\gamma \equiv \frac{(2\gamma_A+\gamma_B+\gamma_k)(2\gamma_A+\gamma_B+3\gamma_k)(\gamma_A+\gamma_k)^2}{(2\gamma_A+\gamma_k)(2\gamma_A+3\gamma_k)(\gamma_A+\gamma_B+\gamma_k)^2}$ with $0 < \gamma < 1$. This expression is negative between its two roots, which are given by

$$t_L = 8n^2\bar{v}\left(1-\sqrt{\gamma}\right), \text{ and } t_U = 8n^2\bar{v}\left(1+\sqrt{\gamma}\right), \tag{A13}$$

where $t_U > \bar{t} \equiv 8\bar{v}n^2$. Defining $t^* = t_L$, we conclude that

$$\Psi \begin{cases} \geq 0 & \text{for} \quad 0 < t \leq t^* \\ < 0 & \text{for} \quad t^* < t < \bar{t}. \end{cases} \tag{A14}$$

. ■

Proof of Proposition 2.
To prove the proposition, it is shown that $\exists\widetilde{t} \in (0, t^*)$ such that $\Delta CS(t) > 0$ for $0 < t \leq \widetilde{t}$ and $\Delta CS(t) < 0$ for $\widetilde{t} < t \leq \bar{t}$. The proof is structured along three steps.
i) First, notice that ΔCS is a convex function, because

$$\partial^2\frac{\Delta CS}{\partial t^2} = (2\gamma_A+\gamma_k)\frac{(16n-6)\gamma_A + (16n-7)\gamma_k}{2^{10}n^4(\gamma_A+\gamma_k)^2} > 0. \tag{A15}$$

ii) Second, evaluating ΔCS in (44) at $t = 0$ and $t = \bar{t}$ yields:

$$\Delta CS(t=0) = \bar{v}\left(\frac{\bar{v}}{2}\left(Q^{S^*}\right)^2 - \frac{\bar{v}}{2}\left(Q^{D^*}\right)^2\right) > 0, \tag{A16}$$

$$\Delta CS\left(t=\bar{t}\right) = -\frac{\bar{v}^2}{2}\left(Q^{D^*}\right)^2 = -\frac{1}{32}\left(\frac{2\gamma_A+\gamma_B+\gamma_k}{\gamma_A+\gamma_B+\gamma_k}\bar{v}\right)^2 < 0, \tag{A17}$$

because $Q^{S^*}\left(t=\bar{t}\right) = 0$. Noticing that ΔCS is a continuous function in t, step *i*) and *ii*) prove the existence and uniqueness of the threshold $\widetilde{t} \in (0, \bar{t})$.
iii) The last step proves that $\widetilde{t} \in (0, t^*)$. Evaluating ΔCS in (44) at $t = t^*$ yields:

$$\Delta CS(t=t^*) = -\bar{v}\left(\frac{1-\gamma}{\gamma}\frac{\bar{v}}{2}\left(Q^{S^*}\right)^2 + \left(\frac{t}{4n} - \frac{t}{8n^2}\right)Q^{S^*}\right) < 0, \tag{A18}$$

because $\frac{1}{\gamma}\left(Q^{S^*}\right)^2 = \left(Q^{D^*}\right)^2$, which follows from the definition of t^* as $\Delta\Pi(t = t^*) = 0$ in (42). ■

B Appendix: Sequential pricing

One could think that the platform should have a first-mover advantage when determining the price of the core-good. Under self-distribution, this alternative approach would not alter the results of our baseline model as the reaction functions of content providers are independent of the core-good price (see (14)). Instead, under delegated distribution the results of our baseline model are modified in the following way.

Plugging the reaction function $p_B = \frac{1}{2}(\bar{v} - p_A)$ into (6) and maximizing allows obtaining the stage-3 equilibrium prices

$$p_A^D = \frac{1-\eta}{2-\eta}\bar{v},\ p_B^D = \frac{1}{2(2-\eta)}\bar{v} \tag{A19}$$

and quantity

$$Q^D = \frac{1}{2(2-\eta)}. \tag{A20}$$

As compared to our baseline model with simultaneous price setting, the price of the core good (for a given η) under sequential competition is higher, while the price of the side good is lower. Overall the effect of the core good dominates in the price of the bundle and, consequently, the quantity is now lower.

Using (A20), allows writing the stage-3 equilibrium profits as follows:

$$\pi_A^D = \frac{1}{2}\bar{v}Q^D, \tag{A21}$$

$$\pi_B^D = \varphi(1-\eta)\bar{v}\left(Q^D\right)^2, \tag{A22}$$

$$\pi_{B_k}^D = (1-\varphi)(1-\eta)\frac{\bar{v}\left(Q^D\right)^2}{n}, \tag{A23}$$

where it can be observed that the profits of the distribution company and content providers have the same functional form as in our baseline model, meaning that they are now lower as the quantity has been proven to be lower. Instead, the platform earns larger profits due to its first-mover advantage.

The optimal ad valorem fees are obtained as the solution of

$$\max_{\eta,\varphi}\left(\frac{\bar{v}Q^D}{2n}\right)^{\gamma_A}\left(\frac{\varphi(1-\eta)\bar{v}\left(Q^D\right)^2}{n}\right)^{\gamma_B}\left(\frac{(1-\varphi)(1-\eta)\bar{v}\left(Q^D\right)^2}{n}\right)^{\gamma_k}, \tag{A24}$$

which yields the following ad valorem fees

$$\eta^{D^*} = \frac{\gamma_A}{\gamma_A+\gamma_B+\gamma_k}, \tag{A25}$$

$$\varphi^{D^*} = \frac{\gamma_B}{\gamma_B+\gamma_k}, \tag{A26}$$

where η^{D^*} is now higher due to the first-mover advantage enjoyed by the platform, while φ^{D^*} remains unchanged. Plugging (A25) and (A26) into (A21)-(A23) yields the following stage-2 equilibrium profits:

$$\pi_A^{D^*} = \frac{1}{2}\bar{v}Q^{D^*}, \quad \text{(A27)}$$
$$\pi_B^{D^*} = \frac{\gamma_B}{\gamma_A+\gamma_B+\gamma_k}\bar{v}\left(Q^{D^*}\right)^2, \quad \text{(A28)}$$
$$\pi_{B_k}^{D^*} = \frac{\gamma_k}{\gamma_A+\gamma_B+\gamma_k}\frac{\bar{v}\left(Q^{D^*}\right)^2}{n}, \quad \text{(A29)}$$

with

$$Q^{D^*} = \frac{\gamma_A+\gamma_B+\gamma_k}{2\left(\gamma_A+2\gamma_B+2\gamma_k\right)}. \quad \text{(A30)}$$

In stage 1, the platform and the content providers adopt market structure S whenever $\Delta\Pi \equiv \pi_A^{S^*} + K\pi_{B_k}^{S^*} - \left(\pi_A^{D^*} + K\pi_{B_k}^{D^*}\right) > 0$, i.e.,

$$\Delta\Pi = \left(1+\frac{2\gamma_k}{2\gamma_A+\gamma_k}\right)\bar{v}\left(Q^{S^*}\right)^2 - \left(\frac{1}{2}+\frac{\gamma_k}{\gamma_A+\gamma_B+\gamma_k}Q^{D^*}\right)\bar{v}Q^{D^*}. \quad \text{(A31)}$$

We observe that $\Delta\Pi > 0$ iff

$$\Psi \equiv \left(\bar{v}-\frac{t}{8n^2}\right)^2 - \gamma_{seq}\bar{v}^2 = \bar{v}^2\left(1-\gamma_{seq}\right) - 2\bar{v}\left(\frac{t}{8n^2}\right) + \left(\frac{t}{8n^2}\right)^2 > 0, \quad \text{(A32)}$$

where $\gamma_{seq} \equiv \frac{4(\gamma_A+2\gamma_B+3\gamma_k)(\gamma_A+\gamma_k)^2(\gamma_A+\gamma_B+\gamma_k)}{(2\gamma_A+\gamma_k)(2\gamma_A+3\gamma_k)(\gamma_A+2\gamma_B+2\gamma_k)^2}$ with $0 < \gamma_{seq} < 1$. This expression is negative between its two roots, which are given by

$$t_L = 8n^2\bar{v}\left(1-\sqrt{\gamma_{seq}}\right), \text{ and } t_U = 8n^2\bar{v}\left(1+\sqrt{\gamma_{seq}}\right), \quad \text{(A33)}$$

where $t_U > \bar{t} \equiv 8\bar{v}n^2$. Defining $t_{seq}^* = t_L$, we conclude that

$$\Psi \begin{cases} \geq 0 & \text{for} \quad 0 < t \leq t_{seq}^* \\ < 0 & \text{for} \quad t_{seq}^* < t < \bar{t}. \end{cases} \quad \text{(A34)}$$

The analysis is identical to the one carried out in the baseline model, except for the fact that $\gamma_{seq} > \gamma$ as long as γ_B is not very small. Under these circumstances, $t_{seq}^* < t^*$ and the area under which market structure D is adopted is now larger.[38] Consequently, awarding a first-mover advantage to the platform under market structure D yields a similar effect as diminishing the bargaining power of the distribution company (see Corollary 1).

[38] The intuition for $\gamma_{seq} < \gamma$ and $t_{seq}^* > t^*$ whenever γ_B is very small, is the following. For small values of γ_B market structure D is already preferred by the platform and the content providers under simultaneous price setting, the first-mover advantage does not represent a substantial gain. In fact, the rise in platform profits due to the first-mover advantage comes at the expense of a reduction in profits for content providers that, overall, makes market structure D less beneficial in this particular situation.

C Appendix: Delegated distribution with side-payments

Alternatively, the distribution company could offer side-payments to the platform and the content providers in order to prevent them adopting a self-distribution market structure, under which the distribution company would obtain zero profits. The distribution company would be willing to offer side-payments up to $\pi_B^{D^*}$. Consequently, whenever the distribution company offers side-payments, the self-distribution model is adopted if $\Delta\Pi \equiv \pi_A^{S^*} + K\pi_{B_k}^{S^*} - \left(\pi_A^{D^*} + \pi_B^{D^*} + K\pi_{B_k}^{D^*}\right) > 0$. In such a way, we compare the total profits generated under each market structure. Making use of (24), (25), (39), (40) and (41), this condition becomes

$$\Delta\Pi = \left(\frac{2\gamma_k}{2\gamma_A + \gamma_k} + 1\right)\bar{v}\left(Q^{S^*}\right)^2 - \left(\frac{2\left(\gamma_B + \gamma_k\right)}{2\gamma_A + \gamma_B + \gamma_k} + 1\right)\bar{v}\left(Q^{D^*}\right)^2 > 0. \tag{A35}$$

Analyzing the determinants of the sign of this profit gap allows to derive the following proposition.

Proposition 3 *The self-distribution market structure is adopted when the degree of product differentiation is low ($0 < t < t^*_{side}$). Instead, delegated distribution is adopted when the degree of product differentiation is high ($t^*_{side} < t < \bar{t}$), where $t^*_{side} = 8n^2\bar{v}\left(1 - \sqrt{\gamma_{side}}\right)$ and $\gamma_{side} \equiv \frac{(2\gamma_A+\gamma_B+\gamma_k)(2\gamma_A+3\gamma_B+3\gamma_k)(\gamma_A+\gamma_k)^2}{(2\gamma_A+\gamma_k)(2\gamma_A+3\gamma_k)(\gamma_A+\gamma_B+\gamma_k)^2}$.*

Proof. After making use of (21) and (35) , and substituting (17) and (30) into (A35), we observe that $\Delta\Pi > 0$ iff

$$\Psi \equiv \left(\bar{v} - \frac{t}{8n^2}\right)^2 - \gamma_{side}\bar{v}^2 = \bar{v}^2\left(1 - \gamma_{side}\right) - 2\bar{v}\left(\frac{t}{8n^2}\right) + \left(\frac{t}{8n^2}\right)^2 > 0, \tag{A36}$$

where $\gamma_{side} \equiv \frac{(2\gamma_A+\gamma_B+\gamma_k)(2\gamma_A+3\gamma_B+3\gamma_k)(\gamma_A+\gamma_k)^2}{(2\gamma_A+\gamma_k)(2\gamma_A+3\gamma_k)(\gamma_A+\gamma_B+\gamma_k)^2}$ with $0 < \gamma_{side} < 1$. This expression is negative between its two roots, which are given by

$$t_L = 8n^2\bar{v}\left(1 - \sqrt{\gamma_{side}}\right), \text{ and } t_U = 8n^2\bar{v}\left(1 + \sqrt{\gamma_{side}}\right), \tag{A37}$$

where $t_U > \bar{t} \equiv 8\bar{v}n^2$. Defining $t^*_{side} = t_L$, we conclude that

$$\Psi \begin{cases} \geq 0 & \text{for} \quad 0 < t \leq t^*_{side} \\ < 0 & \text{for} \quad t^*_{side} < t < \bar{t}. \end{cases} \tag{A38}$$

■

Naturally, in the presence of side-payments delegated distribution is more likely to be adopted. More precisely, the delegated distribution market structure is now adopted for $t^*_{side} < t < \bar{t}$, where $t^*_{side} < t^*$ because

$$\gamma_{side} - \gamma = \frac{2\gamma_B\left(\gamma_A + \gamma_k\right)^2\left(2\gamma_A + \gamma_B + \gamma_k\right)}{\left(2\gamma_A + \gamma_k\right)\left(2\gamma_A + 3\gamma_k\right)\left(\gamma_A + \gamma_B + \gamma_k\right)^2} > 0. \tag{A39}$$

On the other hand, as in the baseline model without side-payments, Corollary 2 remains qualitatively unchanged because $0 < \widetilde{t} < t^*_{side} < \bar{t}$. The inequality $\widetilde{t} < t^*_{side}$ can be observed evaluating ΔCS in (44) at $t = t^*_{side}$, which yields

$$\Delta CS\left(t = t^*_{side}\right) = -\bar{v}\left(\frac{1-\gamma_{side}}{\gamma_{side}}\frac{\bar{v}}{2}\left(Q^{S^*}\right)^2 + \left(\frac{t}{4n} - \frac{t}{8n^2}\right)Q^{S^*}\right) < 0, \tag{A40}$$

because $\frac{1}{\gamma_{side}}\left(Q^{S^*}\right)^2 = \left(Q^{D^*}\right)^2$, which follows from the definition of t^*_{side} as $\Delta\Pi(t = t^*_{side}) = 0$ in (A35).

D Appendix: Fixed fees

In the baseline model fees are ad valorem. Instead, many digital platforms make use of fixed (subscription) fees, such as streaming platforms for movies (e.g., Netflix, Amazon Prime Video, HBO, Disney Plus, etc.), for music (e.g., Spotify, Apple Music, Deezer, Pandora, etc.) or for audiobooks (e.g., Audible, Scribd, Audiobooks, Libro.fm, etc.). From the modeling viewpoint, the ad valorem fees align to some extent the incentives of all the three types of agents (i.e., the platform, the distribution company, and the content providers). Instead, the fixed fee does not produce this effect, so that the agents' decisions are only linked by means of their pricing decisions. The results from our baseline model with ad valorem fees remain qualitatively unchanged with fixed (subscription) fees, as it is shown in the analysis that follows.

Under market structure D, the distribution company pays the platform a fixed fee ϕ for each content provider. In turn, content providers give up copyrights in favor of the distribution company in exchange of another fixed fee ψ. Accordingly, the payoffs of the platform, the distribution company, and content providers are given by

$$\pi_A = p_A Q(p_A, p^e_B) + K\phi, \tag{A41}$$

$$\pi_B = \sum_{k=1}^{K} p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p^e_B) - K\phi - K\psi, \text{ and} \tag{A42}$$

$$\pi_{B_k} = \psi. \tag{A43}$$

Under market structure S, content providers pay the platform a fixed fee ξ. The payoffs of the platform and content providers are now given by

$$\pi_A = p_A Q(p_A, p^e_B) + K\xi, \text{ and} \tag{A44}$$

$$\pi_{B_k} = p_{B_k} Q_k(p_{B_k}, p_{B_j}, p_A, p^e_B) - \xi. \tag{A45}$$

D.1 Prices and fees under self-distribution

The stage-3 equilibrium prices and quantity are now

$$p_A^S = \frac{1}{2}\left(\bar{v} - \frac{t}{8n^2} - \frac{t}{n}\right), \tag{A46}$$

$$p_B^S = p_{B_k}^S = \frac{t}{n} \quad \text{for } \forall k, \tag{A47}$$

$$Q^S = \frac{1}{2\bar{v}}\left(\bar{v} - \frac{t}{8n^2} - \frac{t}{n}\right), \tag{A48}$$

which follows from (15)-(17), considering that the fixed fee ξ has no effect on pricing decisions and that there is no ad valorem fee in the current set-up (i.e., $\mu = 0$). In order to guarantee the positiveness of Q^S, a new upper bound for t given by $\bar{t} \equiv 8\bar{v}\frac{n^2}{8n+1}$ emerges in this extension with fixed fees.

In stage 2, the fixed fee ξ is determined as the result of the following bargaining problem between the platform and each content provider:

$$\max_{\xi} (\pi_A)^{\gamma_A} (\pi_{B_k})^{\gamma_k} = \left(\frac{\bar{v}\left(Q^S\right)^2}{n} + \xi\right)^{\gamma_A} \left(\frac{t}{n^2}Q^S - \xi\right)^{\gamma_k}. \tag{A49}$$

The optimal fee ξ^S charged by the platform to each content provider is given by

$$\xi^{S^*} = \frac{\gamma_A \frac{t}{n} - \gamma_k \bar{v} Q^S}{(\gamma_k + \gamma_A)\, n} Q^S. \tag{A50}$$

Stage-2 equilibrium profits are

$$\pi_A^{S^*} = \frac{\gamma_A}{\gamma_A + \gamma_k}\left[\bar{v}\left(Q^S\right)^2 + \frac{t}{n}Q^S\right], \tag{A51}$$

$$\pi_{B_k}^{S^*} = \frac{\gamma_k}{(\gamma_A + \gamma_k)\, n}\left[\bar{v}\left(Q^S\right)^2 + \frac{t}{n}Q^S\right]. \tag{A52}$$

D.2 Prices and fees under delegated distribution

The stage-3 equilibrium prices and quantity are now

$$p_A^D = p_B^D = \frac{\bar{v}}{3},\ Q^D = \frac{1}{3}, \tag{A53}$$

which follows from (29) and (30), considering that the fixed fee ϕ has no effect on pricing decisions and that there is no ad valorem fee in the current set-up (i.e., $\eta = 0$).

In stage 2, the fixed fees ϕ and ψ are determined as the result of the following bargaining problem between the platform, the distribution company and each content provider:

$$\max_{\phi,\psi} \left(\frac{\pi_A}{n}\right)^{\gamma_A} \left(\frac{\pi_B}{n}\right)^{\gamma_B} (\pi_{B_k})^{\gamma_k} = \left(\frac{\bar{v}\left(Q^D\right)^2}{n} + \phi\right)^{\gamma_A} \left(\frac{\bar{v}\left(Q^D\right)^2}{n} - \phi - \psi\right)^{\gamma_B} (\psi)^{\gamma_k}. \tag{A54}$$

The optimal fee ϕ^D charged by the platform to the distribution company and the optimal compensation ψ^D offered by the distribution company to each content provider are given by

$$\phi^{D*} = \frac{\gamma_A - \gamma_B - \gamma_k}{\gamma_A + \gamma_B + \gamma_k} \frac{\bar{v}\left(Q^D\right)^2}{n}, \quad (A55)$$

$$\psi^{D*} = \frac{\gamma_k}{\gamma_A + \gamma_B + \gamma_k} \frac{2\bar{v}\left(Q^D\right)^2}{n}. \quad (A56)$$

Stage-2 equilibrium profits are

$$\pi_A^{D*} = \frac{\gamma_A}{\gamma_A + \gamma_B + \gamma_k} 2\bar{v}\left(Q^D\right)^2, \quad (A57)$$

$$\pi_B^{D*} = \frac{\gamma_B}{\gamma_A + \gamma_B + \gamma_k} 2\bar{v}\left(Q^D\right)^2, \quad (A58)$$

$$\pi_{B_k}^{D*} = \frac{\gamma_k}{\gamma_A + \gamma_B + \gamma_k} \frac{2\bar{v}}{n}\left(Q^D\right)^2. \quad (A59)$$

D.3 Choice of side-good market structure

In stage 1, the self-distribution market structure is adopted whenever $\Delta\Pi \equiv \pi_A^{S*} + K\pi_{B_k}^{S*} - \left(\pi_A^{D*} + K\pi_{B_k}^{D*}\right) > 0$ holds. Making use of (A51), (A52), (A57), and (A59), this condition becomes

$$\Delta\Pi = \frac{t}{n} Q^{S*} + \bar{v}\left(Q^{S*}\right)^2 - \frac{\gamma_A + \gamma_k}{\gamma_A + \gamma_B + \gamma_k} 2\bar{v}\left(Q^{D*}\right)^2 > 0. \quad (A60)$$

Analyzing the determinants of the sign of this profit gap allows to derive the following proposition.

Proposition 4 *The self-distribution market structure is adopted when the degree of product differentiation is low ($0 < t < t^*_{fix}$). Instead, delegated distribution is adopted when the degree of product differentiation is high ($t^*_{fix} < t < \bar{t}$), where $t^*_{fix} = 8n^2\bar{v}\frac{4\sqrt{4n^2 - \frac{1}{18}(8n-1)(8n+1)\zeta} - 1}{(8n-1)(8n+1)}$ and $\gamma_{fix} \equiv \frac{\gamma_A + \gamma_k}{\gamma_A + \gamma_B + \gamma_k}$.*

Proof. Substituting (A48) and (A53) into (A60) yields $\Delta\Pi > 0$ iff

$$\Psi = \left(\bar{v} - \frac{t}{8n^2}\right)^2 - \left(\frac{t}{n}\right)^2 - \gamma_{fix}\frac{8}{9}\bar{v}^2 > 0, \quad (A61)$$

with $0 < \gamma_{fix} < 1$. This expression is positive between its two roots, which are given by

$$t_L = 8n^2\bar{v}\frac{-3 - 2\sqrt{144n^2 - 2(8n-1)(8n+1)\gamma_{fix}}}{3(8n-1)(8n+1)}, \quad (A62)$$

$$t_U = 8n^2\bar{v}\frac{-3 + 2\sqrt{144n^2 - 2(8n-1)(8n+1)\gamma_{fix}}}{3(8n-1)(8n+1)}, \quad (A63)$$

where $t_L < 0$. Defining $t^*_{fix} = t_U$, we conclude that

$$\Psi = \begin{cases} \geq 0 & \text{for } 0 < t \leq t^*_{fix} \\ < 0 & \text{for } t^*_{fix} < t < \bar{t}. \end{cases} \tag{A64}$$

■

Carrying out a simple comparative-static exercise to ascertain the effect of γ_A, γ_B, and γ_k over t^*_{fix}, it is obtained that the range for t under which scenario S is preferred by platform and content providers expands with the bargaining power of the distribution company (i.e., $\frac{\partial t^*_{fix}}{\partial \gamma_B} > 0$) and shrinks with the bargaining powers of platform and content providers (i.e., $\frac{\partial t^*_{fix}}{\partial \gamma_A} < 0$ and $\frac{\partial t^*_{fix}}{\partial \gamma_k} < 0$). The reason is that platform and content providers are more inclined: *i*) to circumvent the distribution company when it has a stronger bargaining position, and *ii*) to deal with the distribution company when they have a stronger bargaining position vis-à-vis the distribution company.

D.4 Welfare analysis

With the purpose of comparing consumer welfare under both scenarios, $\Delta CS \equiv CS^S - CS^D$ can be written in the following way using expression (43):

$$\begin{aligned} \Delta CS &= \bar{v}\left(\frac{\bar{v}}{2}\left(Q^{S^*}\right)^2 - \frac{\bar{v}}{2}\left(Q^{D^*}\right)^2 - \left(\frac{t}{4n} - \frac{t}{8n^2}\right)Q^{S^*}\right) \\ &= \bar{v}\left(\frac{3t + 8n^2\bar{v} - 16nt}{64n^2\bar{v}}\left(\bar{v} - \frac{t}{8n^2} - \frac{t}{n}\right) - \frac{\bar{v}}{18}\right) \end{aligned} \tag{A65}$$

Looking at the sign of ΔCS, the following result is obtained.

Proposition 5 *Consumers are better off under self-distribution when the degree of product differentiation is low ($0 < t < \widetilde{t}_{fix}$), where $\widetilde{t}_{fix} < t^*_{fix}$. Instead, they are better off under delegated distribution when the degree of product differentiation is high ($\widetilde{t}_{fix} < t < \bar{t}$).*

Proof. First, notice that ΔCS is a convex function

$$\partial^2 \frac{\Delta CS}{\partial t^2} = \left(\bar{v}\frac{\partial Q^S}{\partial t}\right)^2 + \left(\frac{1}{4n} - \frac{1}{8n^2}\right)\left(\frac{1}{8n^2} + \frac{1}{n}\right) > 0. \tag{A66}$$

so that ΔCS is negative between roots. Solving $\Delta CS = 0$ in (A65) for t yields

$$t_L = 8n^2\bar{v}\frac{3(12n-1) - 2\sqrt{2(3 - 22n + 82n^2)}}{3(8n+1)(16n-3)} > 0, \tag{A67}$$

$$t_U = 8n^2\bar{v}\frac{3(12n-1) + 2\sqrt{2(3 - 22n + 82n^2)}}{3(8n+1)(16n-3)} > \bar{t}. \tag{A68}$$

Redefining $t_L \equiv \widetilde{t}_{fix}$, it follows that $\Delta CS > 0$ for $0 < t < \widetilde{t}_{fix}$ and $\Delta CS < 0$ for $\widetilde{t}_{fix} < t < \bar{t}$.

Finally, to show that $\widetilde{t}_{fix} < t^{*}_{fix}$, we proceed as follows. Given that $\frac{\partial t^{*}_{fix}}{\partial \gamma_{fix}} < 0$ (by inspection of t^{*}_{fix}) it is sufficient to show that $t^{*}_{fix}\left(\gamma_{fix} = 1\right) - \widetilde{t}_{fix} > 0$, i.e.,

$$8n^2\bar{v}\frac{4\sqrt{\frac{1}{18}\left(8n^2+1\right)}-1}{\left(8n-1\right)\left(8n+1\right)} - 8n^2\bar{v}\frac{3\left(12n-1\right)-2\sqrt{2\left(3-22n+82n^2\right)}}{3\left(8n+1\right)\left(16n-3\right)} > 0. \tag{A69}$$

This is tantamount to show that

$$\left(16n-3\right)\sqrt{2\left(8n^2+1\right)} + \left(8n-1\right)\sqrt{164n^2-44n+6} - 3\left(8n+1\right)\left(6n-1\right) > 0, \tag{A70}$$

which always holds for $n \geq 2$. ■

The joint observation of Propositions 4 and 5 reveals that the main result of the analysis contained in Corollary 2 from the baseline model with ad valorem fees remains valid under fixed fees, being the only difference the exact values of t^{*}_{fix} and $\widetilde{t}_{fix}$.

E Appendix: Mixed case

Two polar market structures are studied in the baseline model. Instead, self and delegated distribution coexist in reality. This extension considers the mixed case in which there are n_S independent content providers along with n_D distribution companies, each of them acting as the intermediary of $\left(n - n_S\right)/n_D$ content providers. As in the baseline model, n denotes the number of varieties of the side good, which are equidistantly spaced around the Salop circle. Independent content providers B_k are symmetrically distributed on compact segments around the Salop circle between distribution companies and charge the price p_{B_k}. Each distribution company B_ℓ acts as the intermediary of a compact segment of $\left(n - n_S\right)/n_D$ content providers. Consequently, two of the varieties provided by each distribution company B_ℓ compete directly with adjacent varieties provided by independent content providers (or, alternatively, with varieties provided by rival distribution companies if $n_S = 0$). These varieties are priced $p_{B^m_{\ell,k}} = p_{B^m_\ell}$, whereas the remaining $\frac{n-n_S}{n_D} - 2$ varieties are priced $p_{B^c_{\ell,k}} = p_{B^c_\ell}$. This market structure is illustrated in Figure 3.

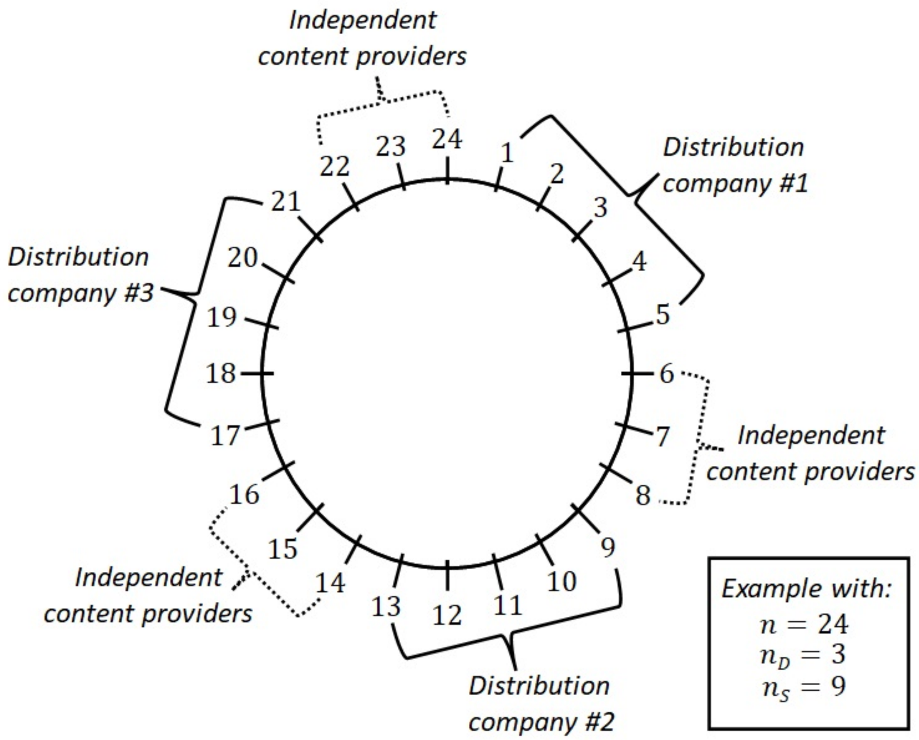

Figure 3: Mixed case

The payoffs of the platform (π_A), each distribution company (π_{B_ℓ}), each content provider making use of a distribution company ($\pi_{B_{\ell,k}}$), and each independent content provider (π_{B_k}) are:

$$\pi_A = \left(p_A + \eta \sum_{\ell=1}^{n_D} \left[w p_{B^m_\ell} \left(\frac{1}{n} + \frac{p_{B^m_{\neg\ell}} - p_{B^m_\ell}}{t}\right) + \left(\frac{n-n_S}{n_D} - w\right) \frac{p_{B^c_\ell}}{n} \right]\right) Q(p_A, p^e_B)$$

$$+\mu \sum_{k=1}^{n_S} p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t}\right) Q(p_A, p^e_B), \tag{A72}$$

$$\pi_{B_\ell} = \varphi(1-\eta) \left[w p_{B^m_\ell} \left(\frac{1}{n} + \frac{p_{B^m_{\neg\ell}} - p_{B^m_\ell}}{t}\right) + \left(\frac{n-n_S}{n_D} - w\right) \frac{p_{B^c_\ell}}{n} \right] Q(p_A, p^e_B), \tag{A73}$$

$$\pi_{B_{\ell,k}} = \frac{(1-\varphi)(1-\eta)n_D}{n-n_S} \left[w p_{B^m_\ell} \left(\frac{1}{n} + \frac{p_{B^m_{\neg\ell}} - p_{B^m_\ell}}{t}\right) + \left(\frac{n-n_S}{n_D} - w\right) \frac{p_{B^c_\ell}}{n} \right] Q(p_A, p^e_B), \tag{A74}$$

$$\pi_{B_\kappa} = (1-\mu) p_{B_\kappa} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_\kappa}}{t}\right) Q(p_A, p^e_B), \tag{A75}$$

$$\ell = 1, 2, ..., n_D, \; k = 1, 2, ..., \frac{n-n_S}{n_D}, \; \kappa = 1, 2, ..., n_S,$$

where w is a binary variable given by

$$w = w(n_D, n_S) = \begin{cases} 0 & \text{for } n_D = 1, n_S = 0 \\ 2 & \text{else.} \end{cases}$$

Notice that $w = 0$ captures the special case in which a single distribution company represents all content providers (which is the situation considered in the baseline model).

The demand for the bundle is now given by

$$Q(p_A, p_B^e) = \frac{1}{\bar{v}} \left(\bar{v} - p_A - p_B^e - \frac{n_S}{n} \frac{t}{8n^2} \right), \tag{A76}$$

where the term $\frac{n_S}{n}\frac{t}{8n^2}$ denotes the expected mismatching cost, taking into account that this mismatching cost is $\frac{t}{8n^2}$ for the share $\frac{n_S}{n}$ of content providers making use of self-distribution and 0 for the remaining share $\frac{n-n_S}{n}$ of content providers making use of delegated distribution. Under rational expectations, consumers expect the side-good price to be $p_{B^m_{\ell,k}} = p_{B_k} = \frac{t}{n}$ and $p_{B^c_{\ell,k}} = p_{B^c_\ell}$. Thus, the expected side-good price is now

$$p_B^e = \underbrace{\frac{n_S + w n_D}{n}}_{Prob(p_B^e = \frac{t}{n})} \frac{t}{n} + \underbrace{\frac{n - n_S - w n_D}{n n_D}}_{Prob(p_B^e = p_{B^c_\ell})} \sum_{\ell=1}^{n_D} p_{B^c_\ell}. \tag{A77}$$

The maximization problem of the platform, the distribution company, and independent content providers becomes

$$\begin{aligned}
\max_{p_A} \pi_A &= \left(p_A + \eta \sum_{\ell=1}^{n_D} \left[w p_{B^m_\ell} \left(\frac{1}{n} + \frac{p_{B^m_{\neg\ell}} - p_{B^m_\ell}}{t} \right) + \left(\frac{n - n_S}{n_D} - w \right) \frac{p_{B^c_\ell}}{n} \right] \right) Q(p_A, p_B^e) \\
&\quad + \mu \sum_{k=1}^{n_S} p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) Q(p_A, p_B^e), \\
\max_{p_{B^c_\ell}, p_{B^m_\ell}} \pi_{B_\ell} &= \varphi (1 - \eta) \left[w p_{B^m_\ell} \left(\frac{1}{n} + \frac{p_{B^m_{\neg\ell}} - p_{B^m_\ell}}{t} \right) + \left(\frac{n - n_S}{n_D} - w \right) \frac{p_{B^c_\ell}}{n} \right] Q(p_A, p_B^e), \\
\max_{p_{B_k}} \pi_{B_k} &= (1 - \mu)\, p_{B_k} \left(\frac{1}{n} + \frac{p_{B_j} - p_{B_k}}{t} \right) Q(p_A, p_B^e).
\end{aligned}$$

Under simultaneous price setting, equilibrium prices are given by

$$p_A^M = \frac{1 - \eta n_D}{2 + (1 - \eta) n_D} \left(\bar{v} - \frac{n_S}{n} \frac{t}{8n^2} \right) - \frac{n_D (\mu - \eta) + 1 + \mu}{2 + (1 - \eta) n_D} \frac{n_S t}{n^2}, \tag{A78}$$

$$\begin{aligned}
p_{B^c_\ell}^M &= \frac{n_D n}{(2 + (1 - \eta) n_D)(n - n_S - w n_D)} \left(\bar{v} - \frac{n_S}{n} \frac{t}{8n^2} \right) \\
&\quad - n_D \frac{2w + n_S (1 - \mu) + w n_D (1 - \eta)}{(2 + (1 - \eta) n_D)(n - n_S - w n_D)} \frac{t}{n},
\end{aligned} \tag{A79}$$

$$p_{B^c_\ell}^M = p_{B_k}^M = \frac{t}{n}, \tag{A80}$$

where superscript M denotes stage-3 equilibrium values in the mixed case.

Substituting these expressions into (A76), we obtain the equilibrium quantity

$$Q^M = \frac{1}{(2+(1-\eta)\,n_D)\,\bar{v}}\left(\bar{v} - \frac{n_S}{n}\frac{t}{8n^2} - (1-\mu)\,\frac{n_S t}{n^2}\right). \tag{A81}$$

The stage-3 equilibrium profits are

$$\pi_A^M = \bar{v}\left(Q^M\right)^2, \tag{A82}$$

$$\pi_{B_\ell}^M = \varphi\,(1-\eta)\,\bar{v}\left(Q^M\right)^2, \tag{A83}$$

$$\pi_{B_{\ell,k}}^M = \frac{(1-\varphi)\,(1-\eta)\,n_D}{n-n_S}\bar{v}\left(Q^M\right)^2, \tag{A84}$$

$$\pi_{B_k}^M = (1-\mu)\,\frac{t}{n^2}Q^M. \tag{A85}$$

In stage 2, each content provider, each distribution company, and the platform bargain on η, φ, and μ, where the optimal ad valorem fees are obtained as the solution of

$$\max_{\eta,\varphi}\left(\underbrace{\frac{\bar{v}}{n}\left(Q^M\right)^2}_{\pi_A^M/n}\right)^{\gamma_A}\left(\underbrace{n_D\frac{\varphi\,(1-\eta)\,\bar{v}\left(Q^M\right)^2}{n-n_S}}_{\pi_{B_\ell}^M/\left(\frac{n-n_S}{n_D}\right)}\right)^{\gamma_B}\left(\underbrace{\frac{(1-\varphi)\,(1-\eta)\,\bar{v}\left(Q^M\right)^2}{n-n_S}}_{\pi_{B_{\ell,k}}^M}\right)^{\gamma_k},$$

$$\max_{\mu}\left(\underbrace{\frac{\bar{v}}{n}\left(Q^M\right)^2}_{\pi_A^M/n}\right)^{\gamma_A}\left(\underbrace{(1-\mu)\,\frac{t}{n^2}Q^M}_{\pi_{B_k}^M}\right)^{\gamma_k}.$$

The equilibrium ad valorem fees are given by

$$\eta^{M^*} = 1 - \frac{2\,(\gamma_B+\gamma_k)}{n_D\,(2\gamma_A+\gamma_B+\gamma_k)}, \tag{A86}$$

$$\varphi^{M^*} = \frac{\gamma_B}{\gamma_B+\gamma_k}, \tag{A87}$$

$$\mu^{M^*} = 1 - \frac{\gamma_k}{2\,(\gamma_A+\gamma_k)}\frac{n^2}{n_S t}\left(\bar{v} - \frac{n_S}{n}\frac{t}{8n^2}\right). \tag{A88}$$

Plugging these fees into the profit functions allows obtaining the following stage-2 equilibrium profits

$$\pi_A^{M^*} = \bar{v}\left(Q^{M^*}\right)^2, \tag{A89}$$

$$\pi_{B_\ell}^{M^*} = \frac{2\gamma_B}{n_D\,(2\gamma_A+\gamma_B+\gamma_k)}\bar{v}\left(Q^{M^*}\right)^2, \tag{A90}$$

$$\pi_{B_{\ell,k}}^{M^*} = \frac{2\gamma_k}{(n-n_S)\,(2\gamma_A+\gamma_B+\gamma_k)}\bar{v}\left(Q^{M^*}\right)^2, \tag{A91}$$

$$\pi_{B_k}^{M^*} = \frac{\gamma_k}{2\,(\gamma_A+\gamma_k)\,n_S}\left(\bar{v} - \frac{n_S}{n}\frac{t}{8n^2}\right)Q^{M^*}, \tag{A92}$$

where

$$Q^{M^*} = \frac{(2\gamma_A + \gamma_B + \gamma_k)(2\gamma_A + \gamma_k)}{8(\gamma_A + \gamma_k)(\gamma_A + \gamma_B + \gamma_k)\bar{v}} \left(\bar{v} - \frac{n_S}{n}\frac{t}{8n^2}\right). \tag{A93}$$

In stage 1 of the mixed case where both self and delegated distribution coexist, the number of content providers making use of self-distribution n_S is now determined endogenously by the condition $\Delta\Pi \equiv \pi_A^{M^*} + K\pi_{B_k}^{M^*} - \left(\pi_A^{M^*} + K\pi_{B_{\ell,k}}^{M^*}\right) = K\left(\pi_{B_k}^{M^*} - \pi_{B_{\ell,k}}^{M^*}\right) = 0$. Making use of (A91) and (A92), this condition becomes

$$\Delta\Pi = \frac{\gamma_k}{2n_S(\gamma_A + \gamma_k)}\left(\bar{v} - \frac{n_S}{n}\frac{t}{8n^2}\right)Q^{M^*} - \frac{2\gamma_k}{(n - n_S)(2\gamma_A + \gamma_B + \gamma_k)}\bar{v}\left(Q^{M^*}\right)^2 = 0. \tag{A94}$$

Looking for the share n_S/n that solves this equation, allows deriving the following proposition.

Proposition 6 *The market share of content providers adopting self-distribution is* $\frac{n_S^*}{n} = 1 - \frac{2\gamma_A+\gamma_k}{4\gamma_A+2\gamma_B+3\gamma_k}$, *where* $0 < \frac{n_S^*}{n} < 1$.

The main difference with respect to Proposition 1 from the baseline model has to do with the fact that the expected mismatching cost in the mixed case is a continuous function of n_S/n, whereas in the baseline model was either $1/8n^2$ (under self-distribution as $\lambda = 1$) or 0 (under delegated distribution $\lambda = 0$). Consequently, there is a similar tradeoff as in the baseline model. While a higher proportion of content providers under self-distribution increases the expected mismatching cost and reduces demand (see (A76)), it allows to circumvent the intermediation of distribution companies. In equilibrium, the relative importance of these two countervailing effects ultimately determines the proportion of content providers under self- and delegated distribution. As suggested in the above proposition and illustrated in Figure 4, the equilibrium share n_S^*/n depends on the bargaining powers.

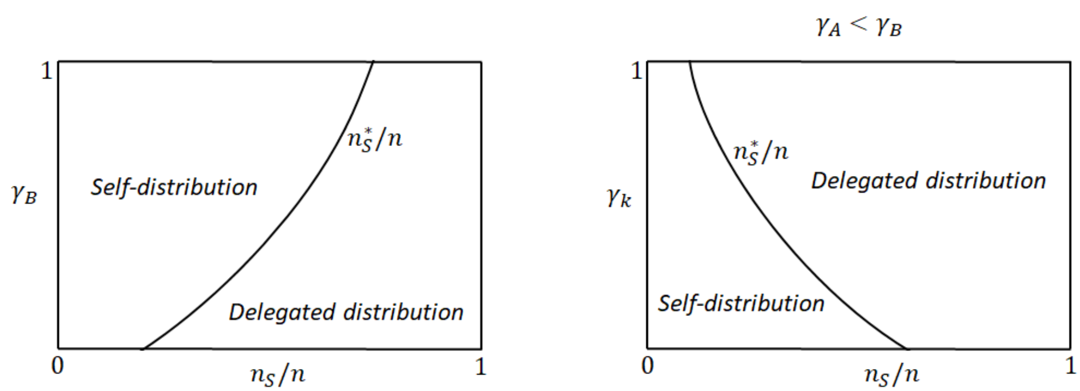

Figure 4: Comparative statics (mixed case)

Corollary 3 *The threshold* n_S^*/n *decreases (increases) with the bargaining power of content providers for* $\gamma_A < \gamma_B$ $(\gamma_A > \gamma_B)$, *increases with the bargaining power of the distribution company, and decreases with the bargaining power of the platform.*

Proof. This follows directly from the partial derivatives:

$$\frac{\partial\left(\frac{n_S^*}{n}\right)}{\partial\gamma_k}=\frac{2\left(\gamma_A-\gamma_B\right)}{\left(4\gamma_A+2\gamma_B+3\gamma_k\right)^2},\ \frac{\partial\left(\frac{n_S^*}{n}\right)}{\partial\gamma_B}=\frac{2\left(2\gamma_A+\gamma_k\right)}{\left(4\gamma_A+2\gamma_B+3\gamma_k\right)^2},\ \frac{\partial\left(\frac{n_S^*}{n}\right)}{\partial\gamma_A}=\frac{-2\left(2\gamma_B+\gamma_k\right)}{\left(4\gamma_A+2\gamma_B+3\gamma_k\right)^2}.$$

■

The interpretation of the comparative statics is similar to the one in the baseline model. Content providers are more inclined: *i*) to circumvent the distribution company when it has a stronger bargaining position, and *ii*) to deal with the distribution company when they have a stronger bargaining position vis-à-vis the distribution company. Therefore, when authors are emerging (i.e., they are characterized by low γ_k), there is a higher likelihood of observing a self-publishing business model. Instead, well-known authors (characterized by high γ_k) will be more prone to make use of a traditional publisher.