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THE BUSINESS MODEL OF A STREAMING PLATFORM

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The business model of a streaming platform*

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Abstract

A streaming platform obtains contents from artists and offers commercial spaces to advertisers. Users value contents' variety and quality of the service and are heterogeneously bothered by ads. Two solutions can be proposed to users. If they pay a positive price, they subscribe to a commercial-free service with an upgrade of quality (Premium). Otherwise, they have free access to service of a basic quality. We find that a wider audience gives incentives to the platform to increase both the advertising intensity and the quality upgrade in the Premium. As a consequence, some people move to the Premium. At the limit, the platform opts for a purely subscription-based business model as the audience reaches a certain level. The parsimonious model we propose is able to give a rationale to the emergence of different business models in the streaming market as well as to the (end of the) disputes between artists and the Spotify model.

Keywords: Media, Advertising, Multi-Sided Markets, Platform, Second-degree price discrimination.
Jel Classification: L21, L82, M37.

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1 Introduction

The online world offers many business opportunities to companies that run platforms turning web-users into subscribers. In particular, online media markets have boomed dramatically, with many big players currently competing (e.g., Google, Amazon, Spotify, Apple, YouTube, Netflix). These players behave in different ways *vis-à-vis* each side of the market, with the consequence of a rich variety of business models. On the user side, Google and Apple Music opt for the offer of a paying subscription, YouTube follows an ad-based business model whereas Spotify presents a mixed model with users self-selecting in their preferred subscription (second-degree price discrimination).

Media platforms are characterized by the interaction of different groups of agents exhibiting cross-group externalities. Namely, a user enjoys more (less) a platform's service when the variety of contents (number of commercials) increases and, in turn, a content provider and an advertiser have stronger incentives to join a platform in which they can meet a wider audience. In terms of business strategy, this brings us to what Caillaud and Jullien (2003) defined as a chicken–and–egg problem: the company needs to find the most profitable way to attract a critical mass in each group. In the music streaming market, Eller (2015) reports that both Spotify and Apple Music offer at least a 30 million–song library. This makes them very attractive to users and, in turn, selling an artistic production to a platform "offering" a broad set of users is valuable to providers, who want their contents to reach the widest possible audience. Moreover, the value of subscribing the platform service for a user depends not only on the variety of contents but also on other features offered by the platform. The latter represent the quality of the platform service, brought by recommendation systems; creation, access off-line and sharing of playlists; synchronization on several devices; quality of page layout/video/sound.

On top of that, real streaming markets show different subscribing solutions, which prove to be different ways to account for these cross–group interactions. For instance, consider the cases of Spotify, Youtube and Deezer. Their free-of-charge solution, the so–called basic subscription, entails frequent commercial interruptions after a few songs. Somehow, users are compensated for the nuisance of ads with free access to music. Contextually, users are given the opportunity to upgrade to a paying solution with quality improvements and absence of commercial interruptions. This business model is commonly called *Freemium*.

Differently, in the purely subscription-based business model of Apple and Google Music, users pay a price and they are allowed to access the contents' catalogue available on the platform. The absence of commercials is usually associated with quality improvements simi-

lar to the ones proposed by the upgraded version of Spotify.[1] Hereafter, we will refer to this business model as *Premium*.

These platforms have been perceived with suspicion by artists, especially when the offer of contents is completely free-of-charge.[2] Indeed, artists may look at the streaming market as a threat to the sale of their artistic productions through alternative channels. Recent empirical articles such as Aguiar and Waldfogel (2018), Wlömert and Papies (2016), and Hiller (2016) show that streaming and purchasing tend to be substitutes. Differently, Aguiar (2017) and Aguiar and Martens (2016) give evidence of complementarity due to an effect described by Belleflamme (2016) as "discovery," that is, streaming is used by subscribers to discover high–value music and match value, leading to an ultimate increase in music consumption.[3] Our model assumes artists to have heterogeneous outside options, and so accounts for the "cannibalization effect" and the fact that this effect may be different among artists.

This paper aims at giving a rationale to the following stylized facts related to streaming market. First, the disputes against the Spotify model have been resolved in the last few years, leading important artists to join the platform (e.g., Radiohead and Taylor Swift). Second, both the number of active users and the share of *Premium* users boomed dramatically in the same period, as documented in Figure 1 and 2. These two aspects are linked with each other and highlight the pivotal role of Spotify's market share. Indeed, the increase in the number of active users (200% in the period 2015-2018) has been associated with the joining decisions of important artists as well as with a boost of the share a people upgrading to the *Premium* subscription (more than 400% increase in the same period).

In the present paper, we provide a parsimonious model in which a monopolistic platform allows the interaction between users, advertisers and content providers. Users are assumed to receive utility from the variety of contents they can stream by subscribing to the platform's service and are heterogeneous according to their aversion towards advertisement. The platform decides on four dimensions. First, it pays per–user royalties to content providers,

[1]These platforms have the precise intention to operate in the "premium" market only. For instance, in The Huffington Post, Kaufman (2016) mentions the following claim posted on Facebook by Hastings (Netflix CEO): "No advertising coming onto Netflix. Period. Just adding relevant cool trailers for other Netflix content you are likely to love."

[2]Among other artists, titles from Taylor Swift and the Beatles were unavailable for a long time on some or all streaming platforms, and the group Radiohead had long-standing disputes with Spotify concerning its business model. See Knopper (2015), Hassan (2016), Linshi (2014), and Forde (2015) for articles discussing these issues in online newspapers and magazines specialized in the digital-music industry.

[3]For a test of discovery, see Datta et al. (2018).

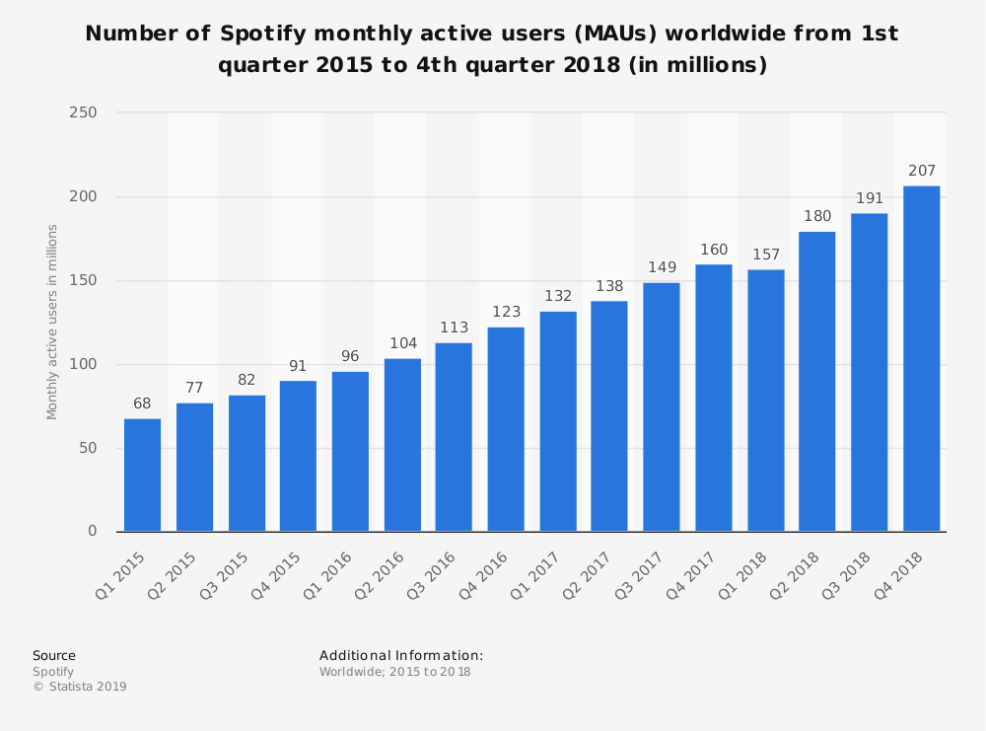

Figure 1: Spotify active users.

which are heterogenous with respect to their outside option. Second, it sets the advertising intensity. Moreover, it sets the subscription price for *Premium* users. Finally, it decides the quality upgrade offered in the *Premium* segment. Our results depend on an exogenous parameter which represents the share of people the platform is able to reach, i.e., its audience.

This share is key in two dimensions. On the one hand, a larger audience results in a lower royalty necessary to bring contents on board. As a consequence, a larger share of consumers results in a larger proportion of contents present in the platform at equilibrium. On the other hand, if the platform reaches a wide audience, offering only the paying subscription is always dominating. This is because a wider audience gives incentives to the platform to increase both the quality upgrade of the *Premium* (so to increase subscription price) and the advertising intensity (so to increase unitary profits from advertising). As a consequence, some people move to the *Premium* subscription. As a sufficient share of consumers can be reached by the platform, this mechanism leads to a situation in which it is optimal to opt for a purely subscription-based model, eliminating advertising and the free subscription.

In conclusion, the present paper explains the relationship between audience, content providers and business models in the streaming markets. All in all, our model predicts that

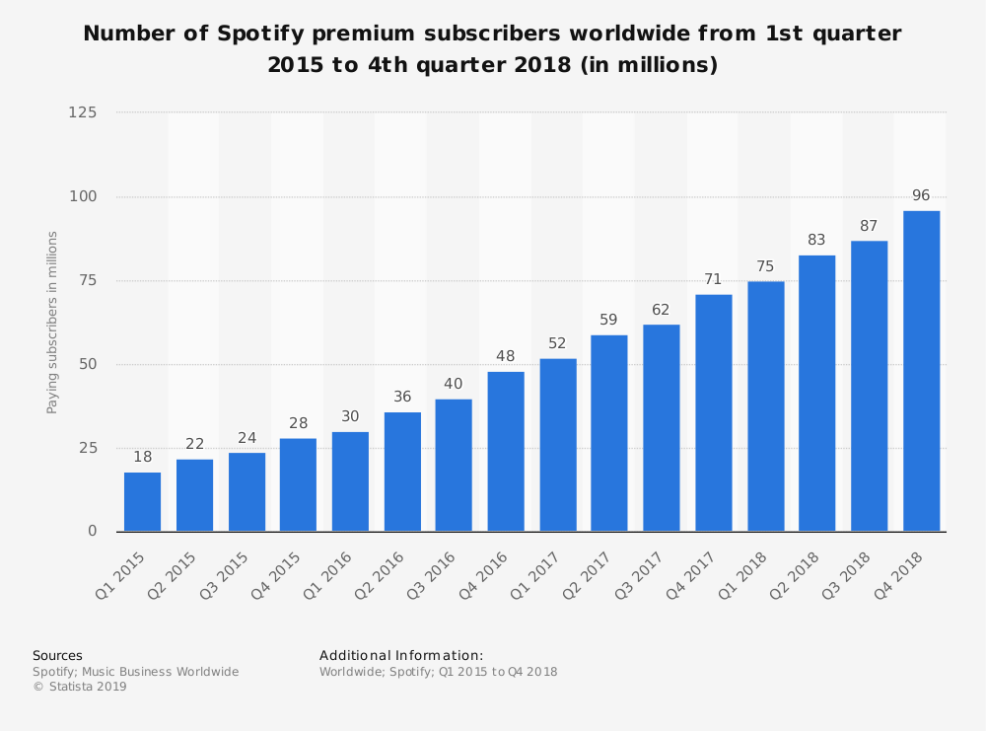

Figure 2: Spotify *Premium* subscriptions.

a platform with a wide audience will only offer a *Premium* subscription, whereas a platform having access to a narrower share of consumers will offer a menu of subscriptions. This is in line with what happens in online markets, where a widening of the audience is usually accompanied to a gradual passage from an advertising-based to a subscription-based business model. Moreover, in our model, content providers would prefer a purely subscription-based system, which explains artists' reluctance to participate in the *Spotify model*.

The rest of the article is organized as follows. The next section presents the related literature. Thereafter, the model is introduced in Section 3 and Section 4 presents the analysis. Finally, Section 5 provides a discussion before drawing the conclusions in Section 6.

2 Related Literature

In the digital world, the complexity of interactions among different groups of agents (through the mediation of platforms) led to the emergence of different successful business models. In

order to give a rationale to these models, it is necessary to develop industry-specific setups. In this sense, the streaming-media market is characterized by users interested in quality of the platform's service and contents variety and advertisers who seek to sell their products. The media industry is one of the archetypal cases of two-sided markets, started by Rochet and Tirole (2003), Armstrong (2006), and Caillaud and Jullien (2003).

The business model (advertising-, subscription-based or mixed) of media platforms has been studied by many scholars both in economics and marketing. In particular, Ferrando et al. (2008), Godes et al. (2009), Kind et al. (2009), and Reisinger (2012) studied advertising and pricing in media markets. These studies do not consider price discrimination in the users' side, which is common practice leading to the emergence of a mixed (advertising and subscription) business model. Peitz and Valletti (2008) highlight the differences between free–to–air and paying media, whereas Calvano and Polo (2019) show how "pay" and "free–to–air" coexist in broadcasting markets, with two ex–ante identical platforms optimally opting for different business models. In our model, the emergence of paying and advertising segments is driven by content acquisition and quality upgrades of the platform service.

Content provision is analyzed by Weeds (2016) and Carroni et al. (2019). The former proposes models suitable to TV competition, where contents are often self-produced by a vertically differentiated platform competing downstream with a rival not owning the same content. The latter study acquisition of contents produced by an external provider. In our model external contents are acquired (through the payment of a royalty) because they create a positive externality to variety-loving users.

We identify preferences for quality and content variety as the main drivers in the choice of subscribers. Hagiu (2009) shows that the demand for "product variety is a key factor determining the optimal platform pricing structures". In our model, the preference for variety induces the platform to costly acquire as many contents as possible. On top of that, quality improvements (i.e., creation, access off-line and sharing of playlists, recommendation systems, synchronization on several devices, quality of page layout/video/sound, offer of HD videos) are important features that allow for versioning and give scope for the implementation of menu-pricing strategies (second-degree price discrimination).

Recent papers have studied within-side price discrimination in two-sided markets. Liu and Serfes (2013) study within-side perfect price discrimination of horizontally differentiated platforms showing how it can be detrimental for the two sides of the market. In a model related to media, Carroni (2018) shows that discriminating prices between old and new subscribers affects the multi-homing decisions of advertising firms. Differently from these two papers, our work considers second-degree price discrimination on the users' side, which

is analyzed also by Jeon et al. (2017) and Lin (2018). In a general setup, Jeon et al. (2017) study within-side second-degree price discrimination, showing how discriminating on one side may help to solve possible tensions between incentive compatible contracts and optimal allocations on the other side of the market.

More closely related to our work, Lin (2018) study the relationship between versioning and price discrimination on one side and the incentives to discriminate on the other side. We share with Lin (2018) the aim to explain the optimal strategy of online media platforms, but we differ in terms of framework and findings. He considers a two-sided market in which each side is somehow segmented by a monopolistic platform. On the users side, content versioning associated to second-degree price discrimination in order for consumers with different taste for quality (high and low types) to self select in the version designed for them. On the advertisers side, heterogeneous firms are offered to be matched with high types, low types or both types of consumers.[4] He shows that the high types could receive more or fewer ads depending on the nuisance cost of advertising. Our paper is somehow complementary to his, as we mainly focus on the impact that the audience reachable by the platform has on the relationship with artists and on the endogenous emergence of a business model (subscription-based only or with versioning). We consider consumers who care about content variety and are heterogeneously bothered by ads,[5] and the choice of the basic access to the platform vs. the upgraded premium access depends on how much a user is bothered by advertising.

3 The Model

A monopolistic platform provides contents to a population of users normalized to 1. The latter are interested in the contents' variety and the quality of the service offered by the platform. The platform decides the quality of the service and sets prices to all sides of the market potentially interested in its service. Artists (hereafter content providers) own the copyrights of their contents and are offered a royalty for their artistic creation to be streamed by the platform. Advertisers pay a fee in order to show their commercials to users. Users either pay a subscription price or have free access to the platform's catalogue. In the free case, hereafter called *Basic*, consumers receive a service of basic quality q_b and their activity into the platform is interrupted by commercials, which cause them a nuisance. In the paying

[4] A similar approach with two-sided matching is followed by Gomes and Pavan (2016).

[5] Differently from Lin (2018), in our model advertising, although informative, does not entail any net value to consumers, as the price they pay to buy the product of an advertising firm is just equal to the quality of the product (see paragraph on advertisers in Section 3).

case, they enjoy an upgrade to quality q_p and no commercial interruptions. We will refer to this ad-free subscription as *Premium*. To highlight more clearly the objectives of all agents involved in the model, let us present each side of the market separately.

Content Providers. A unitary mass of content providers face a trade–off when making their product available on the platform. On the one hand, they receive a per–user royalty r. On the other hand, content providers suffer a loss for other-than-streaming distribution channels (DVDs or CDs). This loss is more severe for very famous artists and is captured by an idiosyncratic parameter v. We consider $v \in \{v_L, v_H\}$, with $v_H > v_L$ and $v_H > 1/2$. We assume that the proportion of low types is $\alpha > 1/2$. Therefore, if one defines s as the share of subscribers, the profit of a content provider with outside option v will be:

$$\pi_{CP} = rs - v. \tag{1}$$

Advertisers. The modeling of the advertisers' side builds on Anderson and Coate (2005) and Peitz and Valletti (2008), who assume that platforms set the advertising intensity and advertisers decide whether to show their commercials to sell their products to users. Products are all sold at a zero marginal cost, without loss of generality. Each producer offers a product of quality α, uniformly distributed on the interval $[0, 1]$. Each quality–α advertiser is monopolistic in the final–good market so that, once the commercial informs a user on product's characteristics and price, the latter is willing to buy a quality–α good at price α. As a consequence, each firm advertises price α, as lowering the price does not improve the probability of sale. The access to the platform is necessary for each advertiser to inform platform's users about the existence of the product sold. The decision of an advertiser depends on how many subscribers can be met on the platform and on the amount paid to the platform to advertise the product, which is the endogenously determined fee f. Accordingly, when a share of users s_b can be reached by paying a fee f, the profit of a quality–α advertiser will be $\alpha s_b - f$. Therefore, all firms with quality at least equal to f/s_b are willing to pay the fee f and, thus, the mass of firms willing to advertise is $D(f, s_b) = 1 - f/s_b$, which is the demand curve for advertising. If the platform supplies a commercial spaces to advertisers, the fee clears the market, so that f is the one the equalizes demand and supply, i.e.,

$$f(a, s_b) = (1 - a)s_b. \tag{2}$$

In what follows, we will refer to the mass of advertisers entering the platform, a, as the ad intensity.

Users. There is a unitary mass of users. A share $\gamma \in (0,1]$ of them is reachable by the platform. Each user receives utility u from enjoying the contents and is disturbed by the presence of ads. Utility positively depends on the variety of contents and on the quality of the service. We further assume that, if a commercials are displayed, each user suffers a disutility equal to $-\beta a$, where the parameter $\beta \sim U[0,1]$ is the idiosyncratic distaste for advertisement. Hereafter, we will call βa the nuisance cost of advertisement. Defining n as the (endogenously determined) mass of contents present in the platform, a type–β agent who joins the platform gets utility:

$$u(\beta) = n + \begin{cases} q_p - p & \text{if premium,} \\ q_b - \beta a & \text{if basic,} \end{cases} \tag{3}$$

where p is the price of the *Premium* subscription, whenever $n > 0$. Notice that utility is zero if no content if offered. Without loss of generality, we normalize the basic quality to $q_b = 0$ and focus our analysis on the endogenous determination of the upgraded quality q_p, which we call q herefter for the sake of simplicity.[6]

The timing of the model is as follows. At stage 0, the platform decides the quality differential between the *Premium* and the basic subscription. At stage 1, the platform attracts contents offering the per-subscriber royalty r. At stage 2, the platform simultaneously sets the *Premium* subscription price p and the advertising intensity a. Given p and a, subscribers choose the type of subscription to opt for and payoffs of all agents are realized.

4 Analysis

This section is devoted to the analysis of the model following a backward-induction reasoning. The first focus is on subscription-price and advertising-fee setting (stage 2, studied in Section 4.1) for given royalty chosen in the previous period. Then, the choice of the optimal royalty (stage 1, studied in Section 2) and the quality choice (stage 0, studied in Section 3) will depend on the anticipation of the future possible subgames.

4.1 Stage 2: Price and advertising intensity

Now, let us assume that the platform sets an upgraded quality q in stage 0 and attracts n contents in stage 1 and now decides how to maximize profits choosing the advertising

[6] We could also have endogenously determined the basic quality q_b, but since our model has full market coverage, we would have trivially found a basic quality of zero.

intensity and the subscription price. The profit takes into account the money raised on *Premium* subscriptions (a share s_p in this case) as well as the advertising revenues. In particular, the profits of the platform are given by:

$$\Pi = \underbrace{s_p(p,a)\cdot p}_{premium} + \underbrace{f(a,s_b)\cdot a}_{advertising\ revenues}, \tag{4}$$

where the fee $f(a, s_b)$ is the one determined in equation (2). At the end of last stage, the decision of the users is on the type of subscription (*Premium* or *Basic*). Comparing the utilities expressed in equation (3), the *Basic* subscription is preferred to the *Premium* one for all agents who have β such that:

$$q + n - p < n - \beta a \Rightarrow \beta < \hat{\beta} \equiv \frac{p-q}{a}, \tag{5}$$

Notice also that users prefer *Premium* subscriptions to no subscription if $p \leq n + q$. In this case, it also holds that all agents with $\beta \in [0, \hat{\beta})$ will subscribe *Basic* and all agents with $\beta \in [\hat{\beta}, 1]$ will subscribe *Premium*. Thus, for a given price p and an advertising intensity a, the demand for subscriptions in the *Premium* and in the basic segment will be, respectively:

$$s_p = \left(1 - \frac{p-q}{a}\right)\gamma \text{ and } s_b = \frac{(p-q)\gamma}{a}. \tag{6}$$

Plugging s_b and s_p into the profit function in equation (4), the maximization problem of the platform becomes:

$$\begin{aligned} \max_{p,a} \Pi = \max_{p,a} \left[p \cdot \left(1 - \tfrac{p-q}{a}\right) + (1-a)\cdot(p-q)\right]\gamma \\ \text{s.t. } q \leq p \leq n+q \\ \text{s.t. } 0 \leq a \leq 1 \end{aligned} \tag{7}$$

The constraint on the price is necessary for having a non–empty set of *Premium* subscriptions. Indeed, when the constraint is violated, the price exceeds the utility given to *Premium* consumers, with the consequence that only basic subscribers join the platform.[7] Moreover, the advertising intensity is bounded to be positive and not too high, otherwise the platform makes profits only on subscriptions. In the second case, if $a = 1$, we fall in a situation in which the advertising intensity is so high that the market–clearing fee becomes zero, so that the platform has no incentives to attract basic subscribers. The solutions to the maximization problem of the platform are summarized in the following Lemma.

[7] Imposing this constraint is optimal for the platform, as we will discuss below, and also guarantees that all agents reachable by the platform, γ, become subscribers in either *Basic* or *Premium*.

LEMMA **1.** *If:*

1. $q < 1$, *the platform offers both the* Basic *and the* Premium *subscription. The price is* $\tilde{p}(q)$ *and the advertising intensity is* $\tilde{a}(q)$,

2. $q \geq 1$, *only the* Premium *subscription is offered at price* $p^*(n, q)$,

where $p^*(n, q) = n + q$, $\tilde{p}(q) = \frac{2+3q+2\sqrt{3q+1}}{9}$, *and* $\tilde{a}(q) = \frac{1+\sqrt{3q+1}}{3}$.

Proof. See appendix A.1 for the formal proof. □

Lemma 1 highlights the optimal strategy in the last stage. Unsurprisingly, the quality chosen at the beginning of the game plays a prominent role. On the one hand, the quality increases the subscription price. This is because the *Premium* segment becomes more attractive to subscribers, so that they are willing to pay a higher price for the upgraded subscription. On the other hand, this makes the *Premium* segment more attractive also for the seller. As a result, the latter will increase the advertising intensity and thus the nuisance for *Basic* subscribers, in order to move people to the *Premium* segment. At the limit, this would translate directly into the offer of the *Premium* subscription only when the quality differential reaches a threshold value (point 2 in Lemma 1). This is because all subscribers prefer to have access to the upgraded *Premium* quality.

Differently, the number of contents attracted increases the value of the platform to the subscribers, regardless the subscription chosen. When both subscriptions are offered, subscription price and advertising intensity simply reflect the extent of strategic substitutability between the two segments, which responds to quality differentials only. However, when $q \geq 1$, the substitutability effect is not there, and the subscription price increases with n.

4.2 Stage 1: Royalty

Let us now analyze stage 1. The platform sets the royalty r anticipating its impact on profits. A content provider would make a title available on the platform if r is sufficient to compensate for the cannibalization effect, i.e., $rs - v \geq 0 \Leftrightarrow v < r\gamma$. The platform has the following alternatives. It can either fix a low royalty and attract only low types, or fix a higher royalty and induce also the entry of the famous artists. In the first case, $r_L^* = v_L/\gamma$ is sufficient to induce $n = \alpha$ content providers to join the platform. Differently, to reach the second goal the platform has to set $r_H^* = v_H/\gamma$, so that also high types are attracted. We can conclude the following:

LEMMA **2.** *If:*

1. $q < 1$ *or* $q \geq 1$ *and* $\gamma \leq \bar{\gamma} \equiv \min\left\{\frac{v_H - \alpha v_L}{1-\alpha}, 1\right\}$, *the optimal royalty is* $r_L^* = v_L/\gamma$ *and* $n_L^* = \alpha$,

2. $q \geq 1$ *and* $\gamma > \bar{\gamma}$, *the optimal royalty is* $r_H^* = v_H/\gamma$ *and* $n_H^* = 1$.

Proof. Proof is in Appendix A.2. □

Lemma 2 states the optimal royalty choice. Recall that the value of n will affect the prices are stated in Lemma 1. Again, the quality differential drives the main results. When it is small ($q < 1$), the seller has incentives to set a small royalty so to attract only content providers with a low outside option. This result is the direct consequence of the substitution effect discussed after Lemma 1. The only objective for the platform is to minimize the cost of attracting at least low types. In other words, the seller faces a between-segment competition when setting the subscription price, so that a marginal increase of contents cannot translate into a higher subscription price. This induces the seller to set the minimal royalty compatible with providing a sufficient variety.

When $q > 1$, only the *Premium* subscription is offered and the share of subscribers accessible by the platform turns out to be the most relevant aspect. When the platform can reach few subscribers (low γ), a content provider would require a large unitary royalty. This makes content attraction too costly. As a consequence, only low-v content providers join the platform (Point 1 of Lemma 2). Oppositely, when γ is large enough, the platform gives access to a large audience, with the consequence that a relatively smaller royalty is sufficient to attract also content providers with a large outside option (Point 2 of Lemma 2).

4.3 Stage 0: Quality

At the beginning of the game, the platform sets the optimal quality q in order to maximize the profit minus the royalty expenditures. We consider quadratic costs of quality provision, i.e., $C(q) = \frac{q^2}{2}$. In Appendix A.3 we demonstrate the existence a cutoff value $\underline{\gamma}$ that is needed to state the following proposition.

Lemma **3.** *If:*

1. $\gamma \leq \underline{\gamma}$, *the equilibrium quality is* $q^* = \frac{\gamma(2\gamma-1)+2\gamma\sqrt{(\gamma^2-\gamma+1)}}{3}$,

2. $\gamma > \underline{\gamma}$, *the equilibrium quality is* $q^{**} = 1$.

Proof. Proof is in Appendix A.3. □

The mechanism behind the result of Lemma 3 is straightforward and depends on the extent in which q affects platform's profits. If the platform opts for a subscription-based model offering only *Premium*, profits are not affected by quality levels enough to compensate the associated cost, so that the platform wishes to provide the minimal quality (which equal to 1 by Lemma 1). Differently, if the platform offers a menu *Premium+Basic*, q represents the quality differential between the *Premium* and the *Basic* segment. Therefore, a higher q moves people from the *Basic* to the *Premium* segment. For this reason, a marginal increase in q has a stronger impact on profits with respect to the "*Premium*-only" case, making the optimal q "internal" and increasing in γ. This is because the positive impact on profits is more important as the share of users gets larger. Once a certain level of γ is reached, the platform wants all people to be in the *Premium* segment but, in order to induce them to move from the *Basic*, the quality need to be fixed at least equal to 1. This jump is depicted in Figure 3.

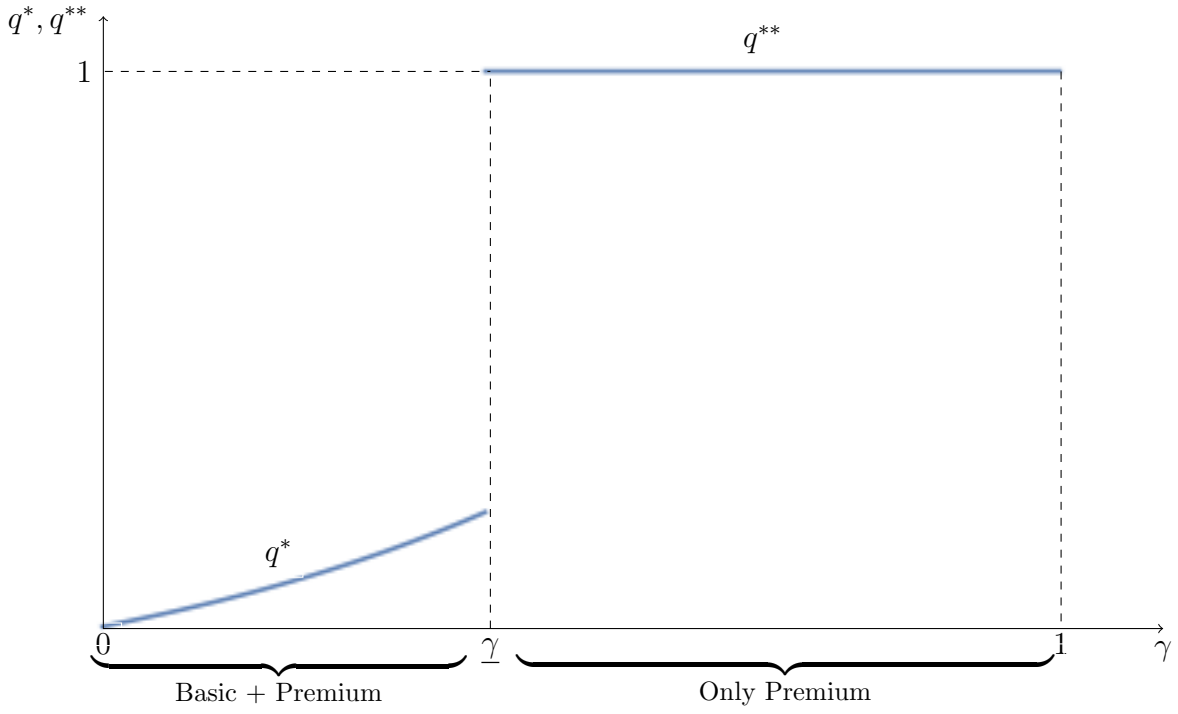

Figure 3: Optimal quality of the *Premium* segment as a function of γ.

5 The role of audience

Our analysis reveals that the platform's choice of quality is the main driver for the emergence of the business model. In particular, the quality upgrade offered in the *Premium* subscription is what moves users to the paying segment. At the limit, this mechanism makes the *Basic* segment fade away. Moreover, if the platform reaches a wide audience, offering only the paying subscription is always dominating. The impact of this choice on content provision, price and advertising intensity is stated in the following proposition, that combines Lemmas 1, 2, and 3.

PROPOSITION **4.** *If:*

1. $\gamma < \underline{\gamma}$, *the platform offers a menu of* Premium *and* Basic *subscriptions and only low-type content providers enter the platform* ($n_L^* = \alpha$). *The price will be* $\tilde{p}(q^*)$ *and the adverting intensity will be* $\tilde{a}(q^*)$

2. $\gamma > \underline{\gamma}$, *the platform offers only the* Premium *subscription. Moreover:*

   (a) *when* $\gamma \in [\underline{\gamma}, \bar{\gamma}]$ *only low-type content providers enter the platform* ($n_L^* = \alpha$) *and the price will be* $p^*(\alpha, 1)$,

   (b) *when* $\gamma > \bar{\gamma}$, *all contents providers enter the platform* ($n_H^* = 1$) *and the the price will be* $p^*(1, 1)$.

Proposition 4 is relevant for two reasons. On the one hand, it shows that as the audience increases, the platform has stronger incentives to attract contents, in particular the ones with higher outside option v_H. Looking at Figure 4, this mechanism is observed going from above to below the curve $\bar{\gamma}$ and it is due to the fact that a broader audience makes the platform more attractive to artists, so that a lower royalty is sufficient to obtain their contents. On the other hand, also price and advertising intensity increase in response to a wider audience. This trivially depends on the fact that the optimal quality upgrade increases in γ and it has a positive impact on price and advertising intensity, whenever a *Premium+Basic* solution is implemented.

Our results give a rationale to some stylized facts of streaming markets. On the one hand, some artists have been reluctant to the Spotify model. This is well documented by the tensions between Spotify and the frontman of the Radiohead, Tom Yorke, and Taylor Swift, among others, before their titles were available on the platform. In terms of our model, as one can notice in Figure 4, the *Basic+Premium* solution will never induce v_H types to join the platform. Moreover, these high types are willing to join only if the share of people

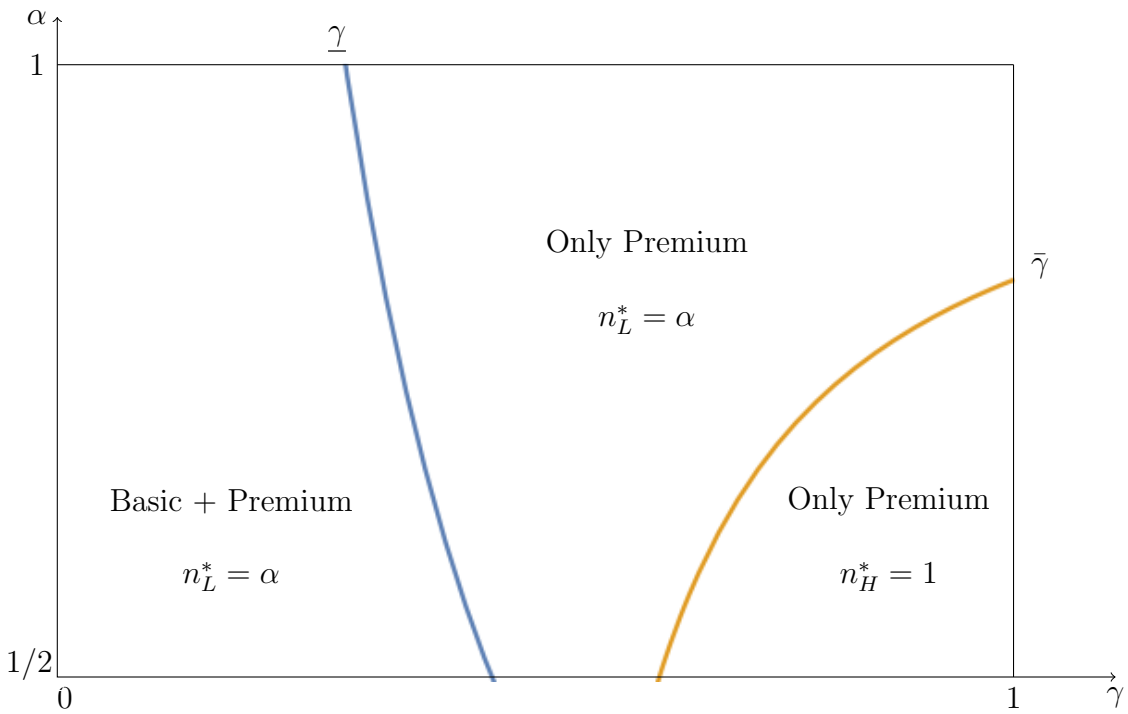

Figure 4: Equilibrium configurations for $\gamma \in [0, 1]$ and $\alpha \in [1/2, 1]$.

reached by the platform is sufficiently high. As a matter of fact, the choice of these artists to join Spotify is essentially linked to the audience reached. Indeed, Spotify's active users increased by 200% in the period 2015-2018. On the other hand, during the same period, the number of *Premium* subscribers increased by more than 400%, tendency that is in line with our finding that a broader audience makes the *Premium* more profitable that the *Basic*.[8]

6 Conclusions

Streaming markets, which have experienced an important boom in the last decade, have raised attention on new, important questions in economics. First, players entered the markets following different business models. For example, Google, Apple, and Netflix entered the streaming market by offering only ad-free solutions. On the contrary, companies like Spotify, Deezer, and Hulu opted for mixed business models. Secondly, these streaming platforms often have a complicated relationship with content providers, who may suffer a cannibalization effect when making their artistic productions (almost) freely accessible within the platforms.

[8]Source https://www.statista.com/statistics/244995/number-of-paying-spotify-subscribers/.

The present model gives a rationale to these stylized facts. On the one hand, we are able to explain the emergence of different business models. The model predicts that a platform with a wide audience will only offer a *Premium* subscription, whereas a smaller platform would instead offer a menu of subscriptions. On the other hand, we highlight the fact that content providers would prefer a subscription-based system, which explains artists' reluctance to participate in the *Spotify model*.

Appendix A

A.1 Proof of Lemma 1.

The interior solution of the problem in (7) is given by $\tilde{p} = \frac{2+3q+2\sqrt{3q+1}}{9}$ and $\tilde{a} = \frac{1+\sqrt{3q+1}}{3}$. Notice that a necessary condition for the constraints to be non-binding is $q < 1$. Otherwise, $\tilde{p} < q$ and $\tilde{a} > 1$. Moreover $\tilde{p} < n + q$ only if the number of contents offered by the platform is sufficiently high $n > \underline{n} \equiv \frac{2(1+\sqrt{3q+1})}{9} - \frac{2q}{3}$. Notice that $\underline{n}$ is decreasing in q and takes a maximal value at $q = 0$, which means that $\underline{n} < 4/9$. Since at least $\alpha > 1/2$ contents will be present on the platform at equilibrium, $n > \underline{n}$. When $q \geq 1$, $\tilde{a} \geq 1$, so that all agents subscribe *Premium* and pay the price leaving them with zero utility, i.e., $p^* = n + q$.

The profits then change depending on n and q. In particular, when: *(i)* $q \geq 1$, we plug p^* and $a = 1$ into the profit function; *(ii)* when $q < 1$, we plug $\tilde{p}$ and $\tilde{\alpha}$ into the profit function. In sum, profits are given by:

$$\Pi(n, q) = \begin{cases} (n+q)\gamma & \text{if } q \geq 1 \\ \frac{\gamma}{27}\left(4 - 9q + 4\sqrt{(3q+1)^3}\right) & \text{if } q < 1 \end{cases} \tag{8}$$

A.2 Proof of Lemma 2

In stage 1, the platform sets the optimal royalty anticipating the effect that this would have on the profits expressed in (8) and taking into account royalty expenditures, which are given by $r \cdot n \cdot s$. Notice that $s = \gamma$ and

$$n = \begin{cases} 0 & \text{if } r < r_L^*, \\ \alpha & \text{if } r \in [r_L^*, r_H^*), \\ 1 & \text{if } r \geq r_H^*. \end{cases}$$

We have two cases:

1. Assume $q \geq 1$. In this case, the platform has two alternatives:

   (a) setting $r = r_L^*$, which attracts a mass α of contents, giving a profit net of royalty expenditures equal to

   $$\Pi(n = \alpha, q > 1) - r \cdot n \cdot s = (\alpha + q)\gamma - r_L^* \cdot \alpha \cdot \gamma = (\alpha + q)\gamma - \alpha v_L$$

   (b) setting $r = r_H^*$, which attracts a mass 1 of contents, giving a profit net of royalty expenditures equal to

   $$\Pi(n = 1, q > 1) - r \cdot n \cdot s = (1 + q)\gamma - r_H^* \cdot \gamma = (1 + q)\gamma - v_H$$

   Solution (a) is preferred to solution (b) if $\gamma < \frac{v_H - \alpha v_L}{1-\alpha}$ and for all γ when $\frac{v_H - \alpha v_L}{1-\alpha} > 1$. As a result, the royalty is r_L^*, so that $n^* = \alpha$ content are present in the platform and the subscription price is equal to $p^*(\alpha, q) = \alpha + q$. If $\gamma < \min\left\{\frac{v_H - \alpha v_L}{1-\alpha}, 1\right\} \equiv \bar{\gamma}$, solution (b) is chosen, so that the royalty is r_H^*, all contents (mass $n^{**} = 1$) are present in the platform and the subscription price is equal to $p^*(1, q) = 1 + q$. This completes the proof of the first two points of Lemma 2.

2. Assume $q < 1$. The platform sets r to maximize $\frac{\gamma}{27}\left(4 - 9q + 4\sqrt{(3q+1)^3}\right) - r \cdot n \cdot s$, which is decreasing in r. Therefore, $r^* = r_L^*$, with the consequence that $n^* = \alpha$. The price will be $\tilde{p}(q)$ and the advertising intensity $\tilde{a}(q)$.

A.3 Proof of Lemma 3

Given the results in Lemma 2, the platform profit (net of royalty expenditures and cost of providing quality) is:

$$\Pi - r \cdot n \cdot \gamma - \frac{q^2}{2} = \begin{cases} \gamma(1+q) - v_H - \frac{q^2}{2} & \text{if } q \geq 1 \text{ and } \gamma > \bar{\gamma} \\ \gamma(\alpha+q) - \alpha v_L - \frac{q^2}{2} & \text{if } q \geq 1 \text{ and } \gamma \leq \bar{\gamma} \\ \frac{\gamma}{27}\left(4 - 9q + 4\sqrt{(3q+1)^3}\right) - \alpha v_L - \frac{q^2}{2} & \text{if } q < 1 \end{cases} \quad (9)$$

Assume $\gamma < \bar{\gamma}$. In this case the platform has two alternatives:

1. Set $q \geq 1$. In this case, the maximization problem becomes $\max_{q \geq 1}[\gamma(\alpha + q) - \alpha v_L - \frac{q^2}{2}]$, which gives $q^* = 1$. The resulting profit will be $\hat{\pi} = \max\{\gamma(\alpha + 1) - \alpha v_L - \frac{1}{2}, 0\}$.

2. Set $q < 1$. In this case, the maximization problem becomes

$$\max_{q\in[0,1)} \pi(q) = \max_{q\in(0,1)} [\frac{\gamma}{27}\left(4 - 9q + 4\sqrt{(3q+1)^3}\right) - \alpha v_L - \frac{q^2}{2}],$$

which gives $q^{**} = \frac{(2\gamma-1)\gamma}{3} + \frac{2\sqrt{\gamma^2(\gamma^2-\gamma+1)}}{3}$.

Comparing the two alternatives, we find that $\pi(q^{**}) > \hat{\pi}$ if $\gamma > \underline{\gamma}$ where $\underline{\gamma}$ is implicitly defined as:

$$\underline{\gamma} = \frac{27 - 2\underline{\gamma}\left\{23 - \underline{\gamma}\left[15 - 2\underline{\gamma}(9 - 8\underline{\gamma})\right] - 2\left[2 - \underline{\gamma}(5 - 8\underline{\gamma})\right]\sqrt{1 - (1-\underline{\gamma})\underline{\gamma}}\right\}}{54\alpha}$$

Notice that $\underline{\gamma}$ is decreasing in α and lies in the interval $(0.30, 0.46)$. Notice that $\bar{\gamma}$ is decreasing in α, so that it has a lower bound at $2v_H - v_L > 1/2 > \underline{\gamma}$. This completes the proof.

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