2017/07

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CORE
CENTER FOR OPERATIONS RESEARCH AND ECONOMETRICS

CORE
Voie du Roman Pays 34, L1.03.01
Tel (32 10) 47 43 04
Fax (32 10) 47 43 01
Email: immaq-library@uclouvain.be
http://www.uclouvain.be/en-44508.html

Content Acquisition by Streaming Platforms: Premium *vs* Freemium *

Elias Carroni[†] Dimitri Paolini[‡]

February 22, 2017

Abstract

We analyze the optimal decision of a monopolistic streaming platform. The platform obtains contents from copyright owners (artists) who are paid with a per–user royalty. Advertisers pay a per–user fee to display their commercials. Users value the variety of contents and are heterogeneously bothered by ads. We show that when commercials generate an intermediate nuisance and the size of the potential market is large, the platform finds it optimal to offer only a paying subscription without displaying any ads. In contrast, a small potential market results in the offer of a menu of subscriptions, with ad–intolerant users paying a positive price and moderately–averse users opting for a free–of–charge solution. The second (first) solution is always preferred when commercials generate a strong (weak) nuisance. We also show that there may emerge a misalignment of the platform's and artists' interests.

*We wish to thank Paul Belleflamme, Ennio Bilancini, Fabio Manenti, Markus Resigner and Shiva Shekhar for their precious suggestions. We would like to acknowledge the participants to the seminar at the DEMB (Modena), at the Department of economics (Parma), to the workshops "IO in the digital economy" (Louvain) and "Economics of Network Industries" (ParisTech) and to the conferences CORE @50 (Louvain) and ASSET 2016 (Thessaloniki). Elias Carroni acknowledges the Labex MMD-II for financial support at the beginning of this project. Dimitri Paolini acknowledges the financial support of MIUR–PRIN 2015 and of Fondazione Banco di Sardegna 2015.

[†]DSE - Università di Bologna.

[‡]DiSEA - Università di Sassari, CRENoS and CORE, Université Catholique de Louvain.

1 Introduction

Recently, the markets for on–demand internet streaming platforms boomed dramatically, with many big players currently competing. Music streaming services such as those offered by Spotify, Google Music, Amazon, Deezer, and Apple Music, and video streaming outlets such as Netflix, Amazon Video, Hulu, and HBOGo are all examples of a conceptual and economic revolution in the provision of copyright-protected contents to final users. This dramatic change in the way consumers purchase and find digital goods has many interesting economic consequences.

Indeed, these industries are characterized by the interaction of the platform with many groups of agents (i.e., copyright owners or COs, users, and advertisers) and by the presence of cross–group network externalities. This brings us to what Caillaud and Jullien (2003) defined as a chicken–and–egg problem i.e., a multi-sided platform needs to attract a critical mass in each group somehow in order to develop a business. On the one hand, acquiring a sufficient variety of copyright–protected contents is needed to induce users to subscribe to the service. In this regard, the real markets show that the platforms acquire a huge set of contents,[1] paying the COs per–click received at the end of a given period. On the other hand, selling an artistic production to a platform "offering" a broad set of users is something valuable to COs, who want their songs/movies to reach the widest possible audience.

A similar cross–group externality also exists between advertisers and users. Namely, the utility that a user obtains by subscribing to a platform selling ad spaces decreases with the number of commercials, since ads interrupt the users' enjoyment of the contents, whereas advertising firms are clearly happier as the number of users increases.

When a platform decides to sell ad spaces, it creates an indirect externality from advertisers to COs, and *vice versa*. Indeed, a higher number of commercials would be associated with a reduction of subscriptions, thus reducing the potential audience of an artist within the platform, whereas the presence of contents is necessary to make the platform more attractive to users and, consequently, to advertisers.

Bearing in mind these non–trivial interactions among the three sides of the market, a company seeking to provide streaming contents faces different issues:

[1] Eller (2015) reports that both Spotify and Apple Music offer at least a 30 million–song library.

choosing between an ad–based or an ad–free business model on the one hand, and attracting a sufficient amount of contents to make a profit from subscribers and advertisers, if following an ad–based model, on the other hand.

As a matter of fact, 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 and Deezer.[2] Their free–of–charge solution, the so–called basic subscription, entails frequent commercial interruptions after a few songs. Somehow, users are compensated for the disturbance of ads with free access to music. Contextually, users are given the opportunity to upgrade to a free–of–ad solution by paying a positive price. This menu of subscriptions is commonly called the *Freemium* business model.

Google, Netflix, and other important players in these markets follow a different road. Their approach is to offer a unique paying solution, intended to be perceived as superior–quality providers. The proof of this precise intention to create a high–quality provider image lies in the concerns of these companies' headquarters in response to rumors about the possibility of commercials coming onto their platforms.[3] Hereafter, we will refer to this business model as *Premium*.

The presence of these platforms is often seen as a threat and is perceived with suspicion by artists, especially when the offer of contents is completely free–of–charge.[4] The relationship between artists and streaming platforms is complicated because artists look at the streaming market as a threat to the sale of their artistic productions through alternative channels. This fact is well documented by recent empirical papers that find that streaming and purchasing tend to be substitutes (see Aguiar and Waldfogel 2014, Wlömert and Papies 2016, and Hiller 2016). However, Aguiar (2015) and Aguiar and Martens (2016) give evidence of complementarity due to an effect described by Belleflamme (2016) as "discovery," that is, streaming is used to discover high–value music and match value for users, leading to an ultimate increase in music consumption.[5] Our model assumes artists

[2]Hulu in the video–streaming market follows the same business model.

[3]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."

[4]Among other artists, titles from Taylor Swift and the Beatles are unavailable on some or all streaming platforms, and the group Radiohead has 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.

[5]For a test of discovery, see Datta et al. (2016).

to have heterogeneous outside options, and so accounts for the "cannibalization effect" and the fact that this effect is different across artists.

Our main objective is to understand the main drivers in the choice between the *Freemium* and *Premium* models. We assess this research question by providing a model in which a monopolistic platform pays per–user royalties to COs and, when ads are attracted, charges advertisers with a per–user fee. 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. We find that the choice between the *Premium* and *Freemium* models is driven by the advertisement nuisance cost and the potential market size of the platform. Clearly, a high (low) nuisance cost leads to *Premium* (*Freemium*) being preferred because the free segment is unappealing (appealing), and thus platforms lose (profit) from advertisers. More interestingly, when nuisance is intermediate, market size becomes more salient: a large platform offers a free–of–ad premium subscription, whereas a small (but not too small) potential demand results in the offer of a menu of subscriptions, with ad–intolerant users subscribing to the premium service and moderately averse users opting for basic service.

The mechanism behind the aforementioned "size effect" is that a wider potential subscription–demand gives the platform strong power *vis–à–vis* COs.[6] This power can be exploited in different ways. Indeed, the fact that COs benefit from an increase in the number of users makes content attraction cheaper for larger platforms, i.e., a smaller royalty is required to attract a given number of COs. As a result, the platforms optimal choice in response to an increase in size could be either(i) to decrease the royalty, keeping the amount of contents fixed or (ii) to keep the royalty fixed to increase contents and therefore the "value" of the platform to users. The choice between the two alternatives is completely different under the *Premium* and *Freemium* models.

In the *Premium* model, a potentially larger set of users lets the platform increase the subscription price. This is due to the fact that, for a given royalty, more contents are attracted, which increases users' willingness to pay because they value variety. Hence, the final subscription price can rise. Differently, under the *Freemium* model, the offer of a free–of–charge subscription generates a proper elasticity to price, as a *ceteris–paribus* increase in price would move people to the

[6]This tendency is confirmed by Waelbroeck (2013), who claims "Overall, digital music distribution is improving the negotiating power of retailers relative to producers of recorded music. This is especially true for online intermediaries who can collect users' information and gain better knowledge of demand conditions."

free segment. Consequently, a platform exploits size effects by saving on royalties rather than raising the subscription price.

Another important finding of the paper is the emergence of a misalignment of incentives between the platform and the COs. Namely, there may exist situations in which the optimal choice of the platform is to follow the *Freemium* business model, even if COs would strictly prefer that *Premium* were chosen. This incentive misalignment emerges when advertisements create a moderate nuisance and the market is ample enough. In those cases, the streaming platform makes money on advertisements and subscriptions, and exploits market size by reducing royalties. From the COs' viewpoint, this is clearly detrimental in relation to the *Premium* model, in which both the royalty and the subscription price would have been higher. The emergence of this misalignment of incentives gives a rationale to the reluctance of many artists to the "Spotify model."

We contribute to the theoretical literature of two–sided markets[7] as well as to the industry–specific literature of two–sided media.[8] This literature mainly focuses on the price structure (i.e., the equilibrium price charged to each side of the market) and on the differences between free–to–air and paying media. With the current paper, we shed new light on the choice between a subscription–based and a mixed (ads plus subscription price) business model. In a model of platform competition, Calvano and Polo (2016) show how "pay" and "free–to–air" coexist in broadcasting markets, with two ex–ante identical platforms optimally opting for different business models. Differently, in our approach, a monopolistic platform attracts contents in which the copyrights are owned by external COs. We show that content acquisition works in a very different way across business models and this ultimately determines the relative profitability of the *Premium* and *Freemium* models. Similar to our study, Weeds (2014, 2016) specifically takes into account content provision in multi–sided media. In models suitable to TV competition, she studies the contractual incentives in a vertical market, showing that exclusivity and non–exclusivity essentially depend on (possible) vertical integration and on the business model of the downstream distributor. Our approach is more suitable to streaming media, which do not have any space constraints (TV programming) and are better described by free entry of COs.

[7]See Rochet and Tirole (2003), Armstrong (2006), and Caillaud and Jullien (2003).

[8]See, among others, Ferrando et al. (2008), Peitz and Valletti (2008), Reisinger (2012), and Calvano and Polo (2016).

The rest of the paper is organized as follows. The next section presents the main components of the model. Thereafter, Sections 3 and 4 present the optimal decisions under the *Premium* and *Freemium* models, respectively. Then, Section 5 completes the equilibrium analysis and discusses the misalignment of incentives between the platform and the COs. Finally, Section 6 presents the conclusions.

2 The Model

An online platform provides streaming contents to a population of users interested in variety. The copyrights of these contents are owned by artists (COs), who are offered a royalty for their artistic creation to be streamed by the platform. The platform might offer a free–of–charge subscription (called basic henceforth) and/or an upgrade to a free–of–ad subscription (premium). Advertisements generate a nuisance, that is, users are somehow disturbed by ads as they will interrupt the enjoyment of the contents. To highlight more clearly the objectives of all agents involved in the model, let us present each side of the market separately.

Copyright Owners. COs face a trade–off when making their product available on the platform. On the one hand, they receive some royalty r, that we assume to be per–user. On the other hand, COs do not like the cannibalization effect that the streaming availability of their products creates on other distribution channels (DVDs or CDs). This is captured by an idiosyncratic parameter v, assumed to be distributed according to a well–defined and continuous distribution function with density $f(\cdot)$ and cumulative density $F(\cdot)$ in the support $[0,1]$.[9] We further assume the hazard rate function, $\frac{f(v)}{1-F(v)}$, to be monotone non–decreasing, in order for our distribution to be regular.[10]

Therefore, if one defines s as the number of subscribers, the profit of a CO with outside option v will be:

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

Advertisers. Each advertiser seeks to sell a product of quality α. The quality of each product is assumed to be uniformly distributed in the interval $[0,1]$. The

[9] One may think that this v can be very high for some artists and can explain their choice to refrain from making their titles available on the platform.

[10] Notice that $\frac{\partial\left(\frac{f(v)}{1-F(v)}\right)}{\partial v} \geq 0$ also implies $\frac{\partial\left(\frac{f(v)}{F(v)}\right)}{\partial v} \leq 0$.

access to the platform is needed to make each product known by the subscribers exposed to ads and it entails the payment of a per–user fee f. For the sake of simplicity, all subscribers exposed to the ads are willing to buy the product at its true quality (i.e., the price of the product is equal to α). The profit of a quality–α firm will be:

$$\pi_a = \begin{cases} (\alpha - f)s_b & \text{if it enters the platform,} \\ 0 & \text{otherwise,} \end{cases} \tag{2}$$

where s_b is the number of subscribers met in the platform, that is, the number of subscribers exposed to ads.[11] In what follows, we will refer to a as the number of advertisers entering the platform or, simply, the ad intensity.

Users. A mass γ of users is reachable by the platform. We will often refer throughout the paper to γ as the size of the potential market of the platform. Each user receives utility u from enjoying the contents and are somehow disturbed by the presence of ads. Users are interested in the variety of contents, so their gross utility (without considering subscription price or the shadow price of advertisement) for a subscriber is given by:

$$u = co, \tag{3}$$

where co is the number of contents available on the platform.[12]

We further assume that, if a commercials are displayed, each user suffers a disutility equal to $-\beta a$, where the parameter $\beta \sim U[0, \bar{\beta}]$ is the idiosyncratic distaste for advertisement. In other words, the per–commercial cost for a type–β user is β and agents with β close to zero are relatively neutral to advertisements, whereas individuals with β close to $\bar{\beta}$ are highly ad–averse. Hereafter, we will call the shadow cost $-\beta a$ the nuisance cost of advertisement. In summary, a type–β agent who joins the platform gets utility:

$$U(\beta) = co - \begin{cases} p & \text{if premium,} \\ -\beta a & \text{if basic,} \end{cases} \tag{4}$$

[11]Notice that $0 \leq s_b < s$: in case of premium, $s_b = 0$; whereas in case of freemium, $s_b > 0$ agents subscribe to basic and the remaining $s - s_b$ subscribe to premium.

[12]Similar to standard models of multi–sided markets, we assume a linearity of users' utility in the number of contents and, for the sake of simplicity, we assume a slope equal to one. The main results of the paper would hold also with an arbitrary and positive slope.

where p is the price of the premium subscription and a is the ad intensity.

We will study and compare two alternative business models. In the first system, simply called *Premium*, the platform offers only contents in a free–of–ad premium subscription. In the second system, the *Freemium* model, the platform displays some ads and offers both a basic and the premium subscription. Individuals sort between premium and basic according to their ad aversion.

The timing of the model is as follows. At time 0, the platform attracts some contents offering royalty r. At time 1, the platform simultaneously sets the premium subscription price p and, if ads are displayed, the advertising charge f. Given p and f, at time 2, the advertisers and the individuals decide whether to join the platform. If they are given the choice, subscribers also choose the type of subscription to opt for.

3 Premium

Let us consider first a scenario where the platform only offers a free–of–ad premium subscription and charges subscribers a price p. The platform maximizes:

$$\Pi_{pre} = s(p, co) \cdot p - r \cdot co(r, s) \cdot s(p, co) \tag{5}$$

The first term represents the money raised from the s subscribers, the number of which depends on the price and on the contents offered. The second term indicates the total amount to be paid to COs. Notice that, at the price–setting stage, the platform has already attracted contents in the previous period through r, so that users are able to see the complete offer of contents and make a fully informed decision about subscription.[13] Given equation (4), it is easy to verify that the number of subscribers that a platform expects to attract when setting a price p will be:

$$s = \begin{cases} \gamma \text{ if } p \leq co \\ 0 \text{ otherwise.} \end{cases} \tag{6}$$

In other words, when they receive the offer of the premium subscription, all users will subscribe at price p provided that this gives them a net utility (weakly)

[13]This is in line with the fact that users are often offered free trials, which allows them to perfectly know and observe the full offer of the platform.

higher than zero. Now, going one step backward, a CO would make a title available on the platform if r is sufficient to compensate for the cannibalization effect. Formally:

$$rs - v \geq 0 \Leftrightarrow v < rs, \tag{7}$$

meaning that $co = F(rs)$. Given these participation decisions, the optimal solution of the maximization problem of the platform will be:

Proposition 1. *Let* $\underline{\gamma} \equiv 1 + \frac{1}{f(1)}$. *If:*

1. $\gamma < \underline{\gamma}$, *the optimal* r^* *is implicitly defined by:*

$$r^* = 1 - \frac{F(r^*\gamma)}{f(r^*\gamma)\gamma}$$

   and the price is $p^* = F(r^*\gamma)$.

2. $\gamma \geq \underline{\gamma}$, *the royalty is* $r^* = 1/\gamma$, *all contents are offered and the subscription price is* $p^* = 1$.

As $f(1) \to 0$, *only case 1 exists.*

Proof. See Appendix A.1. ■

Proposition 1 expresses the equilibrium subscription price and royalty. We can observe the cases.

On the one hand, if the potential market γ is low, the subscription price increases with γ. This means that the platform exploits the power given by an increase in the size of the potential market essentially by raising the price. For a given optimal royalty, the number of contents increases with γ, so that a greater surplus can be extracted. Hence, the final price increases.

As soon as the size of the potential market reaches a threshold, a smaller royalty would be sufficient to attract all contents. Hence, regardless of γ, the price will be at its maximal level ($p^* = 1$) and a rise in γ makes it optimal to save on content acquisition.

The intuition behind royalty and price equilibrium behaviors derives from a change in the incentives of the platform. In both cases, the potential market size is always beneficial to profits, since it makes the platform more appealing to COs who are interested in an audience. The main point for the platform is to understand how to exploit this power. The sudden change in the optimal pricing

behavior clearly depends on the fact that when the market is sizeable enough, this allows for a full acquisition of contents with a positive consequence on the subscription price, set at its maximal level.

Another important consideration is that the emergence of the jump from a price–increase to a royalty–reduction strategy strongly depends on the distribution of the outside option v. Namely, the second strategy is optimal only if the highest vs are sufficiently likely to exist.[14] In those cases, the platform augments the price as the market becomes broader, because a larger market entails a rise in the number of contents available to users.

In contrast, consider as a benchmark case the COs' outside option as distributed according to a $U[0,1]$. It is simple to verify the following lemma, which is the uniform version of Proposition 1.

Lemma 1. *If $v \sim U[0,1]$, then:*

1. *When $\gamma < 2$, the optimal royalty is $r^* = \frac{1}{2}$ and the optimal price is $p^* = \frac{\gamma}{2}$.*
2. *When $\gamma \geq 2$, the royalty is $r^* = 1/\gamma$, all contents are offered and the subscription price is $p^* = 1$.*

Proof. The result is obvious by substituting $F(r^*\gamma)$ with $r^*\gamma$ and $f(\cdot)$ with 1 in Proposition 1. ■

The Lemma above aims to highlight the result proposed with a specific distribution. This distribution is very convenient because it makes the royalty independent of market size γ when the latter is low.[15] To some extent, the passage from a price–increase to a royalty–reduction strategy becomes sharper and easier to reach because a relatively small potential market ($\gamma = 2$) would make all COs enter the platform. As we will see in section 5, using a uniform distribution of v will also allow for a full comparison of *Premium* and *Freemium* profits.

4 Freemium

Now, let us assume that the platform offers both a free–of–ad premium subscription at price p and a free–of–charge basic subscription, letting each subscriber

[14] To put it differently, when $f(1)$ is very close to zero, *Premium* would only lead to "interior solutions" in which some contents are not available to users regardless the size of the potential market.

[15] Notice that a comparative statical analysis of r^* in point 1 of Proposition 1 is clearly distribution–dependent, so that a general effect of γ on r^* cannot be conclusive with general distribution functions.

opt for the favorite solution. The platform maximizes:

$$\Pi^{free} = s_p(p, co, a) \cdot p + f \cdot a(f) \cdot s_b(p, co, a) - r \cdot co(r, s) \cdot s(p, co, a) \quad (8)$$

Compared to the *Premium* model, the profit here takes into account not only the money raised on premium subscriptions (in number s_p in this case) and the cost of royalties, but also the profits from advertisers, represented by the per–user fee raised $f \cdot a$. The decision of users here is not only between subscribing and not subscribing, but also on the type of subscription (premium or basic). The basic subscription is preferred to the premium for all agents that have β such that:

$$u - p < u - \beta a \Rightarrow \beta < \hat{\beta} \equiv \frac{p}{a}, \quad (9)$$

Notice also that users prefer premium subscriptions to abstaining from subscription if $p \leq co$. In this case, it also holds that all agents with $\beta \in [0, \hat{\beta}]$ will subscribe to basic and all agents with $\beta \in [\hat{\beta}, \bar{\beta}]$ will subscribe premium with probability one. Thus, for a given price p and advertisement intensity a, the demand for subscriptions will be:

$$s_p = (1 - \frac{p}{\bar{\beta} a})\gamma \quad (10)$$

for the premium and

$$s_b = \frac{p}{\bar{\beta} a}\gamma \quad (11)$$

for the basic segment.

On the advertisers' side, a firm of quality α will join the platform if the profit is positive, that is, $(\alpha - f)s_b \geq 0$. Clearly, since the mass of advertisers is one, the number of firms that advertise their product will be:

$$a = Prob(\alpha - f \geq 0) = 1 - f, \quad (12)$$

meaning that all advertisers selling a product of quality at least equal to the payment will enter the platform. Given the participation on the subscribers' and advertisers' sides and taking into account the effect that r will have on COs' participation, the platform will maximize profits. The final subscription price, royalty, and ad fee are reported in the following proposition.

Proposition 2. *Let* $\hat{\gamma} \equiv \frac{3\bar{\beta}}{1+\bar{\beta}} F^{-1}\left(\frac{(1+\bar{\beta})^2}{9}\right)$. *Under the Freemium model, if* $\gamma \geq \hat{\gamma}$ *and* $\bar{\beta} < 2$, *the optimal royalty is implicitly defined by:*

$$F(\hat{r}\gamma) = \frac{(1+\bar{\beta})^2}{9},$$

the price is $\hat{p} = \frac{(1+\bar{\beta})^2}{9}$ *and the optimal advertising fee is* $\hat{f} = \frac{2-\bar{\beta}}{3}$. *When* $\gamma < \hat{\gamma}$, *the Freemium model is never profitable, and when* $\bar{\beta} \geq 2$, *the Freemium model collapses to Premium.*

Proof. See appendix A.2. ■

As compared to the *Premium* case, the price under the *Freemium* model takes into account not only the offer of contents but it also has a real "demand" effect. When only premium is offered, the demand is basically inelastic provided that the utility offered is non–negative, whereas a rise of the price of a premium subscription when users are also offered the free–of–charge option is not neutral. Indeed, for a given level of average nuisance, increasing the subscription price makes the basic solution more appealing in relation to the premium one. Therefore, raising the price would have the effect of "moving" users from the premium to the basic segment. For a given set of contents, this demand effect is the only thing that matters to the platform when setting the price and advertisement fees. As a result, the subscription price and the ad fee are independent of γ.

Moreover, the higher the maximal nuisance $\bar{\beta}$, the higher the subscription price and the lower the ad fee at equilibrium. Indeed, a rise in $\bar{\beta}$ makes the basic segment less profitable from the point of view of the platform, which attracts, for a given price and ad intensity, a higher (lower) number of premium (basic) subscribers. Consequently, the platform increases the ad–intensity (as the optimal f becomes smaller) and contextually increases the subscription price, making most of the profits on the premium segment. At the limit ($\bar{\beta} \geq 2$), the ad fee becomes zero and profits are basically made only on premium subscribers. Essentially, the *Freemium* model collapses to *Premium*, with only paying subscribers entering the platform.[16]

Similar to the case of *Premium*, the following lemma expresses Proposition 2 in our benchmark of a uniform distribution of v.

Lemma 2. *Let* $v \sim U[0,1]$. *Provided that* $\gamma \geq \frac{(1+\bar{\beta})\bar{\beta}}{3}$ *and* $\bar{\beta} \leq 2$, *the optimal royalty, price, and advertising fees under freemium are, respectively,* $\hat{r} = \frac{(1+\bar{\beta})^2}{9\gamma}$,

[16] This occurs also when the price is 1 because all contents would be attracted.

$\hat{p} = \frac{(1+\bar{\beta})^2}{9}$, *and* $\hat{f} = \frac{2-\bar{\beta}}{3}$.

Proof. The Lemma is proven by substituting $F(r^*\gamma)$ with $r^*\gamma$ and $f(\cdot)$ with 1 in Proposition 2. ■

5 *Premium* or *Freemium*?

The aim of the present section is threefold. First, it discusses how subscription price and royalty vary between the *Premium* and the *Freemium* models. Second, it addresses the following question: "Does a size–γ platform prefer the *Premium* or the *Freemium* model?" Third, it aims to highlight the extent to which the incentives of the platform in this choice might be misaligned with that of the COs.

The following proposition summarizes the findings of the comparison of price and royalty across regimes.

Proposition 3. *Given the results stated in Propositions 1 and 2, it is always possible to find:*

1. *a maximal γ below which the royalty and the price are higher under* Freemium*,*
2. *a minimal γ above which the royalty and the price are higher under* Premium*.*

Proof. See Appendix A.3. ■

Proposition 3 provides sufficient conditions for royalty and price to be higher under the *Premium* or the *Freemium* model. These sufficient conditions suggest that market size matters in the comparison of the optimal price structure across business models. Namely, as the market becomes wider (narrower), both the price and royalty tend to be higher under the *Premium* (*Freemium*) model.

From these results, we can draw two natural conclusions cornering platform's and COs' preferences for the two systems. On the one hand, COs, who are only interested in the royalty, would prefer the platform to choose the *Premium* model as soon as the potential market gets larger.[17] On the other hand, since price and royalty go towards the same direction, it is very difficult to predict the platform's optimal choices. Indeed, a larger potential market, for example, would make the

[17]This conclusion is confirmed and explained more deeply in Proposition 5.

Premium model generate a higher subscription price, but is also increases the cost of acquiring contents.

Therefore, in order to be able to make a full and conclusive comparison of the two business models, we rely on uniformly–distributed outside options. Using the results expressed in Lemmas 1 and 2, we can provide the following proposition:

Proposition 4. *If $v \sim U[0,1]$, the platform enjoys higher profits under the* Premium *model if either $\gamma \leq \tilde{\gamma}$ or $\gamma \geq \tilde{\gamma}'$, where:*

$$\tilde{\gamma} = \begin{cases} \frac{2(\bar{\beta}+1)^2\left(1-\bar{\beta}-\sqrt{-8\bar{\beta}^2+2\bar{\beta}+1}\right)}{27\bar{\beta}} & \text{if } \bar{\beta} < 0.5 \\ 0 & \text{if } \bar{\beta} \geq 0.5. \end{cases}$$

and

$$\tilde{\gamma}' = \begin{cases} \frac{(2-\bar{\beta})\bar{\beta}(4+\bar{\beta})(\bar{\beta}(\bar{\beta}+2)+10)}{3(\bar{\beta}(24-\bar{\beta}(\bar{\beta}+3))-1)} & \text{if } \bar{\beta} \in [0.042, 0.096) \\ \frac{2(\bar{\beta}+1)^2\left(1-\bar{\beta}+\sqrt{-8\bar{\beta}^2+2\bar{\beta}+1}\right)}{27\bar{\beta}} & \text{if } \bar{\beta} \in [0.096, 0.5] \end{cases}$$

The Freemium *model is preferred otherwise.*

Proof. See Appendix A.4. ■

Proposition 4 highlights the optimal business–model choice of the platform. This choice depends on the size of the potential market (γ) and on the maximal nuisance ($\bar{\beta}$). As we see in Figure 2, when $\bar{\beta}$ is high, the *Premium* model is always the best solution for the platform. The intuition is that an increase in $\bar{\beta}$ implies a stronger negative externality on average, so that the free–of–ad alternative would always be more profitable. As $\bar{\beta}$ gets smaller, the profit under the *Freemium* model becomes gradually higher in relation to that under the *Premium* model. At the limit, when $\bar{\beta}$ gets very close to zero (below 0.042), the *Freemium* model always gives higher profit than the *Premium* model, with the only condition that γ must be sufficiently high.[18]

When $\bar{\beta}$ is intermediate (between 0.042 and 0.5), we observe a more interesting optimal behavior depending on the size of the market. When facing a very tiny market, the platform prefers not to attract any advertising. The interpretation is that the platform cannot make much money on ads, even attracting the entire set of potential subscribers. For these reasons, the platform works as a means

[18] More specifically, Lemma 2 claims that when the size of the potential market is below $\frac{(1+\bar{\beta})\bar{\beta}}{3}$, the *Freemium* model is not a profitable solution.

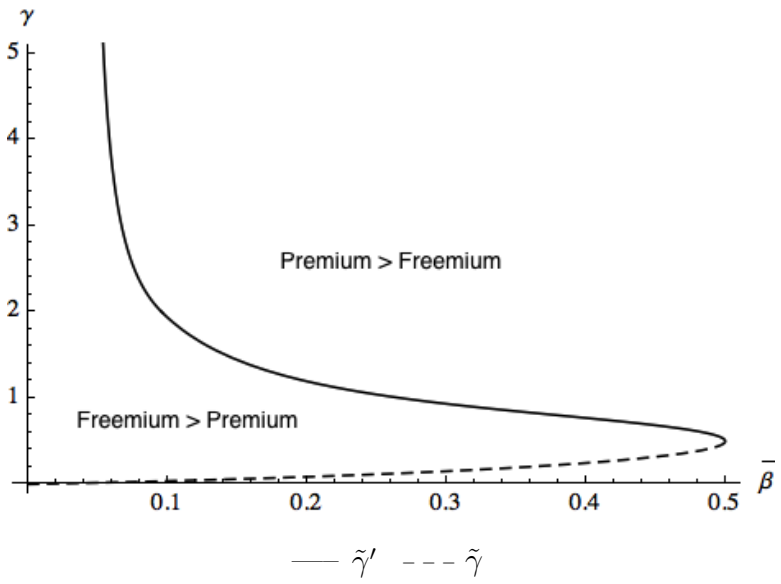

Figure 1: *Freemium vs Premium.*

to distribute contents to the small set of users. As the potential market gets sufficiently large, the gains of the platform become substantial. Size turns out to be crucial in content acquisition, as a broader potential audience makes the platform more attractive to COs. Under the *Premium* model, this power is exploited by increasing the subscription price and, at the limit, it leads to the acquisition of the entire set of contents. Comparatively, under the *Freemium* model, the platform's incentives are different because the presence of a free–of–charge subscription puts pressure on the subscription price to some extent. Thus, the platform exploits its size by saving on royalties rather than increasing the subscription price, which is kept constant with respect to γ.

These optimal decisions of the platform may not be aligned with COs' incentives. To give a first answer to this point, we compare the two royalties in Lemmas 1 and 2. The following holds.

Proposition 5. *If the potential market is sufficiently broad* ($\gamma \geq \min\left\{\frac{2(1+\bar{\beta})^2}{9}, 2\right\}$)*, all COs always prefer the Premium to the Freemium model.*

The intuition behind this proposition is the counterpart of the discussion on Proposition 4. A large potential market entails two consequences for COs. On

the one hand, the potential audience increases, thus boosting profits for a given royalty. On the other hand, it reduces the royalty proposed by the platform. As γ gets sufficiently high, the royalty reduction is more severe in the *Freemium* model because the platform cannot make much money on subscribers, who are given the alternative of a free–of–charge subscription. Hence, COs suffer in the *Freemium* model when the market is sufficiently sizeable.

Combining Propositions 4 and 5, the misalignment of incentives occurs when:

Corollary 1. *If $\bar{\beta}$ is low, the interests of COs and the platform may be misaligned.*

When the maximal nuisance is not substantial, we are in a scenario in which the royalty is higher under the *Premium* model. Nevertheless, given that the average nuisance is low, the platform favors the ad–based (more precisely, mixed) business model as it guarantees higher–than–*Premium* profits (see Figure 2 for a graphical explanation).

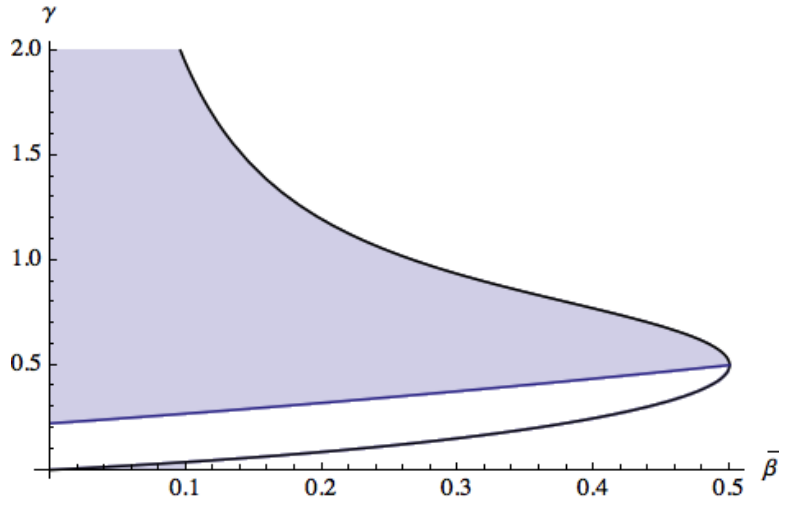

Figure 2: COs: *Freemium vs Premium*.

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, Netflix

(Google, Apple) entered the video–(music–) streaming market by offering only free–of–ad solutions. On the contrary, companies like Spotify, Deezer (music), and Hulu (video) opted for mixed business models. Secondly, these streaming platforms often have a complicated relationship with COs, who may suffer a cannibalization effect when making their artistic productions (almost) freely accessible within the platforms.

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 by means of two elements: ad nuisance and size of potential market. When nuisance is strong (movies), a platform opts for a subscription–based model (e.g. Netflix). In contrast, when ads are perceived as not too disturbing (e.g., video–sharing), a platform prefers a mixed model; an example is Youtube, which is currently offering the choice between free contents and paid access. In between these two extremes, the model predicts that a big platform (e.g., the quintessential digital giant Google) will always prefer the *Premium* model, whereas a small platform (e.g., a promising and innovative new-brand such as Spotify) would instead prefer entering the market by following the *Freemium* model. On the other hand, we highlight the existence of situations in which the platform chooses a mixed business model, whereas COs would prefer a subscription–based system, which explains artists' reluctance to participate in the *Spotify model*.

Appendix A

A.1 Proof of Proposition 1

At the pricing decision stage, users observe the number of contents present on the platform. Clearly, the platform makes zero profits when $p > co$, so this solution is dominated. Moreover, any price strictly below co is dominated as well, as the platform can slightly increase the price without losing demand for subscriptions. Therefore, the equilibrium price will be:

$$p^*(co) = co \tag{13}$$

and $s^*(co) = N$. Going to the royalty decision, the platform anticipates the price and COs' participation, i.e., $co = F(rs^*) = F(r\gamma)$. Clearly, equation (7) tells us that the admissible optimal r^* will lie in the interval $[0, 1/\gamma]$. Indeed, any r^* higher than $1/\gamma$ is dominated because this royalty would attract all contents. Therefore, the maximization problem is constrained and becomes

$$\begin{array}{ll} \max_r \Pi_{pre} & = \max_r \quad s^*(co) \cdot p^*(co) - r \cdot co(r, s^*(co)) \cdot s^*(co) \\ (1-r)F(r\gamma)\gamma, & \end{array} \tag{14}$$

$$\text{s.t. } r < 1/\gamma \qquad .$$

Differentiating Π_{pre} w.r.t. the r first–order condition gives:

$$r^* = 1 - \frac{F(r^*\gamma)}{f(r^*\gamma)\gamma}. \tag{15}$$

When the constraint is violated, $r^*\gamma = 1$, so that $F(r^*\gamma) = 1$. Hence, the problem becomes

$$\begin{array}{c} \max_r (1-r)\gamma \\ \text{s.t. } r \geq 1/\gamma, \end{array} \tag{16}$$

which is clearly maximal at $r^* = 1/\gamma$. Notice that the constraint is violated when

$$\begin{array}{c} \frac{\partial \Pi^{prem}(r)}{\partial r}\big|_{1/\gamma} = \left(1 - \frac{1}{\gamma}\right)\gamma f(1) - 1 > 0 \\ \Leftrightarrow \\ \gamma > 1 + \frac{1}{f(1)}. \end{array} \tag{17}$$

A.2 Proof of Proposition 2

In an equilibrium with a non–empty set of premium subscriptions, we need $p \leq co$ such that all users subscribe to the platform, i.e., $s(a,p) = s_p + s_b = (1 - \frac{p}{\bar{\beta}a})\gamma + \frac{p}{\bar{\beta}a}\gamma = \gamma$. Plugging the ad intensity in (12) and the level of s_b and s_p resulting from (10) and (11), respectively, and rearranging the terms, the maximization problem of the platform reduces to

$$\max_{f,p} \gamma \left(p - co \cdot r + \frac{p((1-f)f - p)}{\bar{\beta}(1-f)} \right). \tag{18}$$

This maximization problem has a solution at $\hat{p} = \frac{(1+\bar{\beta})^2}{9}$ and $\hat{f} = \frac{2-\bar{\beta}}{3}$, which satisfy the first– and second–order conditions. The maximized profit then becomes

$$\Pi_{free} = \frac{\gamma(1 + 3\bar{\beta}^2(\bar{\beta}+3) - 27\bar{\beta} \cdot co \cdot r)}{27\bar{\beta}}. \tag{19}$$

Notice that combining equation (7) with the fact that $s = \gamma$, we find that $co = F(r\gamma)$. So, going one step backwards at the royalty (r) setting stage, it is easy to notice that the profit in (19) is decreasing in r. Therefore, the minimum r sustaining $co \geq p$ will be the optimal one. Formally, r^* will fulfil the following condition:

$$F(\hat{r}\gamma) = p^* \Leftrightarrow F(\hat{r}\gamma) = \frac{(1+\bar{\beta})^2}{9}, \tag{20}$$

which gives the following equilibrium profit:

$$\Pi_{free} = \frac{(1+\bar{\beta})^2\gamma(1+\bar{\beta}-\bar{\beta}3\hat{r})}{27\beta}. \tag{21}$$

Clearly, this is positive only if $\hat{r} < \frac{1+\beta}{3\beta}$. Combining with equation (20), $\hat{r} < \frac{1+\beta}{3\beta}$, is equivalent to

$$\frac{F^{-1}\left(\frac{(1+\bar{\beta})^2}{9}\right)}{\gamma} < \frac{1+\bar{\beta}}{3\bar{\beta}} \Leftrightarrow \gamma > \frac{3\bar{\beta}}{1+\bar{\beta}} F^{-1}\left(\frac{(1+\bar{\beta})^2}{9}\right)$$

A.3 Proof of Proposition 3

Royalties. Notice that the royalty under the *Freemium* model is implicitly defined by:

$$F(\hat{r}\gamma) = \frac{(1+\bar{\beta})^2}{9},$$

whereas in the *Premium* model we have the optimal $r^* = 1/\gamma$ if $\gamma \geq \underline{\gamma} = 1 + \frac{1}{f(1)}$ and

$$F(r^*\gamma) = (1-r^*)f(r^*\gamma)\gamma$$

if $\gamma < 1 + \frac{1}{f(1)}$.

1 The case with $\gamma \geq \underline{\gamma}$ is straightforward. Indeed, $r^* = 1/\gamma$ gives $F(r^*\gamma) = 1 > \frac{(1+\bar{\beta})^2}{9} = F(\hat{r}\gamma)$. Since $F(\cdot)$ is an increasing function, it must hold that $\hat{r} < r^*$.

2 The case with $\gamma < \underline{\gamma}$: Given that $F(\cdot)$ is an increasing function, notice that when

$$F(\hat{r}\gamma) = \frac{(1+\bar{\beta})^2}{9} < (1-r^*)f(r^*\gamma)\gamma = F(r^*\gamma),$$

it must hold that $r^{*free} < r^*$. Since r^* is always higher than 0, taking an arbitrary small $r^* = \epsilon > 0$, one can easily verify that

$$\gamma f(\epsilon\gamma) > \frac{(1+\bar{\beta})^2}{9(1-\epsilon)}$$

is a sufficient condition for the royalty to be higher under the *Premium* model. Following the same reasoning, since $r^* < 1/\gamma$, taking an arbitrary small ϵ and setting $r^* = \frac{1}{\gamma} - \epsilon$, one can easily verify that:

$$\gamma < 1 - \epsilon + \frac{(1+\bar{\beta})^2}{9f(1-\epsilon\gamma)}$$

is a sufficient condition for the royalty to be higher under the *Freemium* model.

Prices. Under the *Freemium* model, the price is $\hat{p} = \frac{(1+\bar{\beta})^2}{9}$, whereas under the *Premium* model, it is either $p^* = F(r^*\gamma)$ when $\gamma < \underline{\gamma}$or $p^* = 1$ when $\gamma \geq \underline{\gamma}$. It is easy to verify the results in the Proposition by using the conditions provided for the royalties.

A.4 Proof of Proposition 4

Plugging in $\hat{p}$, $\hat{f}$, and $\hat{r}$ as expressed in Lemma 2, the equilibrium profit under the *Freemium* model becomes:

$$\Pi_{free} = \frac{(\bar{\beta}+1)^3\left(3\gamma - \bar{\beta}^2 - \bar{\beta}\right)}{81\bar{\beta}}. \tag{22}$$

In contrast, plugging in p^* and r^* of Lemma 2, we get:

$$\Pi_{pre} = \begin{cases} \frac{\gamma^2}{4} & \text{if } \gamma < 2, \\ \gamma - 1 & \text{if } \gamma \geq 2. \end{cases} \tag{23}$$

Comparing the two profits, we find the cutoffs in the Proposition.

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