Competing for cookies: Platforms' business models in data markets with network effects*

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Abstract

We consider platform competition when platforms can either 1) commercialize users' data and in return offer their services for free (data-based business model); 2) protect users' privacy and charge users for participation (subscription-based model); or 3) offer both options (the hybrid model). We find that competition does not always motivate the incumbent platform to protect users' privacy. When network effects are strong, competition can motivate the incumbent to shift from the subscription-based model to the hybrid model; thereby, increasing data commercialization. Yet, the opposite case occurs when network effects are weak. Moreover, allowing the incumbent to adopt the hybrid model is welfare enhancing when network effects are strong, and welfare reducing (or neutral) otherwise.

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1 Introduction

In recent years, users' data have become an important asset and an essential element of platforms' strategy. Platforms collect personal consumer information and use it to improve the

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quality of their service as well as for commercialization purposes, such as selling it to third party vendors or to advertisers. This trend is particularly evident among online platforms like Google, Facebook, TikTok, and Spotify which leverage their large stocks of consumer information to enhance their products and offer free services in exchange for data. Not all platforms, however, base their business strategy on their users data. Platforms like OpenAI, Apple Health, and Ride with GPS,[1] rely on subscription revenues rather than data commercialization. Similarly, Netflix has long followed a subscription-based business model for many years and has only recently introduced a data-based option. This gives rise to the third business model we observe – a hybrid model where users can choose between sharing their data and enjoying the service for free or paying a subscription fee. Likewise, Facebook recently adopted the hybrid model in Europe, by adopting a subscription-based option.

The variance in platforms' choice of business model raises the questions: what determines platforms' choice of business model? How does competition affect this choice? Specifically, does it motivate platforms to adopt a business model that is more privacy-focused and does not rely on commercializing users' data? Moreover, should platforms be prohibited from discriminating between users who share their data and those who do not, as seen in the hybrid business model?

To study these questions, we develop a game with two platforms and users that care about their privacy—i.e., bear a cost if their data is commercialized. Users' disutility from the commercialization of their data differs across users. That is, some users are more sensitive to their privacy than others. Users who join a platform enjoy the network effects generated by all other users on that platform. These network effects can be viewed as the benefit derived from the data the platform collects on all users, and used to improve the quality of the service the platform offers (Markovich and Yehezkel, 2024). For example, data that Netflix collects on a user, contribute to improving Netflix's algorithm, thereby benefiting all other users, irrespective of their choice of plan. Alternatively, the network effects may stem from the direct interactions that users can have with one another on the platform.

Platforms can choose between three business models: (1) data-based; (2) subscription-based; and (3) hybrid. Under the data-based business model, the platform generates revenue from commercializing its users, either by selling their data to third-party providers or by monetizing their time and attention, such as through advertisements. We define the data-based business model broadly to include both the direct sale of user data and the indirect commercialization of user engagement through advertisements. For clarity, however, our discussion will focus on the case where the data-based model corresponds to directly selling users' data. Users that join the platform know that their data will be commercialized and

[1]Ride with GPS is a social route-planning and navigation tool for cyclists.

the cost this would impose on them.

Under the subscription-based business model, users must pay a subscription fee to participate in the platform, yet know that their data will not be commercialized. The hybrid business model combines the two first business models. That is, the platform allows users to choose whether they want to join the platform for free and share their data, knowing the data would be commercialized. Alternatively, users can pay the subscription fee, in which case their data will not be commercialized. For example, Google, Facebook, TikTok, and X utilize the data-based business model, while Apple has been an avid advocate of the subscription-based model. Likewise, the social apps True and Mastodon, the messaging app Signal, and the search engine DuckDuckGo, explicitly chose not to commercialize their users' data.[2] The hybrid model has become more popular, recently, where OpenAI shifted in February 2023 from a data-based model to a hybrid model, while later that year, in November 2023, Meta launched in Europe a no-ads Facebook subscription service. Accordingly, users can choose between a free service by agreeing to have their data tracked and commercialized through advertising, or choose a subscription model which protects their privacy and offers an ad-free experience. Facebook's shift is controversial in Europe. A coalition of 28 organizations has called for an investigation of this business model, arguing that Meta essentially asks users to pay for their privacy.[3]

In order to capture the advantage that a large, dominant platform may have, we assume a two-stage game with an incumbent and an entrant, where the incumbent enjoys a focality advantage. That is, users believe that the incumbent would be the dominant platform in the market.

We find that platforms' optimal business model depends on the strength of network effects. Specifically, if network effects are strong, an incumbent platform should adopt the hybrid model. Due to the strong network effects, the incumbent would like to dominate the market by attracting both privacy sensitive users – with the subscription plan – and privacy insensitive users – with the data plan. When network effects are weak, the incumbent should avoid fierce competition. Hence, the incumbent focuses on the privacy-sensitive users and adopts the subscription-based model which then allows the entrant to differentiate itself and attract with the data-based model users that are not as sensitive to their privacy.

The effect of competition on platforms' optimal business model also depends on the strength of the network effects. In particular, if the commercial value of data is very high or very low, competition has no effect on the incumbent's choice of business model. However, if

[2]True plans on making money by charging users for subscription. Mastodon relies on decentralization, Signal on donations, and DuckDuckGo on keywords, rather than targeted, advertising.

[3]See CPI, February 18, 2024. Available at: https://www.pymnts.com/cpi_posts/privacy-advocates-urge-european-regulators-to-oppose-metas-no-ads-subscription-model/

the commercial benefit of data is moderate, the effect varies with the strength of the network effects. When network effects are weak, competition incentivizes a monopolistic incumbent to move away from the hybrid model and promote privacy by choosing the subscription-based model. In this case, the entrant adopts the data-based model. While the overall choice of plans from the users' perspective remains unchanged, competition may still suppress data collection because the price of the subscription plan under competition is lower than under monopoly, resulting in more users choosing the subscription plan and thus a decreases in data commercialization.

When network effects are strong, competition incentivizes a monopolistic incumbent to shift from the subscription based model to the hybrid one. In this case, not only more data is commercialized compared to the monopolistic outcome, but the incumbent is also able to attract all users and monopolize the market. That is, competition does not necessarily promote a more privacy-sensitive market.

To study the welfare implications of prohibiting platforms from discriminating across users who share their data and those who do not, we compare equilibrium market structure when platforms are allowed to offer the hybrid business model to the structure when this model is banned. This latter case corresponds to the EU General Data Protection Regulation (GDPR) which prohibits such discrimination. We find that the effect of the ability to offer a hybrid business model on welfare largely depends on the strength of network effects. When network effects are strong, the first effect dominates, and the availability of the hybrid model enhances welfare because there is a social value in having all users on the same platform. Yet, when network effects are moderate, the hybrid model can reduce welfare. Finally, when network effects are weak, the hybrid model is not attractive for the platforms and in equilibrium, none of the platforms offers this model to users.

Our paper is mainly related to the literature on how competition shapes platforms' business models. Casadesus-Masanell and Hervas-Drane (2015) study a competitive market where firms compete in prices and qualities, which can be interpreted as privacy. They show that compared to a monopolistic firm, competition leads to a higher degree of privacy while increasing competition intensity does not necessarily imply that privacy is further improved. They also show that low privacy firms tend to subsidize consumers, while high privacy firms charge positive prices. Calvano and Polo (2020) study the business models of two competing platforms that connect between viewers and advertisers, such as a TV channel. They show that ex-ante identical platforms can strategically differentiate themselves by selecting different business models, such that each platform's revenues come from a different side of the market. In a closely related paper, Llanes and Madio (2024) consider a monopolistic AI platform that can adopt a subscription-based model in which it charges a price for its services,

a data-monetization business model in which it monetizes the AI's algorithm's quality, or a freemium model in which it offers both options. Users differ in their willingness to pay for the platform's services (with a fraction of users that are only willing to join the free service). In another closely related paper, Casner and Teh (forthcoming) consider platforms that can adopt a "pure discovery" business model, that generates per-viewer ad revenue for the platform, a "pure membership" model, where content creators charge users a fee from which the platform takes an ad-valorem transaction commission, or a hybrid model that combines the two. We contribute to this literature by explicitly modeling network effects between users and studying their effect on the equilibrium business model. Moreover, in our model the difference in business models is driven by users' heterogeneity in their disutility from privacy.

The economic literature on competing platforms (see Jullien et al., 2021, for a review of the literature) extends the work of Katz and Shapiro (1985) on competition with network effects, where the size of the network creates additional value to the customers. Jullien (2011), Hałaburda and Yehezkel (2013; 2016; 2019), and Markovich and Yehezkel (2022) consider platform competition and coordination in the context of a static game. Hagiu (2006) considers sequential competition on two sides of a market. Hałaburda et al. (2020) and Biglaiser and Crémer (2020) consider dynamic competition. Much of this literature focuses on the coordination problem and the role pricing plays in overcoming this problem by using a divide-and-conquer strategy where platforms compete in subsidizing one set of users in order to attract another set.

Our paper is also related to the literature on privacy and network externalities. Most of this existing literature focuses on the negative externalities associated with users sharing their data where one user's data can help platforms learn and predict the behavior of other users who do not share their data (Fairfield and Engel, 2015; Choi et al., 2019; Acemoglu et al., 2022; Bergemann, Bonatti, and Gan, 2022; Liang and Madsen, 2019). Following Markovich and Yehezkel (2024), our paper recognizes and focuses on the positive externalities—e.g., users that share data help the platform improve the quality of its product and offer higher value to other users. Fainmesser et al. (2022) study how a monopolistic platform's revenue model affects its data policy in terms of data collection and data protection. Considering the net value of network externalities (positive minus negative), they find that relative to the socially desired data strategy, the platform may over- or under-collect users' data and may over- or under-protect it. The authors then show that the inefficiency in data collection can be corrected with taxes or fines imposed on the firms. We add to this literature by focusing on competition and its effect on platforms' business models in terms of commercializing data or charging users for using the platform. O'Brien and Smith (2014) study a model where sellers can commit to privacy policies and consumers have heterogeneous – negative or

positive – preferences over privacy. They find that under perfect competition, firms make the socially optimal decision. Furthermore, a positive and sufficiently large correlation between consumers' valuations for the product and privacy is a necessary condition for the under-supply of privacy by firms. Assuming a two-stage game where data accumulated in the first period can be used to customize products in the second stage, Ke and Sudhir (2023) find that in a perfectly competitive market, whether privacy rights lower or increase profits depends on the expected privacy breach costs. Our paper considers imperfect competition between an incumbent and an entrant platforms. We show how the strategic effect of competition and the threat of entry shape the incumbent's and the entrant's business models. Similar to our paper, Hagiu and Wright (2023) study competition between an incumbent and an entrant platform that collect data on their users. The focus of their analysis, however, is on data-enabled learning across- and within-users and on how a platform's competitive advantage is affected by the shape of the learning function.

Our paper is also related to the growing empirical literature studying the impact of the GDPR. Utilizing data from an online travel intermediary, Aridor et al. (2023) find that the GDPR has resulted in an immediate drop in the total number of advertisements clicked and a corresponding immediate decline in revenue. The remaining set of consumers, however, are higher value consumers to the advertisers, compared with the pre-GDPR set of consumers. Focusing on market concentration, Johnson et al. (2023) find that GDPR increased market concentration among technology vendors where the relative market shares of the largest firms—particularly, Google and Facebook—increase post-GDPR. Using data on apps at the Google Play Store Janssen et al. (2022) show that GDPR induced the exit and reduced entry of new apps by half, resulting in an overall reduced consumer surplus. We add to this literature by analyzing the effect of banning firms from the ability to using a hybrid business model which price discriminates between users that share their data and those who do not share their data for commercialization.

2 The Model

Consider two competing platforms, an incumbent, I, and an entrant, E, and a mass 1 of users. Each platform can collect data from users and can utilize the data for two benefits. The first is enhancing services to other users. This is the network effect of data and we denote it by β. For example, platforms like Google, Netflix, and Spotify use other users' data to improve the quality of their search and suggestion algorithms. Secondly, the platform can "commercialize the user" by, for example, selling their personal data to advertisers or other platforms. Alternatively, the platform can commercialize users by commercializing

their time or attention, for example, with push advertisements. We refer to these options as the platform's "commercial benefit" and denote it by α. Users incur disutility when being commercialized , which we denote by k. User's k's utility from joining platform $i = I, E$ is:

$$U_{ki} = v + \beta n_i - C_i k - p_i, \tag{1}$$

where v is the base benefit from joining a platform,[4] n_i is the number of users that join platform i, $C_i = \{0, 1\}$ is the platform decision on whether not to commercialize the user's data ($C_i = 0$) or to commercialize ($C_i = 1$), in which case the user incurs a costs k. Finally, p_i is the platform's price. Suppose that users differ in their costs from being commercialized: some users are more sensitive to their privacy than others. Likewise, some users suffer higher disutility from observing ads than others. Hence, we assume that k is uniformly distributed on the interval $[0, 1]$. We focus on the interesting case where when the platform commercializes users' data, the market is not fully covered, and thus restrict the parameter space to: $v < 1$ and $0 < \beta < 1 - v < 1/2$. Moreover, this parameter space rules out corner solutions where users gain negative utility.

Each platform can choose between three business models: data-based that we denote by D, subscription-based that we denote by S and a hybrid model, denoted by H. In the data-based business model, $C_i = 1$: the use of the platform is free and its source of revenues is from collecting and commercializing users' data. In this case, the platform's profit is $\pi_i(D, B_j) = \alpha n_i(D, B_j)$, where $n_i(D, B_j)$ is the number of users that join it given that platform j adopts business model $B_j = D, S, H$; and recall that $\alpha > 0$ is the data's commercial benefit to the platform. Under the "subscription based" business model, the platform commits not to commercialize users' data ($C_i = 0$) and instead charges users for participation and earns $\pi_i(S, B_j) = p_i n_i(S, B_j)$. The third, hybrid business model is a combination of the two: the platform allows users to choose between a subscription plan in which it commits not to commercialize the user's data and a free plan where it makes no such commitment and hence commercializes users' data. The platform's profit is $\pi_i(H, B_j) = \alpha n_{iD}(H, B_j) + p_i n_{iS}(H, B_j)$, where $n_{iD}(H, B_j)$ and $n_{iS}(H, B_j)$ are the number of users that join the free and subscription plans, respectively.

The timing is as follows. In the first stage, the incumbent chooses its business model: $B_I = D, S, H$. In the second stage, the entrant chooses its business model $B_E = D, S, H$. Then, in the third stage, the two platforms compete on users. As is usually the case in platform competition with network effects, in the third stage of the game there can be multiple

[4]Our analysis focuses on the effect of platforms' choice of business model on competition. In order to isolate this effect, we assume that both platforms offer the same base benefit.

equilibria, because each user's decision depends on the beliefs regarding the decisions of other users. To this end, we assume that the incumbent has a "focal" position in that whenever possible, users expect other users to join the incumbent. We elaborate on these beliefs in Section 3.

3 Platform competition

We start with the case where the incumbent and the entrant are competing. We then, in the next section, consider the case where the incumbent is a monopoly. We assume that the incumbent chooses its business model first, $B_I = D, S, H$, followed by the entrant, $B_E = D, S, H$, and then the two platforms compete on consumers. We solve the game backwards, and start by solving for the entrant's response to each business model that the incumbent can adopt: starting with the hybrid model, and then the cases where the incumbent adopts the data-based and subscription-based models.

The incumbent adopts the hybrid model

Suppose that the incumbent adopts the hybrid model. The incumbent announces that users can either join for free, conditional on giving their consent to have their data commercialized, or pay a price, p_I, and have their data protected.

We show that in equilibrium, the incumbent dominates the market. The entrant's optimal response is to adopt the subscription-based model and offer it for free. Doing so provides users with the highest alternative utility relative to the utility from joining the incumbent. As the incumbent benefits from a focal position, users expect that all other users join the incumbent, and users' utility from joining the entrant is $0 \times \beta + v - p_E = v$.

Turning to the incumbent, given the price of the subscription plan, p_I, users who join the incumbent choose the subscription plan if $\beta + v - p_I \geq \beta + v - k$, or $k \geq p_I$. Given p_I, users with $k \in [0, p_I]$, i.e., data-insensitive users, join the free plan and the incumbent commercializes their data and earns αp_I. Data-sensitive user with $k \in [p_I, 1]$ join the subscription plan, pay p_I, and the incumbent earns from these users $(1 - p_I)p_I$. Hence, the incumbent's maximization problem is to choose p_I that maximizes:

$$\max_{p_I} \pi_I(p_I|(H,S)) = \alpha p_I + (1 - p_I)p_I, \tag{2}$$

$$\text{s.t.} \quad \beta + v - p_I \geq v \text{ and } p_I \leq 1.$$

The first constraint requires that the user who is indifferent between joining the incumbent's

data-based plan and the subscription-based plan prefers these options over joining the entrant's subscription plan for free. The second constraint requires that there is an internal solution to the indifferent user. The unconstraint solution is $p_I = (1+\alpha)/2$. Notice that users who join the subscription plan gain the utility $\beta + v - p_I = \beta + v - (1+\alpha)/2 < v$, where the inequality follows because $\beta < \frac{1}{2}$. Hence, the maximization problem has a corner solution in which the binding constraint is: $\beta + v - p_I > v$, or $p_I = \beta$. The incumbent earns from the hybrid model:

$$\pi_I(H,S) = (1+\alpha-\beta)\beta,$$

and the entrant earns $\pi_E(H,S) = 0$. The following lemma summarizes the result. All proofs are in the appendix.

Lemma 1. *If the incumbent adopts the hybrid business-model, and the entrant can choose between $B_E = \{D, S, H\}$, then the incumbent dominates the market, charges $p_I = \beta$ and earns $\pi_I(H,S) = (1+\alpha-\beta)\beta$. The incumbent serves all users and commercializes the data of users with $k < \beta$.*

Figure 1 illustrates the incumbent's benefit and cost of adopting the hybrid model. Intuitively, the benefit is that the incumbent dominates the entire market. Therefore, all users enjoy the network effect of all other users. This enables the incumbent to collect the network effects that users that adopt the subscription plan gain not just from other users that adopt the subscription plan, but also from users that adopt the data plan as these users join the same platform. The cost of the hybrid model is that the two platforms compete on the entire market. This results in fierce competition which reduces the incumbent's profit.

The incumbent adopts the data-based model

Suppose that the incumbent chooses the data-based business model. We solve for the market outcome given each of the entrant's potential business model choices.

Suppose first that the entrant adopts the subscription-based model. Then, there is no equilibrium in which the incumbent dominates the market, which makes focality irrelevant in this business model configuration. If such an equilibrium were to exist, $p_E = 0$ and all users join the incumbent. Yet, even when all users join the incumbent, the utility of the most data-sensitive user with $k = 1$ from joining the incumbent is $1 \times \beta + v - 1$, which is lower than the utility v that the user can gain by joining the entrant, because of our assumption that $\beta < 1 - v$. We, therefore, solve for an equilibrium in which the entrant gains a positive market share. Intuitively, adopting different business models creates differentiation, which enables the entrant to gain positive market share despite the incumbent's focality advantage.

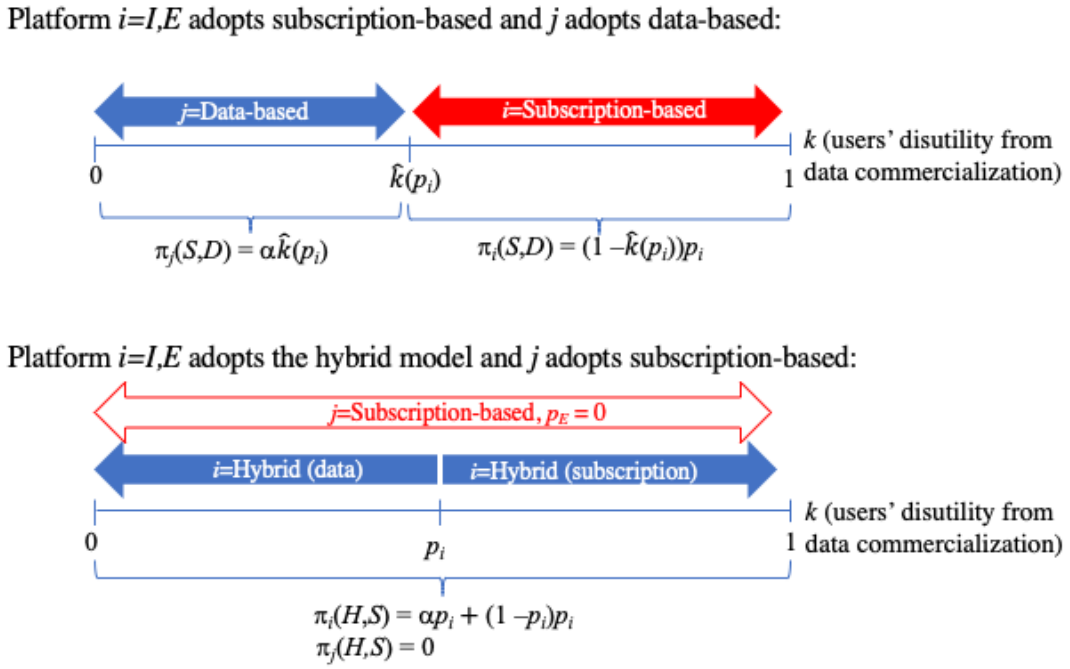

Figure 1: Market share and profits in the various business models configurations under competition

In equilibrium, given that n_E users join the entrant and $n_I = 1 - n_E$ users join the incumbent, there is a user, $\widehat{k}$, who is indifferent between joining the incumbent or the entrant. This user solves:

$$\beta(1 - n_E) + v - \widehat{k} = \beta n_E + v - p_E.$$

When there is an internal solution to $\widehat{k}$ (i.e., $0 < \widehat{k} < 1$), users with $k \in [0, \widehat{k}]$ join the incumbent because they are not sensitive to their privacy and therefore prefer a free service, even if the platform commercializes their data. In contrast, data-sensitive users with $k \in [\widehat{k}, 1]$ prefer the platform that charges a membership fee in order to protect their privacy. Hence, the demand function facing the entrant that solves $n_E = 1 - \widehat{k}$ is:

$$n_E(p_E) = \frac{1 - \beta - p_E}{1 - 2\beta}. \tag{3}$$

Because $\beta < 1/2$, the denominator in (3) is positive. Yet, notice that β has two conflicting effects on the demand facing the entrant. To see how, the inverse demand function of (3) is $p_E(n_E) = 1-\beta-(1-2\beta)n_E$, which rotates counterclockwise around $n_E = 1/2$ as β increases, such that the demand increases with β if $n_E > 1/2$ and decreases with β otherwise. The intuition for this feature of the demand function is that when $n_E > 1/2$, the entrant, who does not commercialize users' data, serves more users than the incumbent and thus also collects more data. Hence, as network effects become stronger, the entrant's demand increases. The

opposite case occurs when $n_E < 1/2$.

The entrant sets p_E to maximize $\pi_E(p_E) = p_E n_E(p_E)$:

$$p_E(D,S) = \begin{cases} \frac{1-\beta}{2}, & \text{if } \beta \leq \frac{1}{3}, \\ \beta, & \text{if } \beta > \frac{1}{3}, \end{cases} \qquad n_E(D,S) = \begin{cases} \frac{1-\beta}{2(1-2\beta)}, & \text{if } \beta \leq \frac{1}{3}, \\ 1, & \text{if } \beta > \frac{1}{3}. \end{cases} \tag{4}$$

As a technical note, recall that the constraint $\beta < 1 - v$ implies that the second row in $p_E(D,S)$ and $n_E(D,S)$ are relevant only when $v < \frac{2}{3}$.

The entrant's price decreases in β while the entrant's market share increases in it.[5] Intuitively, at $\beta = 0$, the two platforms equally share the market. As β increases, the entrant's price decreases while its market share increases, because the entrant can better exploit the increase in network effects for enhancing its demand. Moreover, because the entrant does not commercialize users' data, the entrant can fully dominate the market if β is sufficiently high. The profits of the two platforms in the $(B_I, B_E) = (D, S)$ business model configuration are $\pi_E(D,S) = p_E n_E(p_E)$ and $\pi_I(D,S) = \alpha(1 - n_E(p_E))$, or:

$$\pi_E(D,S) = \begin{cases} \frac{(1-\beta)^2}{4(1-2\beta)}, & \text{if } \beta \leq \frac{1}{3}, \\ \beta, & \text{if } \beta > \frac{1}{3}, \end{cases} \qquad \pi_I(D,S) = \begin{cases} \frac{\alpha(1-3\beta)}{2(1-2\beta)}, & \text{if } \beta \leq \frac{1}{3}, \\ 0, & \text{if } \beta > \frac{1}{3}. \end{cases} \tag{5}$$

The following lemma summarizes the features of the (D, S) market configuration.

Lemma 2. *Suppose that the incumbent adopts a data-based business model and the entrant adopts a subscription-based one. Then, the entrant's price decreases with network effects, yet its market share increase with it. Moreover, if network effects are sufficiently strong, the entrant dominates the market.*

Suppose now that the entrant responds by adopting the data-based model. In the case where both choose the data-based model $(B_I, B_E) = (D, D)$, there are two equilibria: all users join the incumbent and all join the entrant. To solve the problem of multiple equilibria, we follow the literature on platform competition (Caillaud and Jullien (2001; 2003), Hałaburda and Yehezkel, 2016) and assume that the incumbent is "focal". Specifically, when there are two equilibria, one in which the incumbent dominates the market and the second in which the entrant dominates the market, users expect all other users to join the incumbent. Notice that focality permits an equilibrium with two active platforms or an equilibrium in which the entrant dominates the market, whenever there is no equilibrium in which the incumbent dominates the market. Focality grants the incumbent a competitive advantage

[5] We verified that the utility of the indifferent user is always positive because $v > 1/2$, hence all users gain positive utility from joining a platform.

that enables the incumbent to dominate the market whenever possible. This competitive advantage becomes stronger as network effects, β, increase because the benefit of users' expectations that other users will join the incumbent grows significantly.

The case of (D, D) is qualitatively similar to the case of (S, S): because the incumbent is focal, the incumbent dominates the market and the entrant earns 0. For brevity, we analyze this case in the appendix and state here the following result:

Lemma 3. *Suppose that both platforms adopt the data-based business model. Then, the incumbent dominates the market, serves* $n_I = \frac{v}{1-\beta}$ *users and earns* $\pi_I(D, D) = \frac{\alpha v}{1-\beta}$ *while the entrant earns* $\pi_E(D, D) = 0$.

Finally, if the entrant chooses $B_E = H$, the entrant charges a price p_E from users that join the subscription plan, while offering a data plan for free. The analysis of this case is qualitatively similar to the analysis in the previous subsection. For brevity, we relegate it to the proof of lemma 4:

Lemma 4. *Suppose that the incumbent adopts the data-based model* ($B_I = D$)*, and the entrant can choose between* $B_E = \{D, S, H\}$*. Then, there is a threshold,*

$$\overline{\alpha} = \begin{cases} \frac{1-\beta}{\sqrt{1-2\beta}} - 1, & \text{if } \beta < \frac{1}{3}, \\ 2\sqrt{\beta} - 1, & \text{if } \beta > \frac{1}{3}, \end{cases}$$

such that:

(*i*) *For* $0 < \alpha < \overline{\alpha}$*, the entrant adopts the subscription-based model,* $B_E = S$.

(*ii*) *For* $\overline{\alpha} < \alpha$*, the entrant adopts the hybrid model,* $B_E = H$*, and dominates the market.*

Intuitively, the entrant never responds to the incumbent's data-base model by adopting the data-base model because then it loses the market. If data has low commercial value (α is small), then the entrant prefers the subscription based model which does not rely on commercializing user' data. Otherwise, the entrant can use the hybrid model to attract users with high disutility from data commercialization with the subscription plan, and use the network effect they generate to attract the less data-sensitive users with a free plan. This way, the entrant can dominate the market.

Figure 1 illustrates also the incumbent's benefit and cost of adopting the data-based model. From the incumbent's perspective, if the entrant responds by adopting the subscription-based model, the incumbent can share the market with the entrant and compete with the

entrant only on the marginal user (the user who is indifferent between the entrant's subscription plan and the incumbent's data plan); thereby avoiding fierce competition on the entire market. Yet, adopting the data-based model has an important weakness from the incumbent's viewpoint. The entrant adopts the subscription based model only when data has low commercial benefit, in which case the incumbent's profits from the data-based model are low. When the incumbent's potential revenues from the data-based model are high (i.e., when data has a high commercial benefit), the entrant adopts the hybrid model and monopolizes the market. In other words, choosing the data-based model is either not very profitable (when the commercial benefit is small), or exposes the incumbent to the threat of losing the entire market when the commercial benefit is high).

The incumbent adopts the subscription-based model

Suppose now that the incumbent adopts the subscription-based model. As in the case of (D, D), if the entrant also adopts the subscription-based model, the incumbent wins the market due to its focal position and $\pi_I(S, S) = p_I \times 1 = \beta$ and $\pi_E(S, S) = 0$. This logic follows to the case where the entrant adopts the hybrid model. Even if the entrant charges $p_E = 0$ and the incumbent charges $p_I = \beta$, there is an equilibrium in which all users join the incumbent and do not share data, because $\beta \times 1 + v - p_I \geq \beta \times 0 + v - p_E$. Finally, the (S, D) business-model configuration is symmetric to the (D, S) configuration discussed above: $\pi_E(S, D) = \pi_I(D, S)$ and $\pi_I(S, D) = \pi_E(D, S)$. The following lemma summarizes the results:

Lemma 5. *Suppose that the incumbent adopts the subscription-based model ($B_I = S$), and the entrant can choose between $B_E = \{D, S, H\}$. Then, the entrant adopts the data-based model and the platforms' profits are symmetric to the profits in Equation (5) ($\pi_E(S, D) = \pi_I(D, S)$ and $\pi_I(S, D) = \pi_E(D, S)$).*

Similar to the intuition discussed above, adopting the subscription-based model enables the incumbent to soften competition with the entrant, as the two platforms only compete on the marginal user. The subscription model is also beneficial because its profitability does not depend on the size of the commercial benefit, and can therefore be profitable when the commercial benefit is small. Yet, compared with the hybrid model, when adopting the subscription-based model, the incumbent does not cover the entire market, and users that join the incumbent do not benefit from the network effects of users that join the entrant. In this case, the incumbent cannot collect these network effects, which negatively affects its profits.

Equilibrium business model

We can now turn to solving the equilibrium business models when both platforms can adopt $B_i \in \{D, S, H\}$. We start with the case in which $\beta < \frac{1}{3}$. The following proposition identifies the optimal business model for the incumbent to adopt:

Proposition 1. ***(Optimal business model)*** *Suppose that $\beta < \frac{1}{3}$ and that both platforms can adopt $B_i \in \{D, S, H\}$. Then, the incumbent adopts the hybrid model when network effects and the commercial benefit of data are high, and the subscription-based model otherwise. That is, there is a threshold, $\alpha^C_{H,S}$, where*

$$\alpha^C_{H,S} = \frac{(1-\beta)(1-5\beta+8\beta^2)}{4\beta(1-2\beta)}, \tag{6}$$

such that when $\alpha > \alpha^C_{H,S}$, the incumbent adopts the hybrid model and dominates the market. When $\alpha < \alpha^C_{H,S}$, the incumbent adopts the subscription-model while the entrant adopts the data-based model and the two platforms share the market. Moreover, $\alpha^C_{H,S}$ is decreasing in β.

Intuitively, recall from Figure 1, the hybrid model allows the incumbent to monopolize the market. Yet, this comes at the cost of intense competition, because the two platforms compete on the entire market. By adopting the subscription-based model, the incumbent shares the market with the entrant, which in turn results in less intense competition as the two platforms compete only on the marginal user. Additionally, by offering a subscription plan, the hybrid model enables the incumbent to collect the commercial benefit while simultaneously being attractive to users with high disutility from being commercialized.

We therefore have that the hybrid model is more profitable for the incumbent when the commercial benefit is high, as this increases the revenues from the data plan. Moreover, Proposition 1 shows that network effects play a crucial role in the incumbent's decision: $\alpha^C_{H,S}$ is decreasing with β. This implies that given a level of commercial benefit, the incumbent adopts the hybrid model when network effects are strong and the subscription-based model when network effects are weak. The intuition for this result is that when network effects are strong, the incumbent, being the focal platform, does not fear fierce competition. Moreover, the benefit of having all users on the same platform is the higher, the stronger the network effects. Hence, the incumbent adopts the hybrid model and dominates the market. Likewise, when network effects are weak, the incumbent prefers to avoid competition and goes for "live and let live" by adopting the subscription-based model and allowing the entrant to enjoy a positive market share.

Notice that the incumbent never adopts the data-based model. As we show below, this happens because the hybrid model is available and is more profitable than focusing only on

users with low disutility from being commercialized. The intuition for this result is that, as Lemma 4 indicates, when the commercial benefit is high, such that it is a-priori profitable for the incumbent to adopt the data-based model, the entrant can respond by adopting the hybrid model and subsequently dominate the market. That is, the data-based model makes the incumbent vulnerable to entry and market dominance by the entrant. This deters the incumbent from adopting the data-based model in the first place.

Next, consider the case where $\frac{1}{3} < \beta < 1 - v$. If the incumbent adopts the data-based model, then the incumbent loses the market if the entrant adopts either the subscription-based or the hybrid models. Hence, it is never optimal for the incumbent to adopt the data-based model. Again, we are left with the options of adopting the hybrid or the subscription-based model. The incumbent prefers the first option if:

$$\pi_I(H, S) = (1 + \alpha - \beta)\beta > \beta = \pi_I(S, D) \quad \Longleftrightarrow \quad \alpha > \beta.$$

That is, as in the case of $\beta < \frac{1}{3}$, the incumbent adopts the hybrid model if the data's commercial benefit is high.

We conclude this section by highlighting that our model emphasizes the critical role of network effects in determining the optimal business model for platforms. This is especially relevant given nowadays platforms' tendency to take advantage of user data to improve and better tailor their services to their users. We further discuss the managerial implications of this point in Section 6.

4 The effect of competition

In order to study how competition affects the platforms' choice of business model, in this section we first analyze the incumbent's choice of business model when it is a monopolist. We then compare the monopolistic case to the competitive case discussed above.

We start by solving for the monopolist's profit from adopting the hybrid model. The incumbent's monopolistic maximization problem is similar to the maximization problem under competition, as described in equation (2), with the exception that now the users' alternative utility is 0 instead of v. We therefore have:

Lemma 6. *Suppose that the incumbent is a monopoly that adopts the hybrid model. Then, the incumbent charges and earns*

$$p_I(H) = \begin{cases} \frac{1+\alpha}{2}, & \text{if } \alpha < 2(\beta + v) - 1, \\ \beta + v, & \text{if } \alpha > 2(\beta + v) - 1, \end{cases} \tag{7}$$

$$\pi_I(H) = \begin{cases} \frac{(1+\alpha)^2}{4}, & \text{if } \alpha < 2(\beta+v)-1, \\ (1+\alpha-\beta-v)(\beta+v), & \text{if } \alpha > 2(\beta+v)-1. \end{cases} \tag{8}$$

The intuition behind this result is as follows. When α is small, p_I is increasing with α because the incumbent takes advantage of the high commercial value of data and sways users to choose the data-plan over the subscription-plan by charging a higher price for the subscription plan. Once α reaches $2(\beta+v)-1$, the utility that users that join the subscription-plan receive reaches 0. In this case, the incumbent extracts all of the utility users that join the subscription-plan enjoy $(\beta+v)$, and the incumbent cannot keep increasing the price (as a function of α). Notice that, as expected, an incumbent that adopts the hybrid model charges a higher price under monopoly than under competition.[6]

Next, we turn to the incumbent's profit under the two other business model: D, S. If the incumbent chooses the data-based business model, it announces its intention to commercialize users' data. Users will join the incumbent as long as:

$$v + \beta n_I - k \geq 0 \quad \Longleftrightarrow \quad n_I(D) = \frac{v}{1-\beta}. \tag{9}$$

Because by assumption $v < 1-\beta$, not all users join the platform: data-sensitive users prefer to stay out. Yet, as network effects increase, more users join the platform in order to enjoy the network effects generated by other users. The incumbent earns $\pi_I(D) = \frac{\alpha v}{1-\beta}$. If the incumbent adopts the subscription-base business model, because the incumbent benefits from a focal position and users expect other users to join it, the incumbent can attract all users if $p_I \leq v + \beta$. Hence, the incumbent charges $p_I(S) = v + \beta$ and earns $\pi_I(S) = v + \beta$. Comparing all three models we have:

Proposition 2. ***(Monopolist optimal business model)*** *Suppose that the incumbent is a monopolist that can adopt $B_I = \{S, D, H\}$. Then, the incumbent adopts the hybrid model if $\alpha > \alpha^M_{H,S} = \beta + v > 2(\beta+v) - 1$ and adopts the subscription-based model otherwise. Moreover, $\alpha^M_{H,S}$ is increasing in β.*

Similar to the competitive case, under monopoly the hybrid model is always more profitable than the data-based model. Moreover, the hybrid model is profitable when the commercial value is high. Yet, in contrast to the competitive case, under monopoly, the threshold $\alpha^M_{H,S}$ is increasing with network effects, rather than decreasing with it. As Figure 2 shows, under monopoly, the incumbent does not need to share the market and can set the subscription price such that it monopolizes the market and can therefore collect the network effects of all users. In contrast, under the hybrid model, the incumbent can collect the network effects

[6] To see why, we have that $\frac{1+\alpha}{2} > \beta$ whenever $0 < \alpha < 2(\beta+v)-1$ and $\beta+v > \beta$ whenever $\alpha > 2(\beta+v)-1$

only from users that adopt the subscription plan. Therefore, under monopoly, as network effects increase the incumbent has stronger incentives to switch from the hybrid model to the subscription-based one.

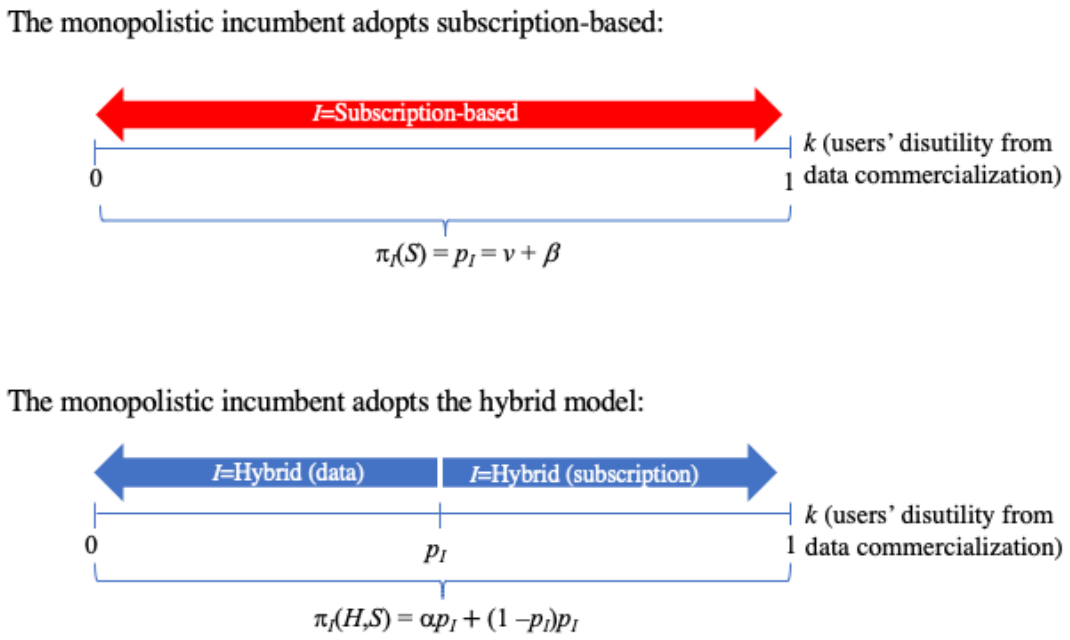

Figure 2: Market share and profits in the various business models configurations under monopoly

This result has an important implication to the comparison between the incumbent's choice of business model under monopoly and under competition. Figure 3 illustrates the two thresholds, $\alpha^M_{H,S}$ and $\alpha^C_{H,S}$ as a function of β, where recall that $\alpha^C_{H,S}$ is equal to (6) when $\beta < \frac{1}{3}$ and equals to β when $\beta > \frac{1}{3}$. The figure shows that for low and high values of α, competition does not change the incumbent's behavior. Specifically, if $\alpha < \min\left\{\alpha^M_{H,S}, \alpha^C_{H,S}\right\}$, the incumbent keeps adopting the subscription-based model. Intuitively, for low commercial value of data, it is optimal to avoid commercializing the users data and instead charge users for the value generated by the platform. For the opposite reason, the incumbent adopts the hybrid model under both monopoly and competition when α is very high, such that $\alpha > \max\left\{\alpha^M_{H,S}, \alpha^C_{H,S}\right\}$.

Yet, competition affects the incumbent's business model for intermediate values of α, when β is either high or low. For low values of β and intermediate values of α, such that $\alpha^M_{H,S} < \alpha < \alpha^C_{H,S}$, competition prompts the incumbent to switch from the hybrid model to the subscription-based model. Here, the hybrid model becomes less profitable for the incumbent, who must compete with the entrant on all users. With small β, the incumbent lacks a strong focal position. This combined with the aggressive competition with the entrant on the entire

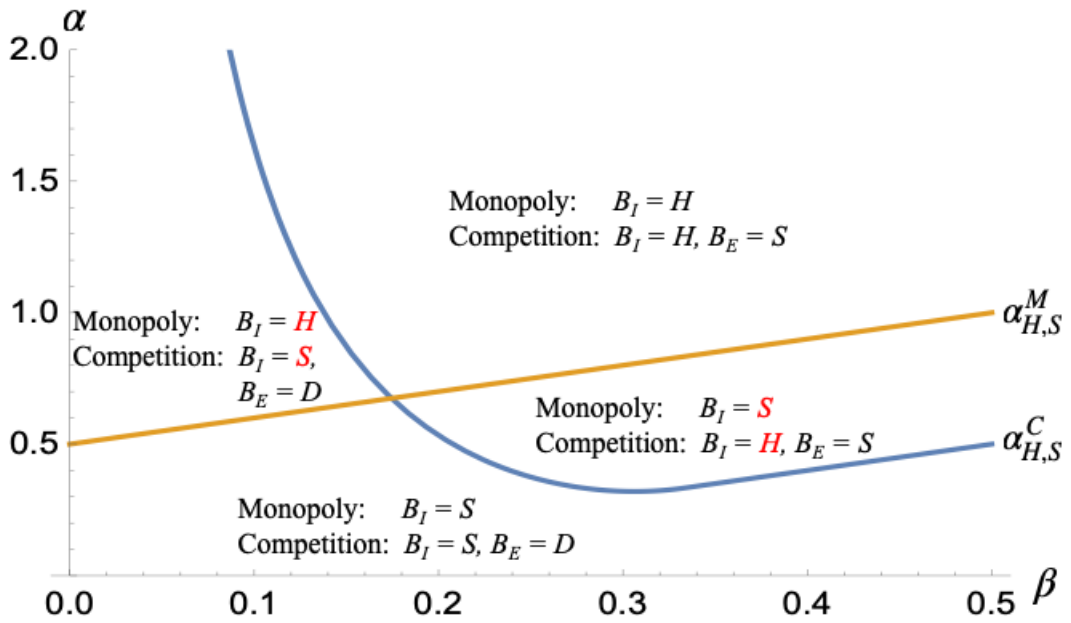

Figure 3: $\alpha^M_{H,S}$ and $\alpha^C_{H,S}$ as a function of β and the equilibrium business models (for $v = \frac{1}{2}$)

market prompts the incumbent to switch from the hybrid model to the less competitive subscription-based model. As a result, the entrant gains a positive market share, and the two platforms compete only for the marginal user. Essentially, with weak network effects, the incentive to avoid competition is strong, driving the incumbent's shift from the hybrid to the subscription-based model.

Conversely, for high β values and intermediate α values, such that $\alpha^C_{H,S} < \alpha < \alpha^M_{H,S}$, competition encourages the incumbent to switch from the subscription-based model to the hybrid model. Here, under monopoly, the incumbent wants to leverage the high β to sell to all users and collect their high network effects. Doing so under competition, enables the entrant to adopt the data-based model and steal the data-insensitive users from the incumbent. Anticipating this, the incumbent adopts the hybrid model and monopolizes the market. The strong network effects enhance the incumbent's focality advantage, thereby mitigating the competitive impact of the hybrid model.

Netflix's introduction of an ad-supported plan alongside its subscription model nicely illustrates the shift to a hybrid business approach in response to increasing competition. Netflix's value proposition heavily depends on leveraging user data, such as viewing habits, to enhance recommendations and even inform content development. In a more competitive landscape with strong network effects, Netflix's transition to a hybrid model is consistent with our predictions.

The following Corollary summarizes these results:

Corollary 1. *Consider the change of a monopolistic incumbent's choice of a business model*

when faced with the threat of competition:

(*i*) *when the commercial benefit is high,* $\alpha > \max\left\{\alpha_{H,S}^{M}, \alpha_{H,S}^{C}\right\}$ *(low,* $\alpha < \min\left\{\alpha_{H,S}^{M}, \alpha_{H,S}^{C}\right\}$*), the incumbent adopts the hybrid (subscription-based) model under both monopoly and competition;*

(ii) *when the commercial benefit is intermediate and network effects are weak, such that* $\alpha_{H,S}^{M} < \alpha < \alpha_{H,S}^{C}$*, competition motivates the incumbent to shift from the hybrid model to the subscription-based model;*

(iii) *when the commercial benefit is intermediate and network effects are strong, such that* $\alpha_{H,S}^{C} < \alpha < \alpha_{H,S}^{M}$*, competition motivates the incumbent to shift from the subscription-based model to the hybrid model.*

Does competition suppress data collection?

In June 2024, a background note by the OECD noted that "...it could be argued that insufficient competition would hinder individual data privacy rights or principles..." The view that competition may provide platforms strong incentives to reduce data commercialization is shared by many. The analysis above can help us shed light on this question. As we show below, we find that competition suppresses data commercialization only when the commercial benefit of data is high.

As Figure 4 shows, when $\alpha < \alpha_{H,S}^{M}$, competition introduces a data-based model that was not offered under monopoly, as a monopolist prefers the subscription model in these conditions. Thus, competition in this parameter space increases data commercialization, which was non-existent under monopoly. Only when $\alpha > \alpha_{H,S}^{M}$, competition suppresses data commercialization. In particular, when network effects are strong, the monopolist remains with the hybrid model that it also offers under monopoly. Still, because the entrant enters with a free subscription plan, the incumbent's subscription fee under competition is lower than under a monopoly.[7] This in turn, increases the number of users that prefer the subscription plan over the data-plan and thereby reduces the overall amount of data commercialized. A similar argument holds when network effects are weak and α is high. In this case, under competition, the incumbent switches from choosing the hybrid model as a monopolist to the subscription model and the entrant enters with the data plan. That is, in general, users have the same choice in terms of plans offered. However, under competition the two plans are offered by two competing platforms, rather than by one platform that allows users to choose their plan. Moreover, competition drives the subscription fee down so prices of the

[7]See Footnote 6.

subscription plan are lower than in the case of a monopolist offering the hybrid model. Thus, again, more users choose the subscription plan over the data plan and less data is commercialized. To see why, notice that under monopoly, the incumbent collects data from $p_I = v + \beta$ users (it is possible to show that $\alpha^M_{H,S} > 2(\beta + v) - 1$). Under competition, we have from (4) that the entrant collects data from $n_E(S, D) = 1 - \frac{1-\beta}{2(1-2\beta)} = \frac{1-3\beta}{2(1-2\beta)}$ users. Yet, $v + \beta > \frac{1-3\beta}{2(1-2\beta)}$, implying that the incumbent collects more data under monopoly than the amount of data that the entrant collects under competition. The analysis above suggests that subscription prices are potentially a useful lever to encourage platforms to adopt more privacy-focused business models.

The following Corollary summarizes these results:

Corollary 2. *Competition suppresses data commercialization if and only if* $\alpha > \alpha^M_{H,S}$.

5 Should the hybrid model be banned?

The competitive effect of the hybrid model has been recently a topic of a strong debate in the European Union (EU). Specifically, in response to regulatory changes in the EU, in November 2023 Meta introduced a paid option for its EU users of Facebook and Instagram where users can choose between (i) paying a monthly fee for an ad-free version of these social networks; or (ii) enjoy a free-of-charge access to a version of these social networks with personalized ads. On July 1, 2024, the European Commission informed Meta that its hybrid business model of "pay or consent" fails to comply with the Digital Markets Act (DMA). Below, we analyze the competitive effect of the availability of the hybrid model. In particular, we analyze the platforms' choice of business model assuming that both platforms can only choose between the data-based and subscription-based business models. In this case, there are 4 market configurations: $(B_I, B_E) = \{(D, S), (D, D), (S, S), (S, D)\}$, all of which have been discussed above. We can, therefore, directly discuss the equilibrium business models.

Consider first the case where $\beta < \frac{1}{3}$ (or, when $v > \frac{2}{3}$, consider the case where $\beta < 1 - v$). Because the entrant loses the market if it chooses the same business model as the incumbent, the entrant always chooses the opposite business model than the incumbent. Taking that into account, the incumbent adopts the data-based business model if and only if:

$$\pi_I(D, S) > \pi_I(S, D) \quad \Longleftrightarrow \quad \alpha > \alpha^C_{D,S} = \frac{(1-\beta)^2}{2(1-3\beta)}. \tag{10}$$

Corollary 3. *If S and D are the only available business models, there is a cutoff $\alpha^C_{D,S} = \frac{(1-\beta)^2}{2(1-3\beta)}$ such that the incumbent chooses the data-based business model ($\pi_I(D) > \pi_I(S)$) iff*

$\alpha > \alpha^C_{D,S}$, *and chooses the subscription-based model otherwise.*

To see how a ban on the hybrid model affects the equilibrium business models, Figure 4 illustrates the threshold values $\alpha^C_{H,S}$ and $\alpha^C_{D,S}$ as a function of β.[8]

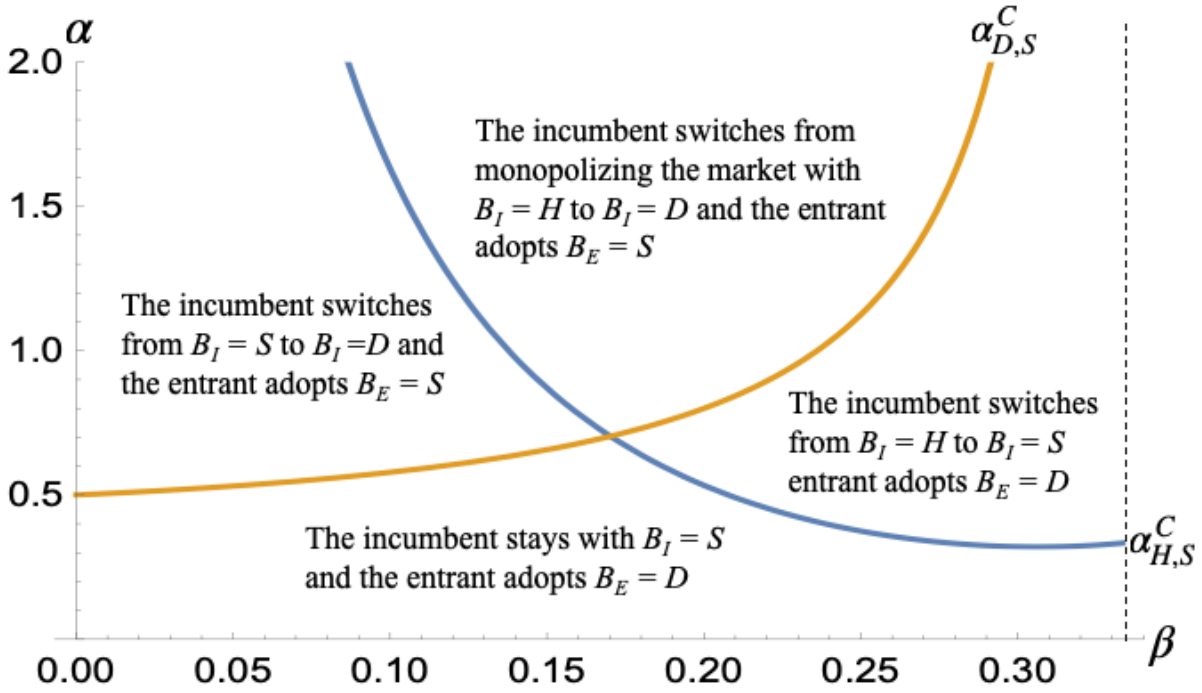

Figure 4: $\alpha^C_{D,S}$ and $\alpha^C_{H,S}$ as a function of β and the equilibrium business models

As the figure shows, there are 4 regions of interest. A ban on the hybrid model has no effect on the incumbent's behavior when α is small. Specifically, when $\alpha < \min\left\{\alpha^C_{H,S}, \alpha^C_{D,S}\right\}$, the incumbent adopts the subscription-based model for all βs, regardless of whether the hybrid model is permitted or not. Here, the data's commercial benefit is low, so it is unprofitable for the incumbent to adopt any business model that relies on data commercialization.

When α is high, such that $\alpha > \max\left\{\alpha^C_{H,S}, \alpha^C_{D,S}\right\}$, the incumbent adopts the data-based model if the hybrid model is banned. Here, if available, the incumbent would rather choose the hybrid model which is preferable to both the data-based model and the subscription-based model because it enables the incumbent to both commercialize the users data and monopolize the market by allowing data-sensitive users to choose the subscription plan.

When α is intermediate and β is high, such that $\alpha^C_{H,S} < \alpha < \alpha^C_{D,S}$, the incumbent switches from the hybrid model to the subscription-based model. Again, the hybrid model is preferable to both the subscription-based model and the data-based model because it enables the incumbent to "benefit from both worlds" and dominate the market.

A less intuitive region is when α is intermediate and β is low such that $\alpha^C_{D,S} < \alpha < \alpha^C_{H,S}$.

[8]Note that both cutoffs are only a function of β.

Here, when platforms do not have the ability to adopt the hybrid model, the incumbent chooses the data-based model. Yet, counterintuitively, when platforms can adopt the hybrid model, the incumbent's strategy changes not to the hybrid model, but rather to the subscription-based model. The intuition for this result is that in this region the incumbent would have preferred to stick to the data-based model. Yet, if the incumbent does so, the entrant would respond by adopting the hybrid model and would monopolize the market. Given that the data-based model is no longer profitable for the incumbent, it switches to the subscription-based model. That is, here, it is the threat of competition combined with the availability of the hybrid model that incentivize the incumbent to choose a privacy focused business model.

Does the hybrid model suppress data commercialization?

The hybrid model is controversial from a policy viewpoint because it arguably discriminates between users who are willing to share their data and users who refuse to share their data. Below, we comment on the implications of the hybrid model for social welfare. The main conclusion of the analysis is that when network effects are strong, allowing platforms to adopt the hybrid model can be in fact welfare enhancing.

We start by asking whether banning the hybrid model under platform competition leads to a reduction in data commercialization. As Figure 4 shows, if $\alpha < \alpha^C_{H,S}$, the availability of the hybrid model has no effect on the amount of data commercialized either because it does not affect the incumbent's behavior ($\alpha < \min\left\{\alpha^C_{H,S}, \alpha^C_{D,S}\right\}$), or because the platforms swap their business models (the incumbent shifts from S to D, and the entrant from D to S). In the latter, because of symmetry, there is no change in prices and thus in the amount of data commercialized.

For intermediate and high levels of α and β, $\alpha > \alpha^C_{H,S}$, banning the hybrid business model shifts the market structure from one where the incumbent dominates the market with a hybrid model to a structure where one platform adopts the data-based model and the other opts for the subscription-based model.

In the former case, the incumbent charges $p_I = \beta$ and hence β users join the incumbent's data plan. In the latter case, we have from equation (4) that the platform that adopts the data-based model collects data from $n_i(S, D) = 1 - \frac{1-\beta}{2(1-2\beta)} = \frac{1-3\beta}{2(1-2\beta)}$ users. Hence, we have that, when $\beta > \frac{1-3\beta}{2(1-2\beta)}$, or $\beta > 1/4$, the hybrid model results in more data commercialized, relative to the (S, D) market configuration. The following corollary summarizes this result:

Corollary 4. *Under platform competition, banning the hybrid model has no effect on data commercialization when $\alpha < \alpha^C_{H,S}$. Otherwise, banning the hybrid model decreases data*

commercialization if $\beta > 1/4$ and increases data commercialization otherwise.

The intuition for the second part of Corollary 4 is that if network effects are strong, the incumbent adopts the hybrid model and charges a high price for the subscription plan, as all users join its platform. This drives more users to adopt the data plan, resulting in more data commercialized than under the (S, D) market configuration.

Is the hybrid model welfare enhancing?

Finally, we ask whether social welfare is higher when platforms can adopt the hybrid model, in comparison with the case in which competition authorities forbid platforms from discriminating users based on whether they are willing to have their data commercialized. Note that we focus our comparison on the case in which there is competition and when $\beta < 1/3$, such that when platforms adopt different business models, both platforms are active in the market.

When platforms can adopt the hybrid model, in equilibrium, the incumbent platform adopts the hybrid model when $\alpha > \alpha^C_{H,S}$. Social welfare in this case is:

$$W_{H,S} = \int_0^{\beta} (v + \beta + \alpha - k)dk + \int_{\beta}^{1} (v + \beta)dk. \tag{11}$$

Otherwise, one of the platforms adopts the data-based business model while the other adopts the subscription based model (the identity of the platform that chooses each business model is irrelevant for welfare). Hence, the hybrid model is relevant for welfare when $\alpha > \alpha^C_{H,S}$. Social welfare in this case is:

$$W_{D,S} = \int_0^{\widehat{k}} (v + \beta\widehat{k} + \alpha - k)dk + \int_{\widehat{k}}^{1} (v + \beta(1 - \widehat{k}))dk, \tag{12}$$

where recall that $\widehat{k} = 1 - n_E(D, S) = \frac{1-3\beta}{2(1-2\beta)}$.

To compare $W_{H,S}$ with $W_{D,S}$, notice that the comparison is unaffected by v because the market is covered in both cases. Given that the comparison is affected only by α and β, Figure 5 illustrates the regions in which the hybrid model is welfare enhancing or reducing, given α and β.

The figure shows that when the hybrid model is relevant (i.e., when $\alpha > \alpha^C_{H,S}$), there is a threshold, α^C_W, such that the hybrid model is welfare enhancing when β is high, and welfare reducing otherwise. The intuition for this result is that, although users can opt out of data commercialization under both market configurations, the hybrid model leads to all users joining the same platform, thereby enhancing their network effect.

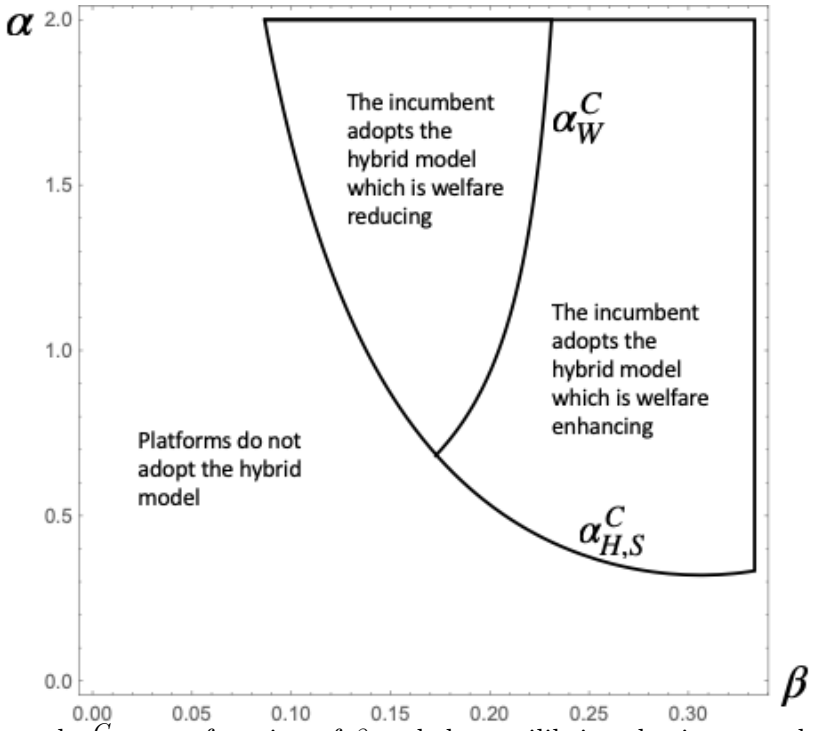

Figure 5: $\alpha_{H,S}^M$ and $\alpha_{H,S}^C$ as a function of β and the equilibrium business models (for $v = \frac{1}{2}$)

6 Managerial Implications

In today's information age, where data plays an increasingly important role in platforms' value creation, platforms are faced with the value capture dilemma of whether to base their business model on the "traditional" practice of charging users for their services, adopt the newer model of monetizing user data, or do both. Our analysis provides guidelines with respect to when it is optimal for platforms to adopt each business model, and thus has important managerial implications both for competing and monopolistic platforms.

What determines platforms' choice of business model? Our analysis offers direct insights into the profitability of the different business models for platforms. Most importantly, we find that when choosing their business model, platforms should consider not only the commercial value of data but also the strength of network effects. While it might seem intuitive that commercializing data would be the profitable business model if the commercial benefit of data is high, our model reveals that for intermediate commercial value, the strength of network effects is crucial for determining the optimal business model. This is particularly important for many of today's most popular platforms, where network effects are often driven by the benefits that data collected on users provides to other users. For example, in the case of a navigation app such as Waze which collects information on drivers' location, the data collected is crucial to other users that use the app and, in fact, is the core of the service that

the app provides. The same principle applies to platforms like Netflix and Spotify, where the value of the service is heavily dependent on user data rather than direct user interactions. Our results indicate that it is imperative for platforms to assess the strength of network effects to determine their optimal business model.

Our findings suggest that when both network effects and the commercial value of data are moderate to high, platforms should go with the hybrid model, because it allows them to attract all users in the market, whether in a competitive environment or under monopoly. Conversely, when network effects are weak, or the commercial value is low, the subscription-based model should be chosen. Indeed, many of today's platforms offer the hybrid model, including platforms in the music streaming market (e.g., Pandora and Spotify), video streaming market (Netflix, Hulu, Disney+), and social media market, with Facebook's launch of a paid plan in Europe. These are all examples of markets with strong network effects and high commercial value. On the other hand, platforms with weak network effects tend to choose the subscription-based model. For example, the network effects in apps like Ride with GPS, a social app that provides route directions to cyclists, are relatively weak. Although the app collects data on the rider's location, the data is mainly used to provide directions to the individual rider rather than to offer real-time information on the location of other users, as in the case of Waze.

How does the threat of competition affect platforms' choice of business model? The market for many of today's most dominant platforms is becoming increasingly competitive. TikTok is challenging Facebook's dominance, Netflix faces strong competition from Hulu, Disney+, and others, and even Google is concerned about Microsoft's integration of ChatGPT with Bing. Our model provides valuable insight for incumbent platforms facing such competition. Specifically, according to our results, platforms under threat of entry should consider changing their business model only if the commercial value of data is moderate. If the value is high or low, a monopolistic platform facing competition should maintain its current model: hybrid if the value is high and subscription-based if it is low.

When the commercial value of data is moderate and network effects are strong, a monopolist facing competition should shift away from the subscription-based model, that is optimal under monopoly, to the hybrid model. Given the strong network effects, the hybrid model would allow the incumbent to attract both privacy-sensitive and non-privacy-sensitive users, making it harder for the entrant to gain a foothold in the market. More generally, our results indicate that in competitive environments, the hybrid model can help incumbents deter entry or prevent entrants from dominating the market.

However, the incumbent should adopt the hybrid model only as long as it is profitable for

the incumbent to deter entry. If network effect are not strong enough to make entry deterrence profitable, the platform should shift to a subscription-based model. Remaining with the hybrid model could lead to intense competition with the entrant over the entire market. In contrast, shifting to the subscription model allows an entrant platform to differentiate itself and offer users a data-based plan; thereby, competing with the incumbent only over the marginal users. Moreover, shifting to the subscription-based model is preferable to the data-based model because the latter would prompt the entrant to adopt the hybrid model and monopolize the market. That is, the subscription model softens competitions and prevents the entrant from dominating the market.

This dynamic is nicely demonstrated by the music- and video streaming markets. Specifically, when Pandora first introduced its music streaming service in the U.S., it launched with a hybrid model. This allowed Pandora to fend off competition for a while. When Spotify launched in the U.S. two years later, it entered with a low price in its subscription plan, intensifying competition. Conversely, Netflix's subscription-based business model led Hulu to differentiate itself by entering the video streaming market with a data-based plan, attracting users with lower privacy concerns.

Does competition suppress data commercialization? Our model also has important policy implications, offering clear guidelines on when competition might encourage platforms to adopt more privacy-focused business models and reduce data commercialization. Our findings indicate that whether competitions suppresses data commercialization mainly depends on the commercial value of data and the degree of network effects. When the commercial value of data is low, then under monopoly, platforms adopt the subscription model and no data is being commercialized. Competition introduces the data-based model or the hybrid model, leading to greater data commercialization. Moreover, the region in which competition leads to greater data commercialization increases with network effects.

Surprisingly, it is when the commercial value is high that competition decreases data commercialization. In this case, while competition does not change the plans offered in the market – both subscription and data plans are available – competition drives subscription prices down. This, in turn, makes the subscription plan attractive to more users and thus results in less data being commercialized. This suggests that regulators can encourage more privacy by regulating prices rather than business models.

Should discrimination based on data-sharing be banned? Our analysis of a ban on the hybrid model offers valuable insights for both managers and policymakers. From the platforms' perspective, if the hybrid model is unavailable–whether due to regulation,

implementation complexity, or simply lack of popularity–if the commercial value of data is high and network effects are not too strong, the incumbent platform should adopt the data-based model. Otherwise, the platform should adopt the subscription model. For example, when Netflix first launched, the commercial value of data was likely low because Netflix had few users, limited knowledge about them, and network effects were weak. Thus, it made sense for Netflix to launch with the subscription model rather than a data-based plan. In contrast, Google's high commercial value at launch justified its adoption of a data-based business model.

In terms of policy implications, our finding that the hybrid model enhances welfare when network effects are strong suggests that an outright ban on the hybrid model, as required under the GDPR, could negatively affect welfare. Therefore, decisions on whether to allow platforms to discriminate based on data-sharing should be made on a case-by-case basis, considering the strength of network effects in the market.

7 Conclusion

Data is becoming an essential asset for platforms and an important determinant of platforms' monetization strategies. We develop a tractable model to study how competition affects platforms' optimal business model in a market with network effects and when data has a commercial benefit to the platforms. Platforms can choose between three business models: data-based, subscription-based, and hybrid. We find that the effect of competition on platforms' optimal business model depends on the interaction between the strength of the network effects and the commercial benefit of data.

We establish three main result. First, competition can have an important effect on platforms' business strategy. Specifically, for intermediate commercial value, the threat of competition motivates an incumbent platform to switch from the subscription-based model to the hybrid model when network effects are strong, and from the hybrid model to the subscription-based model if network effects are weak.

Second, we show that when network effects are strong, competition may in fact increase data commercialization by motivating platforms to adopt the hybrid model rather than the subscription one. That is, competition does not necessarily promote a more privacy-sensitive market.

Our third key result relates to the hybrid business model. Allowing platforms to discriminate across users based on whether they share their data for commercialization–i.e., to offer the hybrid model– may lead to a more concentrated market where the incumbent can deter the entry of a new platform. Still, the hybrid model can be welfare enhancing, if network

effects are strong enough, but reduces welfare for intermediate values of network effects.

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Appendix A

Below are the proofs for all lemmas and propositions in the text.

Proof of Lemma 1:

The result follows directly from the analysis preceding the Lemma. Thus, no additional proof is required.

Proof of Lemma 2:

The result follows directly from the analysis preceding the Lemma. Thus, no additional proof is required.

Proof of Lemma 3:

As both platforms adopt the same business model, there are two equilibria. In both equilibria, all users who join a platform make the same decision: they either all join the incumbent or they all join the entrant. In particular, in both equilibria, $n_i = \frac{v}{1-\beta}$ users join platform i and the remaining users (which are the data-sensitive users) stay out. This is an equilibrium because the user with $k = n_i$ is indifferent between joining a platform or staying out given the expectation that $n_i = \frac{v}{1-\beta}$ users join platform i, and because when all users expect that $n_i = \frac{v}{1-\beta}$ and $n_j = 0$ $(j \neq i)$, all users who join a platform prefer to join platform i. Given the assumption that the incumbent is focal, users play the equilibrium in which they join the incumbent, which earns $\pi_I(D, D) = \frac{\alpha v}{1-\beta}$ while the entrant earns $\pi_E(D, D) = 0$.

Proof of Lemma 4:

Suppose that the incumbent chooses $B_I = D$. Notice first the the entrant will never choose the data-based model as doing so results in no profits for the entrant. Next, suppose that the the entrant chooses $B_E = H$. In this case, focality is meaningless as there is no equilibrium in which the incumbent dominates the market. To see why, note that users can always choose to adopt only the entrant's subscription plan. Yet, recall that in the $(B_I, B_E) = (D, S)$ market configuration, there is no equilibrium in which the incumbent dominates the market.
Therefore, consider an equilibrium in which the entrant dominates the market. The entrant's problem is to set p_E to maximize:

$$\max_{p_E} \pi_E(p_E|(D, H)) = \alpha p_E + (1 - p_E)p_E, \tag{13}$$

$$\text{s.t.} \quad \beta + v - p_E \geq \max\{v - p_E, 0\} \text{ and } p_E \leq 1.$$

The first constraint ensures that the user with $k = p_E$ who is indifferent between the entrant's data plan and subscription plan prefers to join the entrant over joining the incumbent's data

plan or stay out of both platforms. The second constraint ensures that the indifferent user with $k = p_E$ is an internal solution.

The solution to the unconstraint problem is $p_E = \frac{1+\alpha}{2}$, which satisfies the constraint $p_E < 1$ if $\alpha < 1$. Moreover, p_E always satisfy the constraint $\beta + v - p_E \geq v - p_E$ and the constraint $\beta + v - p_E \geq 0$ requires that $\alpha < 2(\beta + v) - 1$, where $0 < 2(\beta + v) - 1 < 1$ because $v > 1/2$ and $\beta < 1 - v$. Hence, for $0 < \alpha < 2(\beta + v) - 1$, the entrant sets $p_E = \frac{1+\alpha}{2}$ and earns $\pi_E(D, H) = \frac{(1+\alpha)^2}{4}$. For $2(\beta + v) - 1 < \alpha$, there is a corner solution with $b + v - p_E = 0$, or $p_E = \beta + v < 1$. The entrant then sets $p_E = \beta + v$ and earns $\pi_E(D, H) = (\beta + v)(1 + \alpha - \beta - v)$. In both cases, the incumbent earns $\pi_I(D, H) = 0$.

Next, suppose that the entrant chooses $B_E = S$. From the analysis of Section 3, when $\beta < 1/3$, the entrant earns in this case $\pi_E(D, S) = \frac{(1-\beta)^2}{4(1-2\beta)}$. When $0 < \alpha < 2(\beta + v) - 1$, the entrant prefers the hybrid model if $\pi_E(D, H) > \pi_E(D, S)$, or $\alpha > \overline{\alpha} = \frac{1-\beta}{\sqrt{1-2\beta}} - 1$, where

$$2(\beta + v) - 1 - \left(\frac{1-\beta}{\sqrt{1-2\beta}} - 1\right) > 2(\beta + \frac{1}{2}) - 1 - \left(\frac{1-\beta}{\sqrt{1-2\beta}} - 1\right) = 1 + 2\beta - \frac{1-\beta}{\sqrt{1-2\beta}} > 0,$$

where the first inequality follows because $v > \frac{1}{2}$ and the second inequality follows when $\beta < 1/3$. Again from the analysis of Section 3, when $\beta > 1/3$, the entrant earns in this case $\pi_E(D, S) = \beta$. When $0 < \alpha < 2(\beta + v) - 1$, the entrant prefers the hybrid model if $\pi_E(D, H) > \pi_E(D, S)$, or $\alpha > \overline{\alpha} = 2\sqrt{\beta} - 1$, where it is possible to show that $2\sqrt{\beta} - 1 < 2(\beta + v) - 1$ and $2\sqrt{\beta} - 1 = \frac{1-\beta}{\sqrt{1-2\beta}} - 1$ at $\beta = 1/3$.

A third option for the entrant is to adopt the data-based model. Yet, when both platform adopt the same business model, the incumbent wins the market due to its focal position while the entrant earns 0.

To summarize, we have that when $0 < \alpha < \overline{\alpha}$, where

$$\overline{\alpha} = \begin{cases} \frac{1-\beta}{\sqrt{1-2\beta}} - 1, & \text{if } \beta < \frac{1}{3}, \\ 2\sqrt{\beta} - 1, & \text{if } \beta > \frac{1}{3}, \end{cases}$$

and $\overline{\alpha} < 2(\beta + v) - 1$, the entrant responds by adopting the subscription-based model. The two platforms earn $\pi_I(D, S)$ and $\pi_E(D, S)$ as defined in Section 3. When $\overline{\alpha} < \alpha < 2(\beta + v) - 1$, the entrant adopts the hybrid model, charges $p_E = \frac{1+\alpha}{2}$ and earns $\pi_E(D, H) = \frac{(1+\alpha)^2}{4}$. When $2(\beta + v) - 1 < \alpha$, the entrant adopts the hybrid model and there is a corner solution in which the entrant sets $p_E = \beta + v$ and earns $\pi_E(D, H) = (\beta + v)(1 + \alpha - \beta - v)$. In both cases, the incumbent earns $\pi_I(D, H) = 0$.

Proof of Lemma 5:

Suppose that the incumbent chooses $B_I = S$. The entrant has three options. First, to also choose $B_E = S$. Given the platforms' prices, p_I and p_E, there is an equilibrium in which all users join the incumbent if: $\beta + v - p_I \geq v - p_E$ or $\beta \geq p_I - p_E$. Likewise, there is an equilibrium in which all users join the entrant if $\beta + v - p_E \geq v - p_I$ or $p_I - p_E \geq -\beta$. As the two conditions overlap, for $\beta \geq p_I - p_E \geq -\beta$ there are two equilibria in which either the incumbent or the entrant dominate the market. Given our focality assumption, in this case all users play the equilibrium in which they join the incumbent. Hence, the equilibrium prices are $p_E = 0$, $p_I = \beta$ and the incumbent dominates the market. As the entrant earns 0, the entrant will never choose $B_E = S$ as a response to $B_I = S$. Second, suppose that the entrant chooses $B_E = H$. The same logic as in the case where the entrant chooses $B_E = S$ follows to the case where the entrant adopts the hybrid model. Even if the entrant charges $p_E = 0$ and the incumbent charges $p_I = \beta$, there is an equilibrium in which all users join the incumbent and do not share data, because $\beta \times 1 + v - p_I \geq \beta \times 0 + v - p_E$. Hence, there is an equilibrium in which the incumbent dominates the market and by our focality assumption, users play this equilibrium. This implies that the entrant will never choose $B_E = H$. As a result, the entrant's best response is to choose $B_E = D$. The outcome of the market configuration (S, D) is symmetric to the market configuration (D, S), where both platforms gains a positive market share and earn positive profits.

Proof of Proposition 1:

Suppose that $\beta < \frac{1}{3}$. We first compare between the incumbent's profit when it adopts $B_I = D$ and the entrant responds by adopting $B_E = S$ (which occurs only when $\alpha < \overline{\alpha}$). We have that $\pi_I(H, S) > \pi_I(D, S)$ if:

$$\pi_I(H, S) = (1 + \alpha - \beta)\beta > \frac{\alpha(1 - 3\beta)}{2(1 - 2\beta)} = \pi_I(D, S), \tag{14}$$

$$\Downarrow$$

$$\alpha < \alpha^C_{D,H} = \frac{2\beta(1 - 2\beta)}{1 - 4\beta}.$$

Yet, $\alpha^C_{D,H} > \overline{\alpha}$, implying that whenever adopting $B_I = D$ motivates the entrant to adopt $B_E = S$ (which occurs when $\alpha < \overline{\alpha}$), it is not optimal for the incumbent to adopt $B_I = D$, as the incumbent prefers $B_I = H$ over $B_I = D$. We are therefore left with two options, either setting $B_I = H$ or setting $B_I = S$. The incumbent prefers the first option when:

$$\pi_I(H, S) = (1 + \alpha - \beta)\beta > \frac{(1 - \beta)^2}{4(1 - 2\beta)} = \pi_I(S, D), \tag{15}$$

$$\Downarrow$$

$$\alpha > \alpha^C_{H,S} = \frac{(1-\beta)(1-5\beta+8\beta^2)}{4\beta(1-2\beta)},$$

where $\alpha^C_{H,S}$ is decreasing with β.

Proof of Lemma 6:

The incumbents' problem in the hybrid model when the incumbent is a monopoly is:

$$\max_{p_I} \pi_I(p_I|(H)) = \alpha p_I + (1-p_I)p_I, \tag{16}$$

$$\text{s.t.} \quad \beta + v - p_I \geq 0 \text{ and } p_I \leq 1.$$

The unconstrained solution is $p_I = \frac{1+\alpha}{2}$. Notice first that $p_I < 1$ if $\alpha < 1$. Moreover, at this price, users gain non-negative utility if:

$$\beta + v - \frac{1+\alpha}{2} \geq 0 \iff \alpha < 2(\beta+v) - 1,$$

where $2(\beta+v)-1 < 1$ because $\beta < 1-v$. Hence, we have that for $\alpha < 2(\beta+v)-1$, $p_I = \frac{1+\alpha}{2} < 1$ and the incumbent earns $\pi_I(H) = \frac{(1+\alpha)^2}{4}$. Next, suppose that $\alpha > 2(\beta+v)-1$. In this case, the constraint $\beta+v-p_I \geq 0$ binds. Therefore, $p_I = \beta+v < 1$ and the incumbent earns $\pi_I(H) = (1+\alpha-\beta-v)(\beta+v)$.

Proof of Proposition 2:

Consider a monopolistic incumbent. We first show that the incumbent always prefers the hybrid model over the data-based model. When $\alpha < 2(\beta+v)-1$, we have:

$$\pi_I(H) - \pi_I(D) = \frac{(1+\alpha)^2}{4} - \frac{v\alpha}{1-\beta} > \frac{(1+\alpha)^2}{4} - \alpha = \frac{(1-\alpha)^2}{4} > 0,$$

where the first inequality follows because $v < 1-\beta$. When $\alpha > 2(\beta+v)-1$, we have:

$$\pi_I(H) - \pi_I(D) = (1+\alpha-\beta-v)(\beta+v) - \frac{v\alpha}{1-\beta} = \frac{(1-\beta-v)(v+\beta(1+\alpha-\beta-v)}{1-\beta}$$

$$> \frac{(1-\beta-v)(v+\beta(\beta+v)}{1-\beta} > 0,$$

where the first inequality follows because $\alpha > 2(\beta+v)-1$ and the second inequality follows because $v < 1-\beta$.

We are therefore left with the comparison between $\pi_I(H)$ and $\pi_I(S)$. When $\alpha < 2(\beta+$

$v) - 1$, we have:

$$\pi_I(H) - \pi_I(S) = \frac{(1+\alpha)^2}{4} - (\beta + v) < -(1 - \beta - v)(\beta + v) < 0,$$

where the first inequality follows because $\alpha < 2(\beta + v) - 1$ and the second inequality follows because $v < 1 - \beta$. Hence, it is optimal to adopt the subscription-based model when $\alpha < 2(\beta + v) - 1$. When $\alpha > 2(\beta + v) - 1$, we have:

$$\pi_I(H) - \pi_I(S) = (1 + \alpha - \beta - v)(\beta + v) - (\beta + v) > 0 \iff \alpha > \beta + v,$$

where $\beta + v > 2(\beta + v) - 1$ because $0 < \beta < 1 - v$. Hence, there is a threshold, $\alpha^M_{H,S} = \beta + v$, where $\alpha^M_{H,S} > 2(\beta + v) - 1$, such that the monopolistic incumbent adopts the subscription-based model if $\alpha < \alpha^M_{H,S}$ and the hybrid model otherwise.