# The Strategic Value of Platform Encroachment: Seller Entry and Network Effects*

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**Abstract**

In a platform market where user participation is endogenous and shaped by direct network effects, we compare the competitive and welfare effects of two alternative business models: pure intermediation and 'encroachment' — a hybrid model where the platform competes with third-party sellers by selling its own private-label products. There are two groups of sellers: entrants, who must pay a specialization cost to access the marketplace, and incumbents, who have already paid it. With encroachment, the platform has no incentive to entirely foreclose their downstream rivals if there are positive network effects. Surprisingly, although encroachment restricts entry, it increases consumer surplus, total welfare, and the incumbents' profit when there is a sufficiently large number of incumbents in the marketplace.

**Keywords:** Hybrid Platforms, Seller Entry, Network Externalities, Market Maturity, Platform Encroachment

**JEL Codes:** L22, L41, L51

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# 1 Introduction

Numerous platforms have recently chosen to enter the territory of their third-party sellers and compete with them by offering so-called 'private labels.' This business strategy, often known as vertical (or platform) 'encroachment' (Arya et al. (2007)), significantly bolstered the profitability of companies like Amazon, Alibaba and JD.com, and has attracted the attention of practitioners, law enforcers and scholars on both sides of the Atlantic (Ha et al. (2022), Zhu (2019), Zhu & Liu (2018), Foerderer et al. (2018), He et al. (2020), among others).

Although there are obvious reasons behind the adoption of such a business model, an immediate consequence of platform encroachment is increased competition with existing third-party sellers. Recent papers have emphasized that encroaching platforms may engage in self-preferencing strategies: pricing and marketing tactics according to which vertically integrated platforms give preferential treatment to their private labels over the products of third-party competitors (e.g., Bisceglia & Tirole (2023), Etro (2021), Padilla et al. (2020), and Peitz (2022), among others).

A relatively unexplored aspect of vertical encroachment pertains to its potential to deter new entry. The objective of this paper is to shed light on the strategic and competitive implications of platform encroachment. We examine an environment where consumer and seller participation in a marketplace is endogenous and shaped by consumer expectations on the size of the marketplace (network effects).[1] On the supply side, we assume Cournot competition among two groups of sellers: entrants and incumbents. Entrants must sink a specialization cost to access the marketplace — e.g., invest resources into sales digitalization, logistics, high-speed delivery services, etc. By contrast, incumbents are established players with a long-standing market presence and well-defined customer relationships: having amortized their entry costs, they impose a significant competitive constraint on the entry of new sellers in the marketplace.[2]

We compare two alternative business models: pure intermediation and encroachment. We first examine how the platform's conduct towards third-party sellers changes with and without vertical encroachment, and investigate how the size of the marketplace impacts this change through consumers' expectations.

[1] Consumers may be reluctant to adopt a platform unless they expect others to do so (e.g., Rohlfs (1974), Katz & Shapiro (1985, 1994), Farrell & Saloner (1985, 1986)). While telecommunication networks, social media, and payment systems provide classic examples of direct network effects, our formulation can also capture indirect feedback effects, such as better reviews and recommendations, greater availability of complements, or increased trust due to higher transaction volumes (e.g., Feldman et al. (2019), Jullien et al. (2021)). For instance, Feldman et al. (2019) emphasize that Alibaba uses seller data to improve its recommendation engine, making marketplace activity itself a source of value. Since our results do not depend on the precise channel through which these externalities arise, we model them in reduced form and abstract from the distinction between direct and indirect network effects.

[2] We focus on a setting with both incumbent sellers and new entrants because platforms differ greatly in maturity and in the scope for additional participation. Some operate in incumbent-heavy environments with limited room for entry, while others are still expanding and rely on new sellers to shape the marketplace. For example, Amazon Marketplace is mature in categories such as books and electronics in the U.S. and Western Europe, but entry opportunities remain more significant in emerging markets and on younger platforms such as Shopee in Southeast Asia. Similarly, Apple's App Store and Google Play are relatively saturated ecosystems, while Huawei's AppGallery or regional app stores still compete to attract developers. The same contrast appears in accommodation, mobility, food delivery, and fintech: Airbnb, Uber, Deliveroo, PayPal, and Venmo are mature in some markets, whereas platforms such as Glovo, Rappi, M-Pesa, or regional mobility and payment platforms continue to expand by onboarding new participants.

Second, we identify the determinants of the number of third-party sellers entering the marketplace in each business model, and compare them. Third, we examine the conditions under which vertical encroachment occurs, identify the drivers of its profitability, and assess its external effects on consumer surplus and sellers' profits.

We show that, even when products supplied in the marketplace are homogeneous,[3] the platform's tendency to favor its private label is tempered by network effects, and diminishes in proportion to the strength of these effects. A vertically integrated platform anticipates that if consumers observe a too-high listing fee (which marginalizes third-party sellers), they will expect a marketplace with a low network value, which will reduce their demand for the products offered in the marketplace (including the platform's private label) at the ultimate detriment of the platform itself.[4]

Furthermore, we establish that a vertically integrated platform attracts (ceteris paribus) fewer third-party sellers than a pure intermediation platform. Although network effects temper the incentive to engage in self-preferencing, an integrated platform always charges higher listing fees than a pure intermediation platform to divert business towards its (more efficient) private label: a result broadly coherent with the existing literature on hybrid platforms (e.g., Anderson & Bedre-Defolie (2021), Zennyo (2022), Etro (2021), and Etro (2023)). By reducing sellers' profit, this higher fee stifles entry and the size of the marketplace. Interestingly, as network effects become stronger, the difference between the number of entrants in a pure intermediation platform and an integrated platform falls, since marginalizing competitors is more costly in terms of lost consumers.

We also study the impact of vertical encroachment on the platform's profit. We assume that encroachment is costly as it requires the platform to develop the infrastructure, technology, and resources required to introduce its private label. As intuition suggests, the platform will enter with a private label when such a cost is relatively small. Moreover, the benefit of this strategy increases with the specialization cost for newcomers. A higher specialization cost reduces the opportunity cost of introducing a private label, since this cost is given by the reduction in fee revenues resulting from the negative impact on entry of the private label.

Interestingly, the impact of network effects on the platform's incentive to enter with a private label depends on the number of incumbents. Stronger network effects favor encroachment when there are many incumbents, as entry is limited in this scenario. Like a higher specialization cost, a greater number of incumbents implies fewer entrants which, in turn, means that the opportunity cost of launching a private label is lower.

Furthermore, the region of parameters where vertical encroachment is profitable expands with the number of incumbents, but only when this number is neither too low nor too high. When there are few incumbents in the marketplace, entry occurs with and without vertical encroachment. Competition, therefore, dissipates downstream profits, making the number of incumbents irrelevant to the choice of

[3]Clearly, the incentive to engage in self-preferencing tactics diminishes as products become more differentiated.

[4]In many platform settings, listing fees are observable or inferable, making public and non-discriminatory contracts a natural benchmark.

the business mode. When, instead, the number of incumbents is large so that entry is deterred under vertical encroachment but not under pure intermediation, the choice of the business mode is shaped by the following forces. First, as the number of incumbents grows, the intermediation revenue rises with and without vertical encroachment since, ceteris paribus, more sellers pay the listing fee: a revenue-enhancing effect. Second, with more incumbents, the marketplace becomes more competitive, and the vertically integrated seller makes lower profit margins: a competition-strengthening effect. When the number of incumbents is large (resp. small), the competition-strengthening effect is stronger (resp. weaker) than the revenue-enhancing effect, reducing (resp. increasing) the platform's incentive to encroach.

The link between vertical encroachment, self-preferencing, and entry directly impacts consumer welfare. With endogenous seller entry, vertical encroachment can reduce consumer welfare because, first, a vertically integrated platform charges higher listing fees than a pure intermediary, which are then passed on to consumers via higher final prices, and, second, because platform encroachment makes entry into the marketplace more difficult and, hence, reduces aggregate output. On the positive side, encroachment enables the platform to eliminate one layer of double marginalization while retaining competition in the marketplace. The number of incumbents is a fundamental determinant of this trade-off. When it is relatively large (the market is sufficiently mature), the elimination of double-marginalization effect prevails, since entry is limited regardless of whether the platform is integrated or not. By contrast, when there are few incumbents, the adverse impact of platform encroachment on entry gains importance and, together with the increase in the listing fees, overturns the gain associated with the reduction of double marginalization.

While encroachment has a clear adverse effect on entry, it has a non-trivial effect on the profitability of the incumbent sellers. When there are relatively few incumbents, endogenous entry neutralizes any other impact of the business mode on incumbents' profits. When the number of incumbents is so large to restrict entry in both regimes, vertical integration reduces the incumbents' profits since incumbents pay a high listing fee and lose business to the private label, which also constrains their prices. Finally, when entry occurs under a pure intermediation model but is blocked under vertical encroachment — i.e., if the number of incumbents is neither too high nor too low — vertical encroachment increases incumbents' profit due to the competition-softening effect associated with restricted entry.

We extend the analysis along a few natural directions. A crucial hypothesis of the baseline model is that consumers observe the platform's listing fees, possibly because it is publicly disclosed by the platform. But, would it not be better for the platform to make sellers secret offers? Under secret contracts, an integrated platform will always find it profitable to shut down all third-party sellers since consumers cannot observe this. However, consumers will rationally anticipate this behavior and respond to encroachment by reducing demand. As a result, when network effects are in place, encroaching platforms will use contract disclosure as a commitment device to keep their marketplaces large and competitive: a phenomenon common, for example, to Amazon and Apple.[5]

We also consider a version of the model where the platform can engage in costly R&D to enhance

[5]See the report by the Analysis Group titled 'Apple's App Store and Other Digital Marketplaces' (link).

network effects. We compare the incentive to invest in these activities with and without encroachment. We show that platform encroachment boosts the incentive to strengthen network effects if there are enough incumbents in the marketplace. This is because larger network effects increase the incremental profits from private-label sales, while simultaneously softening the negative impact of encroachment on entry — and consequently on third-party sales and platform fees — when there are many incumbents.

Finally, our main results remain valid when the platform can charge consumers a participation fee and sellers enter the marketplace after the platform has set the listing fee. Allowing the platform to charge a participation fee to consumers is redundant because it reduces their willingness to pay and, de facto, lowers both the listing fee that the platform can extract from the third-party sellers and the profit of its integrated unit. We also discuss how our results are affected by the use of ad-valorem fees by the platform and by the presence of differentiated products.

**Policy and strategic implications.** The results of our analysis bear directly on the ongoing regulatory debate surrounding the Digital Markets Act (DMA). A central concern of the regulation is whether gatekeeper platforms should be allowed to compete with their own business users by introducing private labels and engaging in forms of self-preferencing. Our model highlights that the impact of vertical (platform) encroachment is not unambiguously harmful, but rather depends on the interaction between entry costs, the number of incumbent sellers, and the strength of network effects.

On the one hand, consistent with the DMA's rationale, our framework shows that encroachment can reduce consumer welfare by raising listing fees, restricting seller entry, and thereby shrinking the size of the marketplace. This aligns with the regulatory suspicion that platform self-preferencing may stifle competition and variety, particularly in markets where entry is still fluid and where the number of incumbents is limited. On the other hand, our model also identifies circumstances under which encroachment can improve welfare, notably when the market is already mature with many incumbents: in this case, the entry margin is exhausted, and the main effect of encroachment is the elimination of double marginalization, which benefits consumers.

From a policy perspective, this suggests that a blanket prohibition of encroachment and self-preferencing — as contemplated by the DMA — may overlook important trade-offs. A more rigorous regulatory approach might be warranted, one that takes into account market maturity and entry conditions. For example, restrictions on encroachment could be more justified in nascent markets, where protecting entry is essential to preserve competition, while being less appropriate in mature markets where entry is already constrained. Similarly, the model underscores the role of transparency: when consumers observe listing fees, network effects discipline the platform's incentives, reducing the scope for harmful exclusionary conduct. This points to disclosure obligations — already part of the DMA toolkit — as an instrument that can mitigate the risks of encroachment without imposing outright bans.

Overall, the analysis supports the idea that the DMA's concern with self-preferencing is well-founded but should be complemented by a recognition of the underlying economic trade-offs. Rather than a one-size-fits-all prohibition, regulatory interventions could be designed to target those market environments

where encroachment most severely undermines entry and consumer welfare.

From a competitive standpoint, instead, our analysis has demonstrated that while platform encroachment tends to limit the entry of new sellers in downstream markets, integrated platforms, driven by network effects, tend to leave space for competitors — a contrast to traditional brick-and-mortar industries where these effects are absent and therefore foreclosure risks are more significant. Integrated platforms shape consumer expectations about their size through the choice of listing fees. They disclose these fees to boost network effects and attract a broader user base. Finally, in terms of strategy, our findings highlight that vertical encroachment is more compelling when entry costs for sellers are higher, particularly in marketplaces with stringent specialization standards. Stronger network effects also amplify the incentive for integration, but primarily in mature marketplaces.

**Related Literature.** By comparing two widespread distribution business models, our paper contributes to the literature on manufacturers' sales format choice. For example, Ha et al. (2022) show that manufacturers can benefit from operating a dual (distribution) channel — i.e., a direct channel (vertical encroachment) and an indirect one. Yet, Liu, Guan & Wang (2021) argue that the benefits of the direct channel tend to vanish when the number of downstream retailers is sufficiently large. This literature (see also Tsay & Agrawal (2004), Arya et al. (2007), Cattani et al. (2006) among others) lacks the crucial aspect of our analysis: the presence of network effects, which is a salient difference between online and traditional brick-and-mortar markets.

Closely related to our work, instead, Song et al. (2020) studies the decision of a vertically integrated platform to open and host a third-party rival in a framework where the decision to join the platform generates a positive spillover on the newcomer since consumers become aware of its product. The vertically integrated platform faces a trade-off between facing stronger competition and monetizing the sales volume of the newcomer via the listing commission. Under the hypothesis of an exogenous commission fee, the author shows that when the spillover effect is minor, the platform opens; however, when the spillover effect is significant, the platform's choice depends on its awareness advantage over the third party. If the platform's private label has a substantial awareness advantage, it may opt to be closed; otherwise, it opens the platform.

There are several differences between this paper and ours. First, in our model, the commission fee is endogenous and reflects the business model. Second, we focus on spillover effects at the network level, rather than at the individual level. Furthermore, a novel feature of our model is the link between the maturity of the marketplace, as measured by the number of incumbents, and the private and social benefits of a dual distribution mode.

We also contribute to the debate on the competitive effects of platform encroachment and hybrid platforms (Zhu (2019), He et al. (2020), Li & Agarwal (2017), Wen & Zhu (2019), Zhu & Liu (2018), Foerderer et al. (2018), Carroni et al. (2021)). Some papers in this literature find that platform entry in competition with third-party sellers can be pro-competitive (e.g., Dryden et al. (2020), Etro (2021), Hagiu & Spulber (2013), Hagiu et al. (2022) and Tremblay (2020)). However, entry in competition with

third-party sellers also opens the channel for well known negative effects such as the shut down of rivals by appropriating value (van den Boom & Samranchit (2020), Anderson & Bedre-Defolie (2020)) and, in some cases, lessening competition among sellers (Lam & Liu (2022), Padilla et al. (2020)). We show that the welfare implications of encroachment are more nuanced and depend on the number of incumbents already present in the market.[6]

With the few exceptions cited above, most of the existing models examining platform encroachment do not allow for fluid seller entry (see, e.g., Jiang et al. (2011), Hervas-Drane & Shelegia (2022), Etro (2021), Zennyo (2022)), and none of them combines this aspect with positive spillovers arising through network effects on the demand side: two salient aspects of modern digital marketplaces. Besides making the novel observation that network externalities weaken the canonical foreclosure doctrine and, therefore, reduce the scope of its applicability to hybrid platforms, our analysis also suggests the innovative point that the number of incumbents in a marketplace is a salient indicator of the welfare effects of platforms adopting such a business model.

## 2 Model Setup

**Environment.** A platform $P$ hosts a marketplace where $N + M \geq 2$ third-party sellers, each denoted by $S_i$, compete for consumers. Among them, $N \geq 2$ are incumbent sellers ($i \leq N$) already active on the platform, while $M \geq 0$ are potential entrants ($i \geq N + 1$) who must incur a fixed specialization cost $I \geq 0$ to reach and serve $P$'s users. This distinction is intended to capture heterogeneity in entry costs: before joining, a new entrant must invest in sales digitalization, logistics, high-speed delivery services, and related capabilities.

The number of entrants $M$ is endogenously determined by a zero-profit entry condition. As in Mankiw & Whinston (1986), we ignore the integer constraint when determining the solution of the entrants' free entry condition. Marginal costs, upstream and downstream, are normalized to 0 without loss of generality. The quantity produced by seller $S_i$ is denoted $x_i \geq 0$.

**Demand side.** Following Katz & Shapiro (1985), we assume that sellers compete by choosing quantities in a market with direct network effects (see, e.g., also Yan et al. (2019), Song et al. (2020), Liu, Zhang & Zhang (2021), Wei et al. (2023)).[7] The inverse demand function is

$$p(X^e, X) \triangleq \max\{0, 1 + \theta X^e - X\}, \tag{1}$$

where $\sum_{i=1}^{N+M} x_i = X$ is the aggregate quantity produced and $X^e$ denotes consumers' expectations about

[6] Choe et al. (2025) consider platform encroachment and the effects of data regulation and find effects of the data regulation on platform encroachment incentives.

[7] The reason we focus on homogeneous products and quantity competition is that under these conditions the platform's incentives to foreclose third-party rivals are strongest. In this sense, our results should be interpreted as conservative. We discuss price competition in the Extensions.

marketplace size, which influences their willingness to pay.[8]

The parameter $\theta \geq 0$ captures the strength of network effects: consumers value the platform more when they expect more users to join. The expectation $X^e$ is formed before third-party sellers choose their output, but after listing contracts have been offered — i.e., listing fees have a 'signaling' content because consumers can infer from them the marketplace size.[9]

**Business model, contracts and payoffs.** We compare two alternative business models.

(*a*) *Pure intermediation platform*: $P$ is independent from all third-party sellers and acts just as an intermediary enabling them to match with consumers.

(*b*) *Platform (vertical) encroachment:* $P$ buys an incumbent (say $S_1$) and offers a private label in competition with the remaining third-party sellers on the platform.

The pure intermediation model is equivalent to a standard vertical structure in which an upstream input provider sells to downstream firms, a setting that has been extensively studied in the vertical contracting literature.

$P$ charges every third-party seller a uniform listing fee $w$ proportional to its sales volume (in the Extensions, we discuss ad-valorem fees).[10] Hence, the payoff of an active third-party seller $S_i$ is

$$(p(X^e, X) - w)\, x_i - \mathbb{I}_i \cdot I,$$

with $\mathbb{I}_i \in \{0, 1\}$ being an indicator function that takes value 0 if $i \leq N$ and 1 if $i \geq N + 1$.

With a pure intermediation model, $P$'s payoff is

$$w \sum\nolimits_{i=1}^{N+M} x_i = wX.$$

With platform encroachment, $P$'s payoff is

$$p(X^e, X)x_1 + w \sum\nolimits_{i=2}^{N+M} x_i - \mathcal{K},$$

where $\mathcal{K}$ denotes the fixed cost associated with encroachment (as in Huang & Chen (2023)).

Focusing on the conservative scenario in which the benefits of encroachment are maximized, we assume that sellers have no outside option, meaning that they have no access to alternative (even inferior)

[8] In the Appendix, we explain how this demand function can be obtained by aggregating the individual demand functions of consumers with heterogeneous tastes.

[9] Le Nagard-Assayag & Manceau (2001), Dranove & Gandal (2003), Schilling (2003), Chintakananda & McIntyre (2014), Fuentelsaz et al. (2015) among others find evidence that consumers form expectations on value from firm announcements. This suggests that consumers are sophisticated and adjust their beliefs on value in markets featuring network effects.

[10] Because contracts are public and equilibrium is symmetric, assuming nondiscriminatory seller terms is without loss of generality. Under encroachment, the platform can instead appropriate market value directly through its integrated seller (as in Zhu & Liu (2018), Jiang et al. (2011), Ryan et al. (2012)) and shut down rivals by setting sufficiently high listing fees.

platforms — i.e., $P$ is a gatekeeper. Therefore, if the platform decides to foreclose rivals (including the incumbents), they exit the market.

**Timing and equilibrium concept.** The sequence of moves is as follows:

- $P$ decides the business model — i.e., pure intermediation or vertical encroachment.
- Each seller $S_i$, with $i \geq N+1$, decides whether to pay the specialization cost $I$ and enter the marketplace, or stay out.
- $P$ publicly announces the listing fee $w$.[11] Consumers form an expectation $X^e$ on the network size.
- Sellers choose outputs, profits materialize and payments are collected.

This timing reflects the idea that while the business model and entry (specialization) are long-run decisions, listing contracts require a shorter time horizon to be negotiated.

Consumers form the expectation $X^e$ before third-party sellers choose their output, but after listing contracts have been offered — i.e., listing fees have a 'signaling' content because consumers can infer from them the marketplace size (more below). The idea that listing fees are public and observed by consumers is far from unrealistic in modern digital markets. For many platforms, this assumption is in fact natural, particularly given the regulatory scrutiny and the public attention that such charges have attracted.[12]

In equilibrium, each seller chooses its output level taking as given consumers' expectations on the marketplace size, $X^e$, under the assumption that these expectations are consistent with the equilibrium outcome (rational expectations) and are formed at the interim stage after contracts have been offered but before output is set — see, e.g., Belleflamme & Peitz (2019).

**Further assumptions.** We assume that the platform does not charge consumers a participation fee for using its services. In the extensions, we show that our results remain valid with a participation fee. Finally, to have downward sloping demand functions we posit that network effects are not too pronounced — i.e., $\theta < \frac{1}{2}$.

[11] The assumption that listing fees are public and observed by consumers is realistic in many digital markets, especially given the regulatory and media attention surrounding platform charges. App store commissions by Apple and Google, Amazon's fees to third-party sellers, and Airbnb's service fees have all been subject to public scrutiny. In such settings, fee structures are often observable or easily inferable, making public and non-discriminatory contracts a natural benchmark.

[12] Competition authorities and policy makers have repeatedly investigated platforms for allegedly extracting excessive access or listing fees from sellers, and these inquiries have made fee structures widely visible. Notable examples include the EU and U.S. antitrust cases against Apple and Google concerning their 30% commission fees on app store sales; investigations into Amazon's fees and commissions charged to third-party sellers; and regulatory challenges to Airbnb's service fees in various jurisdictions. In such environments, fee transparency emerges not only as a feature of the platform's business model but also as a by-product of regulatory oversight, consumer advocacy, and media coverage.

# 3 Pure Intermediation vs. Encroachment

## 3.1 Pure intermediation platform

First consider the case where the platform is a pure intermediary.

**Quantity setting stage.** When a seller $S_i$ enters the marketplace and is offered a listing fee $w$, it solves the following maximization problem

$$\max_{x_i \geq 0} \left( p\left(X^e, X\right) - w \right) x_i. \tag{2}$$

Assuming that $N + M$ sellers are active in the marketplace, imposing rational expectations — i.e., $X^\star = X^e$ — it is easy to show that the solution of the above problem(s) yields

$$X^\star\left(w\right) = \frac{(M+N)(1-w)}{1+(M+N)(1-\theta)},$$

which is increasing in $\theta$. The intuition is that an increase in the level of positive spillover increases the consumers' willingness to pay, thereby inducing every seller to expand its sales volumes.

Moreover, differentiating $p^\star\left(w\right) = 1 - (1-\theta) X^\star\left(w\right)$ with respect to $\theta$,

$$\frac{\partial p^\star\left(w\right)}{\partial \theta} = X^\star\left(\cdot\right) - (1-\theta) \underbrace{\frac{\partial X^\star\left(w\right)}{\partial \theta}}_{(+)}.$$

This equation captures two opposing forces. The first term reflects the fact that as $\theta$ increases, consumers buy more for a given price and, hence, the equilibrium price will increase. The second term captures the impact of an increase in $\theta$ on the elasticity of demand: as $\theta$ grows, $X^\star(\cdot)$ also grows and the elasticity of demand increases. Hence, for given listing contracts, stronger network effects increase the market price in addition to increasing output.

**Contracting stage.** $P$ chooses listing fees to maximize its intermediation revenue, that is

$$\max_{w \geq 0} w \sum_{i=1}^{N+M} x_i^\star\left(w\right) = w X^\star(w).$$

Notice that, having imposed rational expectations at the quantity-setting stage, $P$ internalizes the effect of increasing the listing fees on these expectations.

Differentiating with respect to $w$,

$$\underbrace{X^\star\left(w\right) + w \frac{\partial X^\star\left(w\right)}{\partial w}}_{\text{Margin + Volume effects}} = 0. \tag{3}$$

This condition reflects the impact of higher fees on $P$'s profit. There is a trade-off between upstream margins and downstream volumes: a higher $w$ increases the revenue earned by $P$ on each unit of sale made in the seller market. At the same time, by increasing $w$, $P$ exerts downward pressure on the sellers' output, thereby reducing revenues.

Solving the above conditions for given $M$, we obtain the equilibrium outcome with a pure intermediary.

**Proposition 1** *When $P$ is a pure intermediary, for given $M$, there exists a unique equilibrium in which the listing fee charged to each seller is $w^\star \triangleq \frac{1}{2}$. In this equilibrium, aggregate and individual outputs as well as the market price are increasing in $\theta$.*

As explained above, an increase in $\theta$ is akin to improving the quality of the products sold at the marketplace which increases the consumers' willingness to pay, thereby increasing individual and aggregate output, final price and the platform's profit. Interestingly, the equilibrium listing fee is independent of the degree of the positive spillover effects. This finding is the resultant of two opposing forces. On the one hand, when $\theta$ increases, consumers' value from the positive spillover rise, which (other things being equal) leads to a higher equilibrium price, and thus to a higher fee because platform $P$ has an incentive to extract the increased downstream margin. On the other hand, a higher fee results in double marginalization, which lowers output and thus reduces $P$'s profit. On the net, these two effects compensate each other under our linear-quadratic specification.

**Entry stage.** The entrants' zero profit condition then yields the following.

**Proposition 2** *When $P$ is a pure intermediary, there exist thresholds $N^\star > 2$ and $I^\star > 0$, both increasing in $\theta$, such that sellers enter — i.e., $M^\star \geq 1$ — if and only if $N \leq N^\star$ and $I \leq I^\star$. The number of entrants $M^\star$ is increasing in $\theta$.*

As explained above, more significant network effects temper the platform's incentive to shut down third-party sellers. Yet, when the specialization cost is higher, so that fewer new joiners enter the marketplace, aggregate sales fall, and the incentive to reduce listing fees to elicit the positive effects falls too.

### 3.2 Platform (vertical) encroachment

Consider now the case where $P$ distributes as an incumbent (through $S_1$) in direct competition with other sellers.

**Quantity setting stage.** As before, consumers' expectations are taken as given at the quantity-setting stage. $P$ solves

$$\max_{x_1 \geq 0} \underbrace{p\left(X^e, X\right) x_1}_{\text{Direct sales}} + \underbrace{w \sum_{i=2}^{N+M} x_i}_{\text{Intermediation revenue}} - \mathcal{K},$$

which is the sum of the profit made through its direct sales channel and the intermediation revenue collected from the remaining third-party sellers.

Every (active) third-party seller $S_i$ solves the same problem (2) as before. For given $w$, the solution of the above problem (see the Appendix) yields

$$X^{\star\star}(w) \triangleq \frac{(N+M)(1-w)+w}{1+(N+M)(1-\theta)},$$

with $x_1^{\star\star}(w) \geq x_i^{\star\star}(w)$ for every $i \geq 2$ — i.e., because encroachment eliminates double marginalization, the platform's private label sells more than third-party sellers. Notice that, because encroachment mitigates double marginalization, $X^{\star}(w) < X^{\star\star}(w)$ for given $w$, and the (negative) impact of $w$ on aggregate output is weaker under encroachment. This is because, an increase in $w$ lowers the third-party sellers' sales but increases that of the integrated outlet. Furthermore, the following holds:

**Lemma 1** *There exists a unique 'choke listing fee' $\overline{w}_\theta$, larger than $w^\star$ and increasing in $\theta$, such that all third-party sellers are shut down if and only if $w \geq \overline{w}_\theta$.*

As intuition suggests, a higher $\theta$ makes platform appropriation through rival exclusion less likely, since rivals' presence raises the platform's direct-channel margin.

**Contracting stage.** $P$ maximizes the sum of its seller $S_1$'s direct sales profit and the intermediation revenue collected from the active third-party sellers — i.e.,

$$\max_{w\geq 0} \underbrace{p^{\star\star}(w)x_1^{\star\star}(w)}_{\text{Direct sales profit}} + \underbrace{w\sum_{i=2}^{N+M} x_i^{\star\star}(w)}_{\text{Intermediation revenue}} - \mathcal{K}.$$

Differentiating with respect to $w$ ($i = 2, .., N+M$), by the Envelope Theorem we obtain the following system of first-order conditions

$$\underbrace{\sum_{i=2}^{N+M} x_i^{\star\star}(w) + \sum_{i=2}^{N+M} w\frac{\partial x_i^{\star\star}(w)}{\partial w}}_{\text{Marginal intermediation revenue (?)}} + \underbrace{x_1^{\star\star}(w)\frac{\partial p^{\star\star}(w)}{\partial X}\sum_{i=2}^{N+M}\frac{\partial x_i^{\star\star}(w)}{\partial w}}_{\text{Strategic effect (+)}} + \underbrace{\frac{\partial p^{\star\star}(w)}{\partial X^e}\frac{\partial X^{\star\star}(w)}{\partial w}x_1^{\star\star}(w)}_{\text{Crowding out effect (−)}} = 0. \quad (4)$$

The three terms in the above condition reflect the following forces. First, a higher $w$ has a volume and a margin effect on the intermediation revenue that the platform extracts from the third-party sellers. Second, by reducing the output of the third-party sellers, a higher $w$ impacts positively the retail market price and the platform's direct sale profit: a strategic effect echoing the Stackelberg first-mover advantage. Finally, there is a crowding out effect on consumers' expectations: by increasing the fee charged to rivals, $P$ reduces aggregate output. Hence, in a fulfilled expectations equilibrium, it also reduces the demand enhancing effect generated by consumers' expectations on the network size.

**Proposition 3** *When $P$ is vertically integrated with $S_1$, for given $M$, there is a unique equilibrium in which active third-party sellers are charged $w^{\star\star}(M) > 0$, which is decreasing in $M$ and $N$. Shutdown occurs only when there are no positive spillover effects — i.e., $w^{\star\star} \leq \overline{w}_\theta$ for all $\theta \geq 0$ with equality only at $\theta = 0$.*

$P$ has no incentive to entirely shut down rivals and monopolize the market when network effects are in place — i.e., the equilibrium listing fee is always lower than its choke level. Two opposing forces shape this fee. First, by standard logic, given consumers' expectations, the platform would like to marginalize rivals by charging them a high listing fee. Second, high listing fees crowd out sales because consumers anticipate that their aggregate volume will be lower, reducing their willingness to pay, the equilibrium price and thus $P$'s profit.

**Entry stage.** The entrants' zero profit condition then yields the following.

**Proposition 4** *When $P$ is vertically integrated with $S_1$, there exist thresholds $N^{\star\star} > 2$ and $I^{\star\star} > 0$, both increasing in $\theta$, such that sellers enter — i.e., $M^{\star\star} \geq 1$ — if and only if $N \leq N^{\star\star}$ and $I \leq I^{\star\star}$. The number of entrants is increasing in $\theta$. Moreover, if $M^{\star\star} \geq 1$, the equilibrium listing fee is*

$$w^{\star\star} \triangleq \frac{1}{2} + (1-\theta)\sqrt{I},$$

*which is decreasing in $\theta$, and increasing in $I$.*

Hence, the listing fee set by an integrated platform falls with the extent of network effects and increases with the specialization cost. The rest of the intuition is as before.

**Remark.** Notice that the results are unchanged if encroachment takes the form of private-label entry rather than the acquisition of an incumbent seller. Since the integrated unit does not pay the listing fee, it is weakly more efficient than an independent seller. Therefore, whenever independent sellers are just willing to participate, by the zero-profit condition, the platform's own seller earns positive profits. Private-label entry may then change the number of active sellers and hence shift the thresholds in Proposition 4, but it does not alter the main trade-offs that we have highlighted.

### 3.3 Business model choice

We can now study the impact of vertical encroachment on the platform's profit and identify the determinants of its profitability. To gain intuition, a first helpful step is to investigate how the business model choice affects entry and listing fees (compared to the case of a pure intermediary).

**Proposition 5** *Vertical encroachment hinders entry — i.e., $N^{\star\star} < N^{\star}$, $I^{\star\star} < I^{\star}$ and $M^{\star\star} \leq M^{\star}$. The difference $M^{\star} - M^{\star\star}$ is decreasing in $\theta$. Listing fees are higher with vertical encroachment than without — i.e., $w^{\star\star} > w^{\star}$.*

This proposition shows an intuitive result. Although network effects temper $P$'s incentive to engage in self-preferencing tactics, with encroachment $P$ has an incentive to charge sellers a higher fee because it gains from diverting consumers towards its (less expensive) private label.[13] By reducing sellers' profit, a higher listing fee tends to reduce entry, thereby mitigating the extent of network effects and increasing the gap between the listing fees in the two business models.

Interestingly, as network effects strengthen, the difference between the number of entrants with and without vertical encroachment falls. The reason is that while the listing fee in the pure intermediation model is constant, it falls with $\theta$ under platform encroachment. This is because the integrated platform can directly monetize any increase in consumers' expectations via its private label.

We can now turn to study the profitability of encroachment. Let $\Pi_P^{\star\star}$ be the equilibrium profit of a vertically integrated platform and $\Pi_P^{\star}$ be the profit of a pure intermediary. Comparing profits with and without encroachment, there is a critical cost level

$$\overline{\mathcal{K}} \triangleq \Pi_P^{\star\star} - \Pi_P^{\star} > 0, \tag{5}$$

such that encroachment occurs if and only if $\mathcal{K} \leq \overline{\mathcal{K}}$.

Clearly, when the cost of encroachment is negligible, the platform strictly prefers to enter the territory of its third-party sellers and compete with them. Nonetheless, the intriguing aspect of this analysis lies in how the model parameters influence this critical threshold. The following holds.

**Proposition 6** *$\overline{\mathcal{K}}$ is: (i) increasing in $I$, (ii) increasing in $\theta$ if and only if $N$ is sufficiently large, and (iii) independent of $N$ when $N \leq N^{\star\star}$, and inverted-U shaped with respect to $N$ otherwise.*

As intuition suggests, the region of parameters where vertical encroachment is preferred to pure intermediation expands as the sellers' specialization cost grows. The reason is twofold. First, a smaller number of entrants, as implied by higher specialization costs, lowers the intermediation revenue, which is the only source of profit for a pure intermediation platform. Second, with fewer entrants the downstream market is more profitable for the vertically integrated unit. Hence, as the specialization cost grows, the platform gains relatively more from being integrated.

By contrast, the impact of network effects on the platform's incentive to enter the downstream market is ambiguous and depends on the number of incumbents in the marketplace. Specifically, the region of parameters where $P$ gains from encroaching expands with $\theta$ provided $N$ is sufficiently large. The reason is that entry is restricted in this range of parameters. Hence, the benefits of stronger network effects are not dissipated by the entry of new rivals in the market and can be monetized by the platform's downstream unit.

Finally, to explain how $N$ impacts the incentive to encroach, there are two cases to consider. When entry occurs in both regimes, the number of incumbents does not affect $P$'s incentive to encroach: with

[13] This result is broadly coherent with the existing literature on hybrid platforms (see, e.g., Anderson & Bedre-Defolie (2021), Etro (2021), Etro (2023), Zennyo (2022)).

endogenous entry, what matters is the total number of rivals in the marketplace not their composition. When, instead, entry is blocked with a vertically integrated platform but not with a pure intermediary, a change in $N$ only impacts the vertical integration profit.

First, as the number of incumbents grows, the intermediation revenue rises since more sellers pay the listing fee: a revenue-enhancing effect. Second, since entry is blocked, competition strengthens as $N$ increases, and $P$'s integrated unit makes lower profits: a competition-strengthening effect. When $N$ is not too large, the competition-strengthening effect is weak, while the intermediation revenue-enhancing effect is sizeable and thus dominates. Hence, the incentive to encroach rises with $N$. By contrast, when $N$ is large, the competition-strengthening effect gains prominence and outweighs the intermediation revenue-enhancing effect, reducing the platform's incentive to integrate. A fortiori this happens when $N$ is too high to block entry under both regimes. In this case, the profit of a pure intermediary is increasing in $N$. Hence, other things being equal, pure intermediation becomes relatively more attractive as the number of incumbents rises.

**Multiple acquisitions.** The analysis can be extended to the case in which the platform acquires more than one incumbent seller. The Cournot structure implies that, in this case, the platform will not keep all acquired outlets active. Since acquired outlets are commonly owned and produce the same good, the platform internalizes the competition among them. With no outlet-specific capacity constraints or additional variety benefit, only the total quantity supplied by the integrated business matters. Hence, the platform can optimally concentrate production in one integrated outlet and shut down the additional acquired outlet(s). Multiple acquisitions therefore operate mainly by reducing the number of independent Cournot competitors and fee-paying sellers. At the same time, the remaining integrated outlet is more efficient, since it does not bear the listing fee, and may expand output at the rivals' expense. The qualitative trade-off is unchanged: acquiring more incumbents strengthens the foreclosure effect, but also reduces fee revenue and may weaken the network value generated by independent participation.

### 3.4 External effects

In this subsection, we study the external effects of vertical encroachment — i.e., the impact of this business model on consumers and sellers.

**Consumer surplus.** When seller entry is endogenous, platform encroachment presents two drawbacks for consumers. Firstly, all else being equal, integrated platforms tend to impose higher listing fees compared to pure intermediaries, and these costs are then passed on to consumers in the form of higher final prices. Secondly, because platform encroachment limits new entrants, all else being equal, it reduces the overall production output. However, akin to many vertical mergers, platform encroachment also offers benefits by eliminating one layer of double marginalization while maintaining marketplace competition. Furthermore, the integrated seller, who is more efficient than its rivals, will expand sales to compensate for the rivals' reduced sales, thereby reaching a more efficient allocation of production in the industry.

In the next proposition, we show that the balance between these effects depends on the number of incumbent sellers. For expositional purposes, hereafter, we rule out the case in which $I$ is large enough to deter entry in both regimes — i.e., $I \leq I^{\star\star}$ so that $N^{\star\star} \geq 2$.

**Proposition 7** *There exists a threshold $N_0 \in (N^{\star\star}, N^{\star})$ such that consumers are better off under platform encroachment than a pure intermediary if and only if $N \geq N_0$. The threshold $N_0$ is increasing in $\theta$ and decreasing in $I$.*

This proposition delivers a novel insight: the impact of vertical encroachment on consumer surplus depends on the number of incumbent sellers. To gain intuition, suppose that entry of newcomers occurs under both business models — i.e., focus on the region of parameters where $N < N^{\star\star}$ so that $M^{\star} \geq M^{\star\star} \geq 1$. A pure intermediary attracts more entrants than a vertically integrated platform. Hence, the sum of the negative effect on entry and the impact of (higher) listing fees overcomes the reduction of double marginalization. The reason is that, with a pure intermediary, free entry dissipates the profits of third-party sellers, and all the benefits of competition are passed on to consumers; with vertical encroachment, the integrated unit has market power since it is more efficient than its rivals, and it leverages this market power.

Next, consider the opposite scenario where the number of incumbents is so large ($N > N^{\star}$) that a new entrant is unable to cover the fixed cost irrespective of $P$'s business model. In this region of parameters, platform encroachment does not impact the number of opponents in the marketplace. Hence, the gain associated with lower double marginalization is the dominating force in place.

By continuity, it should be clear that for intermediate values of $N$, where entry happens with a pure intermediary but not under vertical encroachment, consumers continue to benefit from encroachment when the number of incumbents is sufficiently large ($N \geq N_0$). To understand this, recall that $w^{\star\star}$ falls with $N$, so that the entry deterrence effect of vertical encroachment is less problematic. As a result, the positive effect of reducing double marginalization is still the dominating force. The opposite happens when $N$ is smaller than $N_0$ as the effect of vertical encroachment on entry becomes the dominant force.

Finally, notice that since $N_0$ is increasing in $\theta$, strengthening network effects tends to reduce the region of parameters in which consumers benefit from platform encroachment. As $\theta$ grows, entry becomes more profitable since the market size expands. Therefore, the negative impact of platform encroachment on seller participation gets amplified. Precisely for the opposite reason, this region of parameters grows as the specialization cost increases since, by being more costly, entry becomes less of a concern — i.e., $N_0$ is decreasing in $I$.

**Seller profits.** Next, we examine the relationship between $P$'s business model and sellers' profit.

**Proposition 8** *Entrants are indifferent between the two regimes. The impact of the business model on the incumbent sellers' profit depends on $N$ — i.e.,*

- *If $N < N^{\star\star}$, the business model has a neutral impact on the incumbent sellers' profit;*

- *If $N > N^{\star}$, the incumbent sellers are better-off with a pure intermediary than an integrated platform;*
- *If $N \in [N^{\star\star}, N^{\star}]$, there exists a threshold $N_1 \in (N^{\star\star}, N^{\star})$ such that the incumbent sellers are better off with than without platform encroachment if and only if $N \leq N_1$. The threshold $N_1$ is increasing in $\theta$ and decreasing in $I$.*

While vertical encroachment has a clear adverse effect on seller entry, its impact on the incumbents' profit depends on their number. Since the entrants make zero profits in either regime, they are indifferent between the two regimes. Hence, in the following we focus on the profits of the incumbents.

When entry occurs under both business models ($N < N^{\star\star}$), the profit of an active seller is equal to the specialization cost because, up to this cost, all sellers are identical. Hence, incumbents make the same profit with and without encroachment. By contrast, when there is no entry in both regimes ($N > N^{\star}$), vertical encroachment only leads to higher listing fee, thereby reducing the incumbents' profit. Finally, in the intermediate region of parameters where entry occurs only with a pure intermediary ($N^{\star\star} \leq N \leq N^{\star}$), vertical encroachment increases incumbents' profit if their number is not too high. The reason is that this business model restricts entry in the region of parameters under consideration, thus acting as a barrier to entry at the benefit of incumbents.[14] When the number of incumbents is not too high, the competition-softening effect dominates the positive impact of vertical encroachment on the listing fee. Otherwise, when the number of incumbent sellers is sufficiently high, the dominating effect is that on the listing fee because incumbents already compete fiercely among themselves in both regimes.

Interestingly, network effects facilitate the beneficial impact of platform encroachment on the incumbents' profit — i.e., $N_1$ is increasing in $\theta$ — since they reduce the listing fee charged by the platform under encroachment. By contrast, higher specialization costs tend to temper this effect because entry is less likely under both regimes as $I$ raises.

**Total Welfare.** Next, we examine the relationship between $P$'s business model and total welfare, which is defined as the sum of platform's profit, incumbent sellers' profits and consumer surplus.

**Proposition 9** *There exists a threshold $N_2 \in [N^{\star\star}, N^{\star})$ such that total welfare is higher with an integrated platform than with a pure intermediary if and only if $N \geq N_2$.*

As intuition suggests, the effect of $P$'s business model on total welfare aligns with that on consumer surplus since industry profit is always higher with encroachment than with a pure intermediation model.

# 4 Extensions

We now argue that the qualitative implications of our analysis remain valid when some of the main assumptions of the baseline model are relaxed.

[14] The competition-softening effect of platform encroachment through another mechanism is discussed in Lam & Liu (2022).

**Endogenous network effects.** We have assumed that the network effects parameter $\theta$ is exogenous. However, one could imagine that platforms can engage in costly activities to foster these positive externalities — e.g., through advertising and promotional campaigns, R&D, and activities that strengthen complementarities between the products offered on the marketplace. For example, Chi et al. (2022) find evidence that vertical encroachment is accompanied by greater platform support, which may positively benefit the sellers participating the marketplace. Hence, following Miric et al. (2021) and Ha et al. (2022), we now examine how these incentives vary across business models.

Higher network effects increase the appeal of the marketplace. They raise consumer willingness to pay and, in turn, make entry by third-party sellers more profitable. A pure intermediation platform is incentivized to foster consumer expectations to increase aggregate sales on the marketplace, thereby raising the fees it collects from the sellers. Under vertical encroachment, instead, the platform mainly cares about the impact of these effects on the market price because they translate into higher demand for its private label. In fact, the positive impact of $\theta$ on entry does not necessarily benefit a vertically integrated platform since its private label will be exposed to greater competition.

In the next proposition, we explain how these effects balance out.

**Proposition 10** *There exists a threshold $N_3 \in (N^{\star\star}, N^{\star})$ such that platform encroachment stimulates investment if and only if $N \geq N_3$.*

The positive effect of network externalities on entry diminishes when the number of incumbents grows. Hence, a vertically integrated platform has a stronger incentive than a pure intermediary to foster these effects when $N$ is sufficiently large to restrict entry of new sellers. Furthermore, when there is a significant number of incumbents, enhancing network effects allows an integrated platform to raise the market price and protect its private label from competition by the incumbents. However, one must keep in mind that incentives to innovation in own products may decrease for other independent sellers. Specifically, by increasing its fees under vertical integration, the platform lowers the margins of the incumbent sellers and may thus reduce their incentive to innovate in their own products. This negative balancing effect must be taken into account when evaluating the innovation incentives due to platform encroachment.

**Access fees to consumers.** We now examine whether the implications of our analysis change when the platform can charge a uniform participation fee, hereafter denoted by $T$, to consumers. The rest of the assumptions are as in the baseline model, with the only caveat that $P$ also sets $T$ in addition to setting $w$.

From Katz & Shapiro (1985), the inverse demand function with a participation fee (see the Appendix) is

$$p(\cdot) \triangleq \max\{0, 1 + \theta X^e - T - X\}.$$

In contrast to the listing fee charged to the third-party sellers, the participation fee charged to consumers directly reduces consumers' willingness to pay.

In the Appendix, we show that the platform is indifferent between using different combinations of the listing fee charged to the third-party sellers and the participation fee charged to consumers to extract surplus. That is, in the pure intermediation regime, any combination of $w$ and $T$ such that $w+T=w^{\star}$ is optimal from the platform's point of view; likewise, under platform encroachment, any combination of $T$ and $w$ such that $w+T=w^{\star\star}$ is optimal from platform's point of view. Hence, aggregate and individual sales (and therefore equilibrium prices) are the same as in the baseline model, implying that our results remain valid even if $P$ can charge consumers a participation fee.

**Alternative timing.** We have assumed that specialization and entry decisions are made before the platform sets listing fees. As explained above, the idea behind this timing is that contracts are often renegotiated, while both the choice of the business model and specialization decisions require a relatively longer time horizon. Yet, one may wonder whether our qualitative insights change in a game where the timing of entry and contracting decisions are reverted — i.e., listing fees are offered before entry. The peculiar feature of this game is that entry decisions are influenced by listing fees. Hence, in this setting, the platform anticipates the effect that an increase in listing fees produces on the number of rivals competing in the marketplace.

All results obtained in the baseline model remain valid with this alternative timing. Yet, other things being equal, the vertically integrated platform has a stronger incentive to raise the listing fee than a pure intermediation platform. The reason is that, by so doing, the platform reduces entry and protects its integrated seller from competition in the marketplace — see, e.g., Anderson & Bedre-Defolie (2021).

Notice, however, that the resulting listing fee is suboptimal after entry. The platform faces a standard time inconsistency problem: once sellers have made their specialization decisions, $P$ has an incentive to renege on the listing fee announced before entry. Anticipating this behavior, sellers will base their entry decisions on the optimal listing fee for the platform ex-post. Hence, in addition to presuming that contracts have a time horizon longer than organizational and entry decisions, assuming that listing fees are offered before entry is a fragile hypothesis also because $P$ will ex-post find it optimal to adjust the listing fee to the actual number of sellers that enter the marketplace.

**Ad-valorem fees.** In our analysis, we made the simplifying assumption that platforms charge per-unit listing fees. In practice, many platforms (e.g., Amazon, Etsy, Uber Eats) levy ad-valorem fees — i.e., a percentage of the transaction value. We focused on per-unit fees because it is well known in the IO literature that vertical oligopolies with endogenous ad-valorem fees are intractable. Yet, both types of fees give rise to double marginalization, albeit through different mechanisms.

Under per-unit fees, the platform increases the seller's marginal cost by a constant amount, inducing the seller to reduce the quantity distributed (or raise its retail price) and pass the fee on to consumers; this sequential markup reduces demand and generates the standard double-marginalization problem. Under ad-valorem fees, the platform extracts a fraction of the transaction price, so the seller internalizes that any price increase (or quantity reduction) enlarges both its margin and the platform's share. This flattens the marginal revenue and again results in higher prices.

Therefore, while per-unit fees impose a constant wedge per unit sold, ad-valorem fees scale with price and thus introduce a nonlinear distortion. Nonetheless, in both cases, consumers face inefficiently high prices and reduced output, so the qualitative welfare implications of double marginalization apply regardless of the fee structure. However, analytical solutions — and thus sharp welfare comparisons — are only tractable under per-unit fees.

To illustrate the new forces at play with ad-valorem fees, let $\alpha \in [0,1]$ denote the (common) ad-valorem rate charged by the platform to the third party sellers. Assume that all sellers (including the one integrated with the platform) incur a constant marginal distribution cost $c > 0$.[15] $P$ solves

$$\max_{x_1 \geq 0} (p\left(X^e, X\right) - c)x_1 + \alpha p\left(X^e, X\right) \sum_{i=2}^{N+M} x_i - \mathcal{K}.$$

Every (active) third-party seller $S_i$ solves

$$\max_{x_i \geq 0} p\left(X^e, X\right)(1-\alpha)\, x_i - c x_i.$$

The first-order conditions are

$$p\left(X^e, X\right) - (x_1 - c) - \underbrace{\alpha \sum_{i=2}^{N+M} x_i}_{\text{Revenue-stifling effect}} = 0,$$

for the platform and

$$p\left(X^e, X\right) - x_i = \frac{c}{1-\alpha}, \quad \forall i \geq 2,$$

for the third-party sellers.

From these conditions, one can see that ad-valorem fees introduce an additional effect relative to per-unit fees. In particular, under an ad-valorem scheme the platform has weaker incentives to engage in self-preferencing. The reason is that, when the platform expands the output of its own brand, it lowers the market price, which in turn reduces the distribution revenue it collects from third-party sellers. Thus, ceteris paribus, ad-valorem fees attenuate foreclosure incentives and create more room for entry compared to per-unit fees, thereby reinforcing the pro-competitive aspect of encroachment. At the same time, because $\alpha$ appears in the denominator of the first-order condition for third-party sellers' output choice, an increase in $\alpha$ raises their marginal cost, generating double marginalization and leading to an increase in final prices.[16]

**Differentiated products.** It can be shown that the findings above remain robust when the analysis is extended to differentiated products and price competition. In fact, under encroachment, two forces

[15] If $c = 0$, it is well known that the platform fully extracts the profit of the third-party sellers.

[16] Solving the model in closed form, however, produces output functions with $\alpha$ in the denominator, which makes the platform's first order condition with respect to $\alpha$ a high-degree polynomial and hence analytically intractable.

tend to reinforce the main mechanism. First, a higher listing fee increases the marginal cost faced by third-party sellers and therefore induces them to charge higher retail prices. With price competition and differentiated products, prices are strategic complements: when third-party sellers raise their prices, the platform's integrated unit optimally responds by raising its own price as well. This softens retail competition and leads to a higher overall price level, which in turn worsens consumers' expectations about the value of joining the platform and depresses demand (a closely related mechanism is analyzed in Bisceglia et al. (2022)).

Second, higher listing fees also make entry less attractive for third-party sellers. This reduces product variety on the platform, which is particularly costly when products are horizontally differentiated, since consumers derive value not only from lower prices but also from the availability of a broader set of options. As a result, encroachment affects demand through both a price channel and a variety channel.

Taken together, these forces suggest that the adverse demand consequences of encroachment are, if anything, amplified in environments with differentiated products and price competition. This reinforces the relevance of the main results and indicates that our benchmark model provides a conservative representation of the underlying mechanism.

# 5 Concluding remarks

Our analysis shows that platform encroachment reshapes competitive dynamics not only by affecting entry and consumer welfare, but also by altering the strategic conduct of platforms. Integrated platforms use listing fees as both a revenue instrument and a signaling device: high fees can restrict entry, but transparent disclosure fosters consumer participation by strengthening network effects. Likewise, the profitability of private labels depends on the balance between entry costs, the number of incumbents, and the intensity of competition — highlighting why encroachment is more attractive in mature markets with high specialization standards. Finally, by reducing double marginalization while retaining a degree of competition, encroachment can serve as a strategic lever to balance efficiency and market power. These findings underscore that platform integration is best understood not as a one-dimensional foreclosure strategy, but as a broader business model choice shaped by expectations, transparency, and the management of network effects.

# Appendix

**Demand microfoundation.** The demand side features direct network externalities and is modeled à la Katz & Shapiro (1985). Consumers are heterogeneous in their basic willingness to pay and are homogeneous in their valuation for the network effect. Assume, for simplicity, that the basic willingness to pay, denoted by $r$, is uniformly distributed over the support $[0,1]$ across consumers. The expected utility of a consumer of type $r$ buying from $S_i$ is

$$u\left(X^e, P_i\right) \triangleq r + \theta X^e - P_i, \quad \forall i = 1, ..., N+M,$$

where, as explained above, $X^e$ is the aggregate output that consumers expect sellers to distribute. The parameter $\theta \geq 0$ measures how consumer utility reacts to a change in these expectations.

Under the above specification, sellers have positive demand only if the following 'no arbitrage condition' holds

$$P_i - \theta X^e = P_j - \theta X^e, \quad \forall i, j = 1, ..., N+M, \tag{6}$$

Since sellers are perfectly compatible, it must be $P_i = P$ for every $i = 1, ..., N+M$. Therefore, consumers buy the product only if

$$r \geq r^\star \triangleq \underbrace{P - \theta X^e}_{\text{Reservation price}}.$$

Hence, the total demand for the product distributed within the marketplace is

$$X\left(X^e, P\right) \triangleq 1 - \Pr\left[r \leq r^\star\right] = 1 + \theta X^e - P,$$

yielding the (inverse) demand function in (1).

**Assumption 1.** *We posit that the extent of network effects is not too pronounced — i.e., $\theta < \frac{1}{2}$ — to have downward sloping demand functions.*

**Proof of Proposition 1.** When a seller $S_i$ enters the marketplace and is offered a listing fee $w$, it solves the following maximization problem

$$\max_{x_i \geq 0} \left(p\left(X^e, X\right) - w\right) x_i. \tag{7}$$

Recalling that consumers' expectations $X^e$ have already been formed before sellers set output, differentiating with respect to $x_i$ (holding $X^e$ constant) we have the following first-order conditions

$$p\left(X^e, X\right) - w - x_i = 0 \quad \Rightarrow \quad x_i^\star\left(X^e, X\right) \triangleq 1 - w + \theta X^e - X, \quad \forall i = 1, .., N+M. \tag{8}$$

Assuming that $N+M$ sellers are active in the marketplace, imposing rational expectations — i.e., $X^\star = X^e$

— by solving the system of equations in 8 it is easy to show that

$$X^{\star}(\cdot) \triangleq \sum_{i=1}^{N+M} x_i^{\star}(\cdot) = \frac{(M+N)(1-w)}{1+(M+N)(1-\theta)}, \tag{9}$$

with each seller $S_i$'s individual output level being

$$x_i^{\star}(\cdot) \triangleq 1 - w - (1-\theta) X^{\star}(\cdot), \quad \forall i = 1, .., N+M. \tag{10}$$

The equilibrium price is, therefore, $p^{\star}(\cdot) \triangleq 1 - (1-\theta) X^{\star}(\cdot)$.

As expected, the output set by each seller falls with listing fees charged by the platform. Simple inspection of the total marketplace sales reveals that, holding the listing fees constant, $X^{\star}(\cdot)$ is increasing in $\theta$. The intuition is that an increase in the level of positive spillover $\theta$ increases the consumers' willingness to pay, thereby inducing every seller $S_i$ to expand their sales volumes. Moreover, differentiating $p^{\star}(\cdot)$ with respect to $\theta$, we get

$$\frac{\partial p^{\star}(\cdot)}{\partial \theta} = X^{\star}(\cdot) - (1-\theta)\underbrace{\frac{\partial X^{\star}(\cdot)}{\partial \theta}}_{(+)} = \frac{N+M}{\left(1+(N+M)(1-\theta)\right)^2}(1-w).$$

As discussed in the main text, there are two opposing effects of an increase in $\theta$: (i) consumers buy more for a given price and, hence, the equilibrium price will increase; (ii) $X^{\star}(\cdot)$ also grows and the elasticity of demand increases. Under the observation that $1 \geq w$, which ensures that aggregate output is positive (a conjecture that will be verified ex-post), the first effect dominates. Hence, for given listing contracts, stronger network effects increase the market price in addition to increasing output.

Consider now the contracting stage. Solving the system of first-order conditions in (3) yields the optimal symmetric listing fee $w^{\star} \triangleq \frac{1}{2}$. Substituting this value in the expressions for total and individual output of each seller in equations (9) and (10), yields

$$X^{\star}(M) \triangleq X^{\star}(M, w^{\star}) = \frac{N+M}{2(1+(N+M)(1-\theta))}, \tag{11}$$

$$x^{\star}(M) \triangleq x^{\star}(M, w^{\star}) = \frac{1}{2(1+(N+M)(1-\theta))}. \tag{12}$$

The equilibrium market price is then

$$p^{\star}(M) \triangleq p(X^{\star}(M), X^{\star}(M)).$$

Differentiating the equilibrium total output, individual outputs and the price with respect to $\theta$ yields

$$\frac{\partial X^{\star}(M)}{\partial \theta} = \frac{(M+N)^2}{2((1+(M+N)(1-\theta)))^2} > 0, \tag{13}$$

$$\frac{\partial x^{\star}(M)}{\partial \theta} = \frac{(M+N)}{2((1+(M+N)(1-\theta)))^2} > 0, \tag{14}$$

$$\frac{\partial p^{\star}(M)}{\partial \theta} = \frac{(M+N)}{2((1+(M+N)(1-\theta)))^2} > 0. \tag{15}$$

For every $N$ and $M$, the following holds

$$X^{\star}(M) \geq X^{M} \triangleq \frac{1}{2-\theta},$$

where $X^{M}$ is the output that would be chosen by a fully integrated monopolist who is therefore unable to use listing contracts as a communication device to influence consumers' expectations and exploit the positive spillover effects to its own advantage. ■

**Proof of Proposition 2.** From the sellers' first-order conditions, the profit of an entrant seller $S_i$ is

$$\pi_i^{\star}(M) \triangleq x^{\star}(M)^2 - I. \tag{16}$$

Solving the expression in equation (16) for $M$, yields the number $M^{\star}$ of new joiners. Specifically, ignoring for simplicity the integer constraint, the corresponding zero-profit condition implies a unique solution

$$M^{\star} \triangleq \frac{1}{1-\theta}\left(\frac{1}{2}\sqrt{\frac{1}{I}} - 1\right) - N,$$

which, as expected, is positive only if the investment cost $I$ is not too large. Moreover, $M^{\star}$ is increasing in $\theta$ — that is, the more responsive demand is to consumers' expectations, the higher the number of entrants, and decreasing in $N$: the presence of a higher number of incumbent sellers restricts entry.

Then, the inequality $M^{\star} \geq 1$ holds if

$$N \leq N^{\star} \triangleq \frac{1}{1-\theta}\left(\frac{1}{2}\sqrt{\frac{1}{I}} - (2-\theta)\right),$$

with $N^{\star} \geq 2$ if and only if

$$I \leq I^{\star} \triangleq \frac{1}{4(4-3\theta)^2}.$$

Differentiating $I^{\star}$ with respect to $\theta$, we find that

$$\frac{\partial I^{\star}}{\partial \theta} = \frac{3}{2(4-3\theta)^3} > 0,$$

which concludes the proof. ■

**Proof of Lemma 1.** Recalling that consumers' expectations have already been formed when $P$ sets output, we obtain the following system of first-order conditions

$$p\left(X^e, X\right) - x_1 = 0 \qquad \text{and} \qquad p\left(X^e, X\right) - x_i - w = 0, \quad \forall i \geq 2. \tag{17}$$

From the above conditions it is immediate that $P$ distributes more than the rival sellers. Imposing the rationality requirement — i.e., $X^e = \sum_{i=1}^{N+M} x_i$ — and solving the system of equations in equation 17 yields

$$X^{\star\star}(\cdot) \triangleq \frac{(N+M)(1-w)+w}{1+(1-\theta)(N+M)}, \qquad p^{\star\star}\left(\cdot\right) \triangleq 1-(1-\theta)\, X^{\star\star}(\cdot), \tag{18}$$

and

$$x_1^{\star\star}(\cdot) \triangleq p^{\star\star}\left(\cdot\right) \geq x_i^{\star\star}(\cdot) \triangleq p^{\star\star}\left(\cdot\right) - w, \quad \forall i \geq 2. \tag{19}$$

Furthermore, given the listing fees offered to $S_i$'s third-party rivals, we can solve $x_i^{\star\star}(\cdot) = 0$ with respect to $w$ and obtain the following 'choke listing fee'

$$\overline{w}_\theta \triangleq \frac{1}{2-\theta}, \tag{20}$$

meaning that all third-party sellers are shut down if and only if $w \geq \overline{w}_\theta$, with $\overline{w}_\theta$ being increasing in the spillover level $\theta$. As intuition suggests, the higher $\theta$, the less likely is the platform to appropriate the seller market by shutting down rivals. This is because the presence of rivals in the marketplace positively affects the margin of the platform in the direct channel. ■

**Proof of Proposition 3.** When $P$ is vertically integrated with $S_1$, for given $M$, there is a unique equilibrium in which active third-party sellers are charged $w^{\star\star}\left(M\right)$ which is obtained by solving the system of first-order conditions in (4) and given by

$$w^{\star\star}\left(M\right) \triangleq \frac{1+\left(N+M+2\right)\left(1-\theta\right)}{2\left(\theta^2+\left(N+M+3\right)\left(1-\theta\right)\right)}.$$

Differentiating $w^{\star\star}(\cdot)$ with respect to $M$ and $N$ yields

$$\frac{\partial w^{\star\star}(\cdot)}{\partial M} = \frac{\partial w^{\star\star}(\cdot)}{\partial N} = -\frac{(1-\theta)^2\theta}{2((3+M+N)(1-\theta)+\theta^2)^2} < 0.$$

Substituting the above fee into the output of the platform's sellers, the output of the independent sellers and the total output as presented in equations (18) and (19) yields

$$x_1^{\star\star}\left(M\right) \triangleq \frac{\left(N+M\right)\left(1-\theta\right)+3-\theta}{2\left(\theta^2+\left(N+M+3\right)\left(1-\theta\right)\right)} > x_i^{\star\star}\left(M\right) \triangleq \frac{\theta}{2\left(\theta^2+\left(N+M+3\right)\left(1-\theta\right)\right)} \geq 0, \quad \forall i \geq 2,$$

$$X^{\star\star}\left(M\right) = \left(N+M-1\right)x_i^{\star\star}\left(M\right) + x_1^{\star\star}\left(M\right) \triangleq \frac{N+M+3-2\theta}{2\left(\theta^2+\left(N+M+3\right)\left(1-\theta\right)\right)}.$$

The first inequality arises directly from the assumption that $\theta < 1/2$. It is straightforward to note that

at $\theta = 0$, the output of each individual seller is $x_i(M) = 0$ for every $i \geq 2$. This implies that $w^{\star\star} \leq \overline{w}_\theta$ for all $\theta \geq 0$ with equality at $\theta = 0$.

Finally, substituting the above total output into the price function, yields

$$p^{\star\star}(M) \triangleq 1 - (1-\theta)\frac{N + M + 3 - 2\theta}{2\left(\theta^2 + (N+M+3)(1-\theta)\right)} \geq 0.$$

■

**Proof of Proposition 4.** From the sellers' first-order conditions, the profit of an entrant $S_i$ is

$$\pi_i^{\star\star}(M) \triangleq x_i^{\star\star}(M)^2 - I. \tag{21}$$

Solving the expression in (21) for $M$, yields the number $M^{\star\star}$ of new joiners. Specifically, ignoring again the integer constraint, the corresponding zero profit condition implies a unique solution

$$M^{\star\star} \triangleq \frac{\theta}{1-\theta}\left(\frac{1}{2}\sqrt{\frac{1}{I}} - \theta\right) - (N+3). \tag{22}$$

The inequality $M^{\star\star} \geq 1$ then holds if

$$N \leq N^{\star\star} \triangleq \frac{1}{1-\theta}\left(\frac{\theta}{2}\sqrt{\frac{1}{I}} - (2-\theta)^2\right),$$

with $N^{\star\star} \geq 2$ if and only if

$$I \leq I^{\star\star} \triangleq \frac{\theta^2}{4(6-\theta(6-\theta))^2}$$

To show $M^{\star\star}$ is increasing in $\theta$, we first note that

$$\frac{\partial^2 M^{\star\star}}{\partial\theta\partial I} = -\frac{1}{4(1-\theta)^2 I^{3/2}} < 0.$$

Now, it is sufficient to show that, at $I = I^{\star\star}$,

$$\frac{\partial M^{\star\star}}{\partial\theta}|_{I=I^{\star\star}} = \frac{6-\theta^2}{\theta(1-\theta)} > 0.$$

The above expression is positive for all $0 < \theta < 1/2$.

Differentiating $I^{\star\star}$ with respect to $\theta$ yields

$$\frac{\partial I^{\star\star}}{\partial\theta} = \frac{\theta(6-\theta^2)}{2(6-\theta(6-\theta))^3} > 0.$$

Finally, when $M^{\star\star} \geq 1$, the equilibrium listing fee is

$$w^{\star\star} \triangleq w^{\star\star}(M^{\star\star}) = \frac{1}{2} + (1-\theta)\sqrt{I}.$$

It is straightforward to see that $w^{\star\star}$ is independent of $N$, increasing in $I$ and decreasing in $\theta$. ■

**Proof of Proposition 5.** Comparing $N^{\star\star}$ and $N^{\star}$ gives

$$N^{\star} - N^{\star\star} = \frac{1}{2}\left(2(2-\theta) + \sqrt{\frac{1}{I}}\right) > 0.$$

Comparing $I^{\star}$ and $I^{\star\star}$ yields

$$I^{\star} - I^{\star\star} = \frac{(1-\theta)(3-3\theta)(3-\theta-\theta^2)}{(4-3\theta)^2(6-\theta(6-\theta))^2} > 0.$$

Further, comparing $M^{\star\star}$ with $M^{\star}$, we observe that

$$M^{\star} - M^{\star\star} = 2 + \frac{1}{2\sqrt{I}} - \theta > 0,$$

which is decreasing in $\theta$.

Finally, comparing the listing fees under the two regimes gives

$$w^{\star\star} - w^{\star} = \sqrt{I}(1-\theta) > 0,$$

with this difference being decreasing in $\theta$ and increasing in $I$. ■

**Proof of Proposition 6** From equation (5), recall that

$$\overline{\mathcal{K}} = \Pi_P^{\star\star} - \Pi_P^{\star},$$

where for given $M$, the profit of a pure intermediary platform is

$$\Pi_P^{\star}(M) \triangleq \sum_{i=1}^{N+M} w_i^{\star} x_i^{\star}(\cdot) = \frac{N+M}{4(1+(N+M)(1-\theta))},$$

while the profit of an integrated platform is

$$\Pi_P^{\star\star}(M) \triangleq p^{\star\star}(M)x_1^{\star\star}(M) + \sum_{i=2}^{N+M} w_i^{\star\star}(M)x_i^{\star\star}(M) = \frac{3+M+N}{4(\theta^2+(3+M+N)(1-\theta))}.$$

For $N < N^{\star\star}$ , recall that

$$\overline{\mathcal{K}} = \Pi_P^{\star\star}(M^{\star\star}) - \Pi_P^{\star}(M^{\star}) = \frac{\sqrt{I}}{2} > 0, \tag{23}$$

which is independent of $\theta$ and $N$ and increasing in $I$.

For $N \in [N^{\star\star}, N^{\star}]$, we have

$$\overline{\mathcal{K}} = \Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}) = \frac{1}{4}\left(\frac{3+N}{(\theta^2+(3+N)(1-\theta))} - \frac{1-2\sqrt{I}}{(1-\theta)}\right),$$

which is clearly increasing in $I$. Differentiating the above profit difference with respect to $N$, we observe that

$$\frac{\partial \overline{\mathcal{K}}}{\partial N} = \frac{\theta^2}{4(\theta^2+(3+N)(1-\theta))^2} > 0.$$

Differentiating the above profit difference with respect to $\theta$, we observe that

$$\frac{\partial \overline{\mathcal{K}}}{\partial \theta} = \frac{2\sqrt{I}(\theta^2+(3+N)(1-\theta))^2 - \theta(2(3+N)(1-\theta)+\theta^3)}{4(\theta^2+(3+N)(1-\theta))^2(1-\theta)^2}.$$

Additionally, differentiating the above term with respect to $N$, we observe that

$$\frac{\partial^2 \overline{\mathcal{K}}}{\partial \theta \partial N} = \frac{\theta(3+N-\theta^2)}{2(\theta^2+(3+N)(1-\theta))^3} > 0.$$

The above expression is always positive.

Then, computing the difference for the extreme cases yields

$$\begin{aligned}
\frac{\partial \overline{\mathcal{K}}}{\partial \theta}|_{N=N^{\star\star}} &= -\frac{\theta^2\sqrt{I} - 4(1-\theta)^2 I^{\frac{3}{2}} - 2I\theta^3(2-\theta)}{2(1-\theta)^2(\theta - 2\sqrt{I}(1-\theta))^2} < 0, \\
\frac{\partial \overline{\mathcal{K}}}{\partial \theta}|_{N=N^{\star}} &= \frac{\sqrt{I}(1+4I(1-\theta)^4 - 2\theta + 2\sqrt{I}(2-\theta(6(1-\theta)+\theta^3)))}{2(1-\theta)^2(1+2\sqrt{I}(1-\theta)^2)^2} > 0.
\end{aligned}$$

Thus, by the Intermediate-Value Theorem we can state that there exists a critical $\overline{N} \in [N^{\star\star}, N^{\star}]$ such that $\frac{\partial \overline{\mathcal{K}}}{\partial \theta} > 0$, for $N > \overline{N}$ and, $\frac{\partial \overline{\mathcal{K}}}{\partial \theta} < 0$ otherwise.

For $N > N^{\star}$, we have

$$\overline{\mathcal{K}} = \Pi_P^{\star\star}(0) - \Pi_P^{\star}(0) = \frac{3+N\left(1-\theta^2\right)}{4(1+N(1-\theta))\left(\theta^2+(3+N)(1-\theta)\right)} > 0.$$

Differentiating the above profit difference with respect to $\theta$, we observe that

$$\frac{\partial \overline{\mathcal{K}}}{\partial \theta} = \left(\frac{(3+N)(3+N-2\theta)}{4((3+N)(1-\theta)+\theta^2)^2} - \frac{4N^2}{(4(1+N(1-\theta)))^2}\right) > 0.$$

It is straightforward to show that the above expression is always positive.

Additionally, differentiating the above term with respect to $N$, we observe that

$$\frac{\partial \overline{\mathcal{K}}}{\partial N} = -\frac{(1-\theta)(3-\theta+N(1-\theta))(3+N-2\theta-(N-1)\theta^2)}{4(1+N(1-\theta))^2\left(\theta^2+(3+N)(1-\theta)\right)^2} < 0,$$

which concludes the proof. ■

**Proof of Proposition 7.** In our setting, aggregate output is a sufficient statistic for consumer surplus. If the total output is higher in one business model, then consumer surplus is also higher in that business model.

For $N < N^{\star\star}$, we have

$$X^{\star\star} - X^{\star} = \frac{1-2(2-\theta)\sqrt{I}}{2(1-\theta)} - \frac{1-2\sqrt{I}}{2(1-\theta)} = -\sqrt{I} < 0.$$

For $N \in [N^{\star\star}, N^{\star}]$, we have

$$X^{\star\star} - X^{\star} = \frac{1}{2}\left(\frac{3+N-2\theta}{\theta^2+(3+N)(1-\theta)} - \frac{1-2\sqrt{I}}{1-\theta}\right).$$

Differentiating the above difference in the total output with respect to $N$, we observe that

$$\frac{\partial (X^{\star\star} - X^{\star})}{\partial N} = \frac{(2-\theta)\theta}{2(\theta^2+(3+N)(1-\theta))^2} > 0.$$

Additionally, computing the difference in outputs for the extreme values of $N$ yields

$$\begin{aligned}
(X^{\star\star} - X^{\star})|_{N=N^{\star\star}} &= -\frac{\sqrt{I}(2+\theta)}{\theta - 2\sqrt{I}(1-\theta)} < 0, \\
(X^{\star\star} - X^{\star})|_{N=N^{\star}} &= \frac{(1-\theta)(2I+\sqrt{I})}{1+2(1-\theta)^2\sqrt{I}} > 0.
\end{aligned}$$

Thus, by the Intermediate Value Theorem, there exists a critical value

$$N_0 \triangleq \frac{\theta(2-\theta) - 2\sqrt{I}(3-\theta(3-\theta))}{2(1-\theta)\sqrt{I}},$$

such that $N > N_0$ implies $X^{\star\star} - X^{\star} > 0$. Else, $X^{\star\star} - X^{\star} < 0$. Differentiating the threshold $N_0$ with respect to $\theta$ and $I$, it is immediate to show that it is increasing in $\theta$ for every $I \leq I^{\star\star}$, and decreasing in $I$.

For $N > N^{\star}$, we have

$$X^{\star\star} - X^{\star} = \frac{1+2(1-\theta)+N(1-\theta)^2}{2(1+N(1-\theta))(\theta^2+(3+N)(1-\theta))} > 0.$$

The above inequality holds for all $\theta < 1/2$. ■

**Proof of Proposition 8.** The profit of third-party sellers, for given $M$, is

$$\pi_i^\star(M) \triangleq (p(X^\star(M), X^\star(M)) - w^\star)x^\star(M) = \frac{1}{4(1+(N+M)(1-\theta))^2}$$

and

$$\pi_i^{\star\star}(M) \triangleq (p^{\star\star}(X^{\star\star}(M), X^{\star\star}(M)) - w^{\star\star})x^{\star\star}(M) = \frac{\theta^2}{4\left(\theta^2+(3+M+N)(1-\theta)\right)^2}.$$

For $N > N^\star$, we have

$$\pi_i^{\star\star}(0) - \pi_i^\star(0) = \frac{\theta^2}{4\left(\theta^2+(3+N)(1-\theta)\right)^2} - \frac{1}{4(1+N(1-\theta))^2} < 0.$$

It is straightforward to show that the above is negative.

For $N \in [N^{\star\star}, N^\star]$, we have

$$\pi_i^{\star\star}(0) - \pi_i^\star(M^\star) = \frac{\theta^2}{4\left(\theta^2+(3+N)(1-\theta)\right)^2} - I.$$

Differentiating the above profit difference with respect to $N$, we observe that the profit difference is unambiguously falling in $N$. Additionally, solving $\pi_i^{\star\star}(0) - \pi_i^\star(M^\star) = 0$ with respect to $N$, there exist a unique threshold

$$N_1 \triangleq \frac{\theta - 2\sqrt{I}(3-\theta(3-\theta))}{2(1-\theta)\sqrt{I}},$$

such that $N \leq N_1$ implies $\pi_i^{\star\star}(0) - \pi_i^\star(M^\star) > 0$. Else, for all $N > N_1$, we must have that this difference is negative. Differentiating the threshold $N_1$ with respect to $\theta$ and $I$, it is immediate to show that it is increasing in $\theta$ for every $I \leq I^{\star\star}$, and decreasing in $I$.

For $N < N^{\star\star}$, we have

$$\pi_i^{\star\star}(M^{\star\star}) - \pi_i^\star(M^\star) = 0.$$

Finally, we consider industry profit. For given $M$, we have

$$\Pi^\star(M) \triangleq \Pi_P^\star(M) + N\pi_i^\star(M) = \frac{N+(N+M)(1+(N+M)(1-\theta))}{4(1+(N+M)(1-\theta))^2},$$

and

$$\Pi^{\star\star}(M) \triangleq \Pi_P^{\star\star}(M) + (N-1)\pi_i^{\star\star}(M) = \frac{(2(N+1)+M)\theta^2 + (3+N+M)^2(1-\theta)}{4(\theta^2+(3+N+M)(1-\theta))^2}.$$

For $N < N^{\star\star}$, we have

$$\Pi^{\star\star}(M^{\star\star}) - \Pi^\star(M^\star) = \frac{1+4I(N-1)(1-\theta)-2\theta\sqrt{I}}{4(1-\theta)} - \left(\frac{1-2\sqrt{I}}{4(1-\theta)} + NI\right) = \frac{\sqrt{I}(1-2\sqrt{I})}{2} > 0.$$

For $N \in [N^{\star\star}, N^{\star}]$, we have

$$\Pi^{\star\star}(0) - \Pi^{\star}(M^{\star}) = \frac{1}{4}\left(\frac{((3+N)(1-\theta)+\theta^2)^2(2\sqrt{I} - 4IN(1-\theta)) - \theta^2(2-\theta)^2}{(1-\theta)((3+N)(1-\theta)+\theta^2)^2}\right) > 0.$$

The numerator is always positive for $I < I^{\star\star}$. For $N > N^{\star}$, we have

$$\Pi^{\star\star}(0) - \Pi^{\star}(0) = \frac{(3 + N\left(1+\theta^2\right) - 2\theta(N+1))(3+N-\theta+N\theta(1-3\theta+\theta^2))}{4(1+N(1-\theta))^2\left(\theta^2+(3+N)(1-\theta)^2\right)} > 0,$$

which concludes the proof. ■

**Proof of Proposition 9.** Total welfare is computed as the sum of industry profit and consumer surplus. For given $M$, we have

$$TW^{\star}(M) \triangleq \Pi^{\star}(M) + CS^{\star}(M) = \frac{3N^2 + (3M+2)(M+2N) - 2(M+N)^2\theta}{8(1+(M+N)(1-\theta))^2},$$

and

$$TW^{\star\star}(M) \triangleq \Pi^{\star\star}(M) + CS^{\star\star}(M) = \frac{3(3+N+M)^2 - 2\theta(3+N+M)(5+N+M) + 2\theta^2(2(N+2)+M)}{8(\theta^2+(3+N+M)(1-\theta))^2}.$$

For $N < N^{\star\star}$, we have

$$TW^{\star\star}(M^{\star\star}) - TW^{\star}(M^{\star}) = \frac{I(1+\theta) - \theta\sqrt{I}}{2(1-\theta)} < 0.$$

The above is negative for $I < I^{\star\star}$.

For $N \in [N^{\star\star}, N^{\star}]$, we have

$$TW^{\star\star}(0) - TW^{\star}(M^{\star}) = \frac{1}{8}\left(\frac{(3+N-2\theta)(3(3+N)-2\theta(N+2))}{((3+N)(1-\theta)+\theta^2)^2} - \frac{3-2\theta+4I(1+2N(1-\theta)^2) - 4(2-\theta)\sqrt{I}}{(1-\theta)^2}\right).$$

The above welfare difference is concave in $N$

$$\frac{\partial^2(TW^{\star\star}(0) - TW^{\star}(M^{\star}))}{\partial N^2} = -\frac{(2-\theta)\theta(6+2N(1-\theta)-\theta^2(13-6\theta))}{4((3+N)(1-\theta)+\theta^2)^4} < 0.$$

Additionally, we observe that $(TW^{\star\star}(0) - TW^{\star}(M^{\star}))|_{N=N^{\star\star}} < 0$ and

$$\left(\frac{\partial(TW^{\star\star}(0) - TW^{\star}(M^{\star}))}{\partial N}\right)\Bigg|_{N=N^{\star\star}} > 0.$$

Further, computing the difference in total welfare at $N = N^{\star}$, we note that $(TW^{\star\star}(0) - TW^{\star}(M^{\star}))|_{N=N^{\star}} > 0$. This implies that there exists a cut-off of $N_2$ such that the difference in total welfare is positive if only

if $N > N_2$. Else, $TW^{\star\star}(0) - TW^{\star}(M^{\star}) < 0$.

For $N > N^{\star}$, we have

$$TW^{\star\star}(0) - TW^{\star}(0) = \frac{3(3+N)^2 - 2\theta(3+N)(5+N) + 2\theta^2(4+2N)}{8((3+N)(1-\theta)+\theta^2)^2} - \frac{4N+3N^2-2N^2\theta}{8(1+N(1-\theta))^2} > 0.$$

The above is always true for $\theta < 1/2$. ■

**Proof of Proposition 10.** To establish investment incentives to enhance network externalities, it is sufficient to compare the marginal revenues with respect to $\theta$ of the platform under both regimes.

For $N < N^{\star\star}$, recall from equation (23) that profit difference is independent of $\theta$ implying that investment incentives are unchanged.

For $N \in [N^{\star\star}, N^{\star}]$, we have

$$\frac{\partial(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}))}{\partial\theta} = \frac{2\sqrt{I}\left((N+3)(1-\theta)+\theta^2\right)^2 - \theta\left(2(N+3)(1-\theta)+\theta^3\right)}{4(1-\theta)^2\left((N+3)(1-\theta)+\theta^2\right)^2}.$$

Differentiating the above expression with respect to $N$ yields that

$$\frac{\partial^2(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}))}{\partial\theta\partial N} = \frac{\theta(N+3)-\theta^3}{2\left((N+3)(1-\theta)+\theta^2\right)^3} > 0.$$

Next, observe that

$$\left(\frac{\partial(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}))}{\partial\theta}\right)\Big|_{N=N^{\star\star}} = -\frac{\theta^2\sqrt{I} + 2I\theta((2-\theta)^2\theta - 2) - 4(1-\theta)^2 I^{\frac{3}{2}}}{2(1-\theta)^2\left(2(1-\theta)\sqrt{I}-\theta\right)^2} < 0$$

$$\left(\frac{\partial(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}))}{\partial\theta}\right)\Big|_{N=N^{\star}} = \frac{\sqrt{I}\left(1+4I(1-\theta)^4 - 2\theta + 2\sqrt{I}\left(2-\theta\left(6(1-\theta)+\theta^3\right)\right)\right)}{2(1-\theta)^2\left(1+2(1-\theta)^2\sqrt{I}\right)^2} > 0.$$

Solving

$$\frac{\partial(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(M^{\star}))}{\partial\theta} = 0$$

for $N$ yields

$$N_3 \triangleq \frac{\theta - \sqrt{I}(6(1-\theta)+2\theta^2) + \theta\sqrt{1+2\theta^2\sqrt{I}-4\theta\sqrt{I}}}{2\sqrt{I}(1-\theta)} \in [N^{\star\star}, N^{\star}].$$

For $N > N^{\star}$, comparing the marginal revenues with respect to $\theta$ under vertical integration with marginal revenues with respect to $\theta$ under vertical separation, we observe that

$$\frac{\partial(\Pi_P^{\star\star}(0) - \Pi_P^{\star}(0))}{\partial\theta} = \frac{9+4N(6-\theta(8-3\theta))-6\theta+2(1-\theta)^2N^3+(1-\theta)N^2\left(13-\theta\left(9-\theta^2-\theta\right)\right)}{4(1+N(1-\theta))^2((N+3)(1-\theta)+\theta^2)^2} > 0.$$

The above is always positive for $\theta < 1/2$. ■

**Access fees to consumers.** Suppose that $P$ charges a participation fee $T$ to every consumer that buys in the marketplace.

The expected utility of a consumer of type $r$ buying from $S_i$ is

$$u(\cdot) \triangleq r + \theta X^e - p_i - T, \quad i = 1, \ldots, N+M.$$

Under the above specification, $S_i$ and $S_j$, for $i \neq j$, have positive demand only if the following 'no arbitrage condition' holds

$$p_i - \theta X^e + T = p_j - \theta X^e + T.$$

As a result, it must be $p_i = p_j = p$. Consumers, therefore, patronize either $S_i$ or $S_j$ if and only if

$$r \geq r^\star \triangleq p - \theta X^e + T.$$

The total demand for the product distributed within the marketplace is

$$X(p, T, X^e) \triangleq 1 - \Pr[r \leq r^\star] = 1 - [p + T - \theta X^e],$$

whose inverse is

$$p(X^e, X, T) \triangleq \max\{0, 1 + \theta X^e - T - X\}.$$

<u>*Pure intermediation*</u>. For given $w_i$, $S_i$ $(i = 1, \ldots, M+N)$ solves

$$\max_{x_i \geq 0} (p(X^e, X, T) - w_i) x_i - \mathbb{I}_i \times I$$

with $\mathbb{I}_i \in \{0, 1\}$ being an indicator function that takes value 0 if $i \leq N$ and 1 if $i \geq N+1$.

Assuming that $N+M$ sellers are active in the marketplace, imposing rational expectations — i.e., $X^\star = X^e$ — it is easy to show that

$$X^\star(\cdot) \triangleq \sum_{i=1}^{N+M} x_i^\star(\cdot) = \frac{1 - T - \frac{1}{N+M}\sum_{i=1}^{N+M} w_i}{1 - \theta + \frac{1}{N+M}}, \tag{24}$$

so that $S_i$'s individual output level is

$$x_i^\star(\cdot) \triangleq 1 - T - w_i - (1-\theta) X^\star(\cdot), \quad \forall i = 1, .., N+M. \tag{25}$$

The equilibrium price is, therefore, $p^\star(\cdot) \triangleq 1 - T - (1-\theta) X^\star(\cdot)$.

Moving backward to the contracting stage, $P$ chooses the sellers' listing fees and the consumers' participation fee to maximize

$$\max_{(w_i)_{i=1}^{N+M}, T} \underbrace{\sum_{i=1}^{M+N} w_i x_i^\star(w_i, w_{-i}, T)}_{\text{Intermediation revenue}} + \underbrace{T X^\star(w_i, w_{-i}, T)}_{\text{Consumers' participation fees}}.$$

Differentiating with respect to $w_i$, we have

$$\underbrace{x_i^\star\left(w_i, w_{-i}, T\right) + \sum_{j=1}^{M+N} w_j \frac{\partial x_j^\star\left(w_j, w_{-j}, T\right)}{\partial w_i}}_{\substack{\text{Margin + volume + strategic effects} \\ \text{on the intermediation revenue (?)}}} + \underbrace{T\frac{\partial X^\star(\cdot)}{\partial w_i}}_{\text{Effect on participation fees } (-)} = 0, \quad \forall i = 1, \ldots, M+N.$$

This simply reflects the negative impact of the sellers' fees on the direct revenue made by the platform on its consumer base, over and above the effects identified in the baseline model.

Differentiating with respect to $T$, we have

$$\underbrace{\sum_{i=1}^{M+N} w_i \frac{\partial x_i^\star\left(w_i, w_{-i}, T\right)}{\partial T}}_{\text{Intermediation volume effect } (-)} + \underbrace{X^\star(\cdot) + T\frac{\partial X^\star(\cdot)}{\partial T}}_{\text{Margin + volume effects on participation fees (?)}} = 0.$$

As expected, a higher $T$ has an indirect effect on $P$'s wholesale revenue since it reduces the individual output of each seller, but it also impacts the participation fees collected by the platform directly from consumers.

Solving the above first-order conditions, it follows that, with a pure intermediary, there is a continuum of equilibria — i.e., every pair $T^\star$ and $w^\star$ is optimal as long as

$$T^\star + w^\star = \frac{1}{2}.$$

All these equilibria are equivalent in terms of individual and aggregate output — i.e.,

$$x^\star \triangleq \frac{1}{2(1+(M+N)(1-\theta))}, \quad X^\star \triangleq \frac{M+N}{2(1+(M+N)(1-\theta))}.$$

The multiplicity of equilibria can be easily understood: $P$ can extract surplus from consumers either by increasing the consumer participation fee and gaining on the participation fees, or by increasing the listing fee to extract a higher intermediation revenue. In a symmetric equilibrium, these instruments have the same marginal benefit as this benefit is equal to the aggregate output, and the same marginal cost since from the expression of $X^\star(\cdot)$ it is easy to see that $T$ and $w_i$ have the same marginal impact on aggregate output.

*Vertical encroachment*. When $P$ is vertically integrated, it solves

$$\max_{x_1 \geq 0} \underbrace{p\left(X^e, X, T\right) x_1}_{\text{Direct sale revenue}} + \underbrace{\sum_{i=2}^{M+N} w_i x_i}_{\text{Intermediation revenue}} + \underbrace{TX}_{\text{consumers' fees}}.$$

Each seller $S_i$ for $i > 1$ solves

$$\max_{x_i \geq 0} \left(p\left(X^e, X, T\right) - w_i\right) x_i.$$

Differentiating with respect to $x_1$ and $x_i$ for $i \geq 2$, respectively, and imposing rational expectations — i.e., $X^e = \sum_{i=1}^{N+M} x_i^{\star\star}$ — and solving simultaneously yields

$$X^{\star\star}(\cdot) \triangleq \frac{1-(1-\frac{1}{M+N})T-\frac{1}{N+M}\sum_{i=2}^{N+M} w_i}{1-\theta+\frac{1}{N+M}}, \qquad p^{\star\star}(\cdot) \triangleq 1-T-(1-\theta)X^{\star\star}(\cdot), \tag{26}$$

and

$$x_1^{\star\star}(\cdot) \triangleq p^{\star\star}(\cdot)+T \geq x_i^{\star\star}(\cdot) \triangleq p^{\star\star}(\cdot)-w_i, \qquad \forall i \geq 2. \tag{27}$$

Moving backward to stage $t=2$, the platform solves

$$\max_{(w_i)_{i=2}^{M+N},T} p^{\star\star}(\cdot)x_1^{\star\star}(\cdot)+\sum_{i=2}^{M+N} w_i x_i^{\star\star}(\cdot)+TX^{\star\star}(\cdot).$$

Differentiating with respect to $w_i$ for $i \geq 2$, by the Envelope Theorem, we obtain

$$\underbrace{x_i^{\star\star}(\cdot)+w_i\frac{\partial x_i^{\star\star}(\cdot)}{\partial w_i}+\sum_{j\neq i}^{M+N} w_j\frac{\partial x_j^{\star\star}(\cdot)}{\partial w_i}}_{\text{Marginal intermediation revenue}}+\underbrace{\frac{\partial p(\cdot)}{\partial X}x_1^{\star\star}(\cdot)\sum_{j=2}^{M+N}\frac{\partial x_j^{\star\star}(\cdot)}{\partial w_i}}_{\text{Strategic effect }(+)}+$$
$$\underbrace{+\frac{\partial p(\cdot)}{\partial X^e}\frac{\partial X^{\star\star}(\cdot)}{\partial w_i}x_1^{\star\star}(\cdot)}_{\text{Network externalities }(-)}+\underbrace{T\sum_{j=2}^{M+N}\frac{\partial x_j^{\star\star}(\cdot)}{\partial w_i}}_{\text{Effect on participation fees }(-)}=0.$$

The intuition for this condition is, mutatis mutandis, similar to that discussed in the pure intermediation regime, and will be omitted for brevity.

Differentiating with respect to $T$, by the Envelope Theorem, we obtain

$$\underbrace{\left(\underbrace{\frac{\partial P(\cdot)}{\partial T}}_{(-)}+\underbrace{\frac{\partial P(\cdot)}{\partial X}\sum_{i=2}^{M+N}\frac{\partial x_i^{\star\star}(\cdot)}{\partial T}}\right)x_1^{\star\star}(\cdot)}_{\text{Margin effect on direct sales }(?)}+\underbrace{\frac{\partial p(\cdot)}{\partial X^e}\frac{\partial X^{\star\star}(\cdot)}{\partial T}x_1^{\star\star}(\cdot)}_{\text{Network externalities }(-)}+$$
$$+\underbrace{\sum_{i=2}^{M+N} w_i\frac{\partial x_i^{\star\star}(\cdot)}{\partial T}}_{\text{Effect on intermediation revenue}}+\underbrace{X^{\star\star}(w_2,T)+T\sum_{i=2}^{M+N}\frac{\partial x_i^{\star\star}(\cdot)}{\partial T}}_{\text{Margin and volume effects on participation fees }(?)}=0.$$

The participation fee charged to consumers has a volume and a margin effect on the revenue collected by the platform from its final users, and indirect effects on the intermediation and the direct sale revenues.

Solving the above first-order conditions, it follows that, with an integrated platform, there is a con-

tinuum of equilibria — i.e., every pair $T^{\star\star}$ and $w^{\star\star}$ is optimal as long as

$$T^{\star\star} + w^{\star\star} \triangleq \frac{1 + (N + M + 2)(1 - \theta)}{2(\theta^2 + (N + M + 3)(1 - \theta))}.$$

These equilibria are outcome equivalent for what concerns individual and aggregate output — i.e.,

$$x_1^{\star\star}(M) \triangleq \frac{(N + M)(1 - \theta) + 3 - \theta}{2(\theta^2 + (N + M + 3)(1 - \theta))} > x_i^{\star\star}(M) \triangleq \frac{\theta}{2(\theta^2 + (N + M + 3)(1 - \theta))} \geq 0, \quad \forall i \geq 2,$$

$$X^{\star\star}(M) = (N + M - 1) x_i^{\star\star}(M) + x_1^{\star\star}(M) \triangleq \frac{N + M + 3 - 2\theta}{2(\theta^2 + (N + M + 3)(1 - \theta))}.$$

The equilibrium price is

$$p^{\star\star}(M) \triangleq 1 - (1 - \theta)\frac{N + M + 3 - 2\theta}{2(\theta^2 + (N + M + 3)(1 - \theta))} \geq 0.$$

The intuition behind the multiplicity of equilibria is as in the case of pure intermediation and hinges on the substitutability between $T$ and $w_i$. Notice that individual and aggregate outputs in both regimes — i.e., with and without vertical integration — are as in the benchmark model.

Summing up, the competitive and welfare effects of the merger are identical to the ones discussed in the benchmark model with $T = 0$.

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