WORKING PAPERS

N° 1733

April 2026

"Seller-Side Tying of Platform Services"

Alexandre de Cornière, Kinshuk Jerath and Greg Taylor

Toulouse School of Economics

Seller-Side Tying of Platform Services*

Alexandre de Cornière[†] Kinshuk Jerath[‡] Greg Taylor[§]

January 2026

Abstract

This paper analyzes seller-side tying on digital platforms, where access to a core intermediation service is conditioned on sellers using an ancillary service (e.g., fulfillment or payments). We model a monopoly platform matching consumers and competing sellers across many product categories, with consumers valuing the ancillary service heterogeneously. When adoption is voluntary, sellers under-adopt because asymmetric adoption creates vertical differentiation that softens price competition, raising prices and reducing platform participation. Tying restores high adoption, intensifies competition, and increases consumer surplus. A ban on tying or structural separation lowers adoption and can harm consumers.

1 Introduction

Online platform marketplaces have revolutionized the way buyers and sellers connect, reducing transaction costs, expanding access to a global consumer base, and improving the overall efficiency of commerce. By harnessing network effects and exploiting substantial economies of scale, a handful of platforms — most notably Amazon, Apple, and Google — have emerged as dominant gatekeepers in their respective markets. This growing market power and centrality have not gone unnoticed by regulators and policymakers. The Digital Markets Act (DMA) in the European Union, for instance, explicitly targets "core platform services" provided by these dominant players, aiming to ensure fairness and market contestability.

*We are grateful to Jana Gieselmann, Gaston Llanes, Johannes Johnen, Devesh Raval, Andrew Rhodes and Julian Wright. Thanks are also due to participants at various seminars and conferences for useful comments and discussions. De Cornière acknowledges funding from ANR under grants ANR-17-EURE-0010 (Investissements d'Avenir program) and ANR-24-CE26-7812 (Economie des Ecosystèmes Numériques).

[†]Toulouse School of Economics, University of Toulouse Capitole; alexandre.de-corniere@tse-fr.eu

[‡]Columbia Business School, Columbia University; kj2323@gsb.columbia.edu

[§]Oxford Internet Institute, University of Oxford; greg.taylor@oii.ox.ac.uk

The provision of ancillary services by platforms to third-party sellers is also a key area of regulatory focus. These services include order fulfillment, payment processing, customer support, insurance, product photography, and more — each designed to enhance the seller's product offering and improve the buyer's shopping experience. Yet, a practice that has drawn particular scrutiny is the frequent coupling, or "tying", of these ancillary services to the platform's core intermediation service. In other words, sellers sometimes face pressure to adopt additional services from the platform as a condition for accessing its primary marketplace. We emphasize that these settings are distinguished from most of the extant literature by the fact that the relevant services are offered to sellers and not directly to consumers — a distinction we will show to be of importance.

For example, Amazon has faced allegations that it steers consumers toward sellers who use its fulfillment services, effectively making widespread adoption of these ancillary offerings a prerequisite for visibility and sales success. Similarly, Apple and Google have come under fire for requiring the use of their proprietary payment systems within their app stores. This tying[1] of ancillary services to the core marketplace offering not only raises concerns about market foreclosure and the exclusion of independent service providers, but also highlights the delicate regulatory challenge of curbing potentially anticompetitive practices without stifling the innovation and efficiency gains these platforms have delivered.

In this paper we study a model with a monopoly platform and a set of competing sellers, and ask the following questions: when is it profitable for the platform to offer a (costly) ancillary service? What are the incentives to tie it to the core service? What would be the effects of a ban on tying, or of a break-up of the platform? How does offering the service on the seller side (and potentially tying it) differ from offering the service on the consumer side (and potentially tying it)?

In the baseline model, a monopoly platform can offer two services: a *core* service (such as enabling transactions between buyers and sellers) and an *ancillary* one (such as order fulfillment: storage, delivery, etc.). The platform serves a large number of product markets. In each market, two sellers offer a homogeneous good and compete in prices. The ancillary service increases the value of the product to consumers, but consumers are heterogeneous with respect to how much they value the service. For instance, some consumers are in urgent need of a product and are willing to pay a lot for one-day shipping, while others are more patient. The platform charges unit fees for each service, and bears a cost for providing the ancillary service. Consumers have heterogeneous outside options, so that total participation to the platform is elastic.

We first characterize the equilibrium of the game. When the platform leaves sellers free to choose whether to adopt the ancillary service, too few of them choose to do so. Indeed, once a seller adopts the ancillary service, its competitor is better-off not adopting

[1]We use "tying" as an umbrella term to designate a variety of related practices (tying, bundling, self-preferencing).

it: two vertically differentiated sellers achieve higher profits than two homogenous (albeit high quality) sellers. Such asymmetric under-adoption results in higher prices and lower consumer surplus than if all sellers adopted the service. Tying the core and ancillary services is thus a way for the platform to foster consumer participation, and is optimal for the platform if the cost of the ancillary service is low enough. For higher cost levels, the platform is better-off not offering the ancillary service at all, to prevent vertical differentiation by sellers.

As an interesting contrast, we show that, if consumers were the ones to decide whether to buy the ancillary service, the platform would not tie the two services. This is because tying would not affect competition among sellers but would induce inefficient over-consumption of the ancillary service. Relatedly, the platform might charge consumers for access to the ancillary service (such as when Amazon requires consumers to subscribe to Prime to receive free one-day shipping on orders it fulfills). However, as longs as the sellers still need to opt-in to offering the ancillary service, tying influences seller competition and our results go through.

Coming back to seller-side tying, we then consider two possible policy interventions: a ban on tying, and a structural separation of the core and ancillary services. We find that a ban on tying may backfire, by leading the platform to stop offering the ancillary service altogether, thereby harming consumers. Next we study the consequences of a break-up, forcing the platform to divest its ancillary service activity. Because the core and ancillary services are complementary, separation would lead to double marginalization if the new provider of ancillary service was a monopolist. In order to shut down this well-understood mechanism, we assume that the assets are sold to a competitive fringe of firms, who then offer the ancillary service at cost. Such a policy results in a return of the under-adoption problem, and leads to higher prices and lower consumer surplus than under tying. Although both a ban and break-up would be bad news for consumers, we show that such an intervention can increase "total user surplus" (i.e., the aggregate surplus of consumers and sellers). A third policy relevant scenario is one where the platform faces competition on the market for the ancillary service. We show that, at least in the short run, tying still benefits consumers when it is profitable.

We also analyze a number of extensions in order to gauge the robustness of our results, and discuss some of them here. First, we relax the assumption that sellers operate in a Bertrand duopoly. With exogenous vertical differentiation, we show that tying may benefit sellers as well, if the increase in consumer participation dominates the reduced (but still positive) mark-up. We also show that tying may still be profitable for the platform with more than two sellers, though the scope for profitable tying is reduced (because seller market power is less important). Second, we allow the platform to use richer tools than unit fees. With two-part tariffs, the platform can replicate the integrated monopoly solution, and does not tie its ancillary service, because vertical differentiation allows a better segmentation of the market. This underlines the fact that the profitability of tying has its source in a contractual imperfection, as is often the case in the literature, though the mechanism presented here is new. We also show that the logic of our baseline analysis extends to the case where the platform charges ad valorem fees instead of unit fees. Finally, we show that our main results continue to hold under non-uniform distribution for consumers' willingness to pay and outside option.

Related literature Our paper relates to three strands of the literature: (i) tying and self-preferencing in digital markets, (ii) work on how platforms shape the intensity of competition between sellers, and (iii) research on platform business models.

First, the paper contributes to the literature on tying and self-preferencing in digital markets. The standard tying story is that of a firm, dominant in market A, who ties product A to product B, thereby extending its market power over market B. This literature, which goes back to the 1970s and the Single Monopoly Profit Theory (summarized, e.g., in Fumagalli et al. (2018)), has witnessed a recent spark of contributions incorporating features that are specific to digital markets, and putting forward new efficiency arguments (Bakos and Brynjolfsson, 1999; Choi, 2010; Amelio and Jullien, 2012) or anticompetitive motives (Choi and Jeon, 2021; Choi et al., 2024). In the platform context, a related practice is that of self-preferencing, where a dominant hybrid platform (who also acts as a seller) steers consumers towards its own products. In this context, tying can be viewed as an extreme form of self-preferencing. Kittaka et al. (2023) and Etro (2024) survey the burgeoning literature on this topic.

One key difference between our paper and most of the ones above is that we study a situation where tying/self-preferencing applies to services offered to sellers, as opposed to consumers, and affects the strategic behavior of sellers. Li (2024) and Anderson et al. (2025) also consider seller-side tying/self-preferencing by a platform, but in models without competition between sellers. Relatedly, De Cornière and Taylor (2021 and 2024) study models where tying by an upstream firm affects downstream firms' behavior.

Second, our paper is related to work studying how platforms can shape competition through the use of various tools (Hagiu, 2009; De Cornière, 2016; Belleflamme and Peitz, 2019; Teh, 2022). Our contribution here is to show that tying can be seen as a tool to intensify competition among sellers, thereby fostering consumer participation. One caveat, though, is that tying is only optimal when the platform is somewhat constrained in the pricing tools at its disposal.

Third, the paper relates to research on platform business models. A large literature studies how platforms monetize their intermediation role, in particular through commissions on goods sold and the choice between marketplace and reseller formats (e.g., Jiang et al., 2011; Hagiu and Wright, 2015; Abhishek et al., 2016). More recently, platforms have increasingly relied on additional revenue sources, such as advertising and sponsored listings on the consumer side (Long et al., 2022; Belleflamme and Johnen, 2023; Abhishek et al., 2025; Long and Amaldoss, 2024; Long and Liu, 2024), and ancillary services such as fulfillment and delivery on the seller side (Lai et al., 2022; Iyengar et al., 2023; Li et al., 2024a; Li et al., 2024b; Li et al., 2025)). Our contribution to this literature is to study how tying an ancillary service to access to the core marketplace affects the platform's ability to monetize these services, and how this interacts with competition between sellers and consumer participation. In that sense, ancillary services in our model are not only a source of revenue, but also a governance tool that the platform can use to shape market outcomes, which is directly relevant for current policy debates on the regulation of self-preferencing and tying practices.

2 Model

There are a large number of product markets, each served by two ex ante homogeneous *sellers*. The sellers produce output at marginal cost $c \geq 0$ and sell them at price p_i.

In order to reach *consumers*, the sellers must list their products on a monopoly *platform*. The platform provides two services. The first, denoted A, is the platform's core transaction-enabling function and is essential for trade between sellers and consumers to take place. Service B is a non-essential *ancillary service* that increases the value of transactions for consumers. However, it is sellers who choose whether to use the ancillary service. The platform provides service A at zero marginal cost, but incurs a marginal cost of $k \geq 0$ for each transaction involving a seller that uses the ancillary service. We begin by assuming that the platform charges sellers a unit fee f_A for each transaction served, plus an additional f_B if the transaction includes the ancillary service.

Consumers have unit demand and value the base good at $v \geq c$. For each product market, consumers have an idiosyncratic type, $\theta \sim U[0,1]$, independent across markets, measuring their taste for quality, and get extra utility $\theta\Delta$ if they buy from a seller that uses the ancillary service, with $\Delta \geq k$. There is a mass of consumers who can access the platform for free but have an idiosyncratic outside option worth ω, uniformly distributed with unit density on $[0, m]$. Consumers join the platform only if they expect their surplus from trading there to exceed ω, and we assume m is large enough that the marginal consumer is interior. Our main results extend to more general distributions of ω and θ, as we show in Section 7.

The timing of the game is as follows:

1. The platform chooses whether to tie A and B or to offer them independently, and sets its fees.

2. Sellers choose whether to adopt the ancillary service, B (if the platform gives them a choice).

3. Sellers simultaneously set their prices.

4. Each consumer chooses whether to join the platform or not.

5. Consumers learn their θ and make purchase decisions.

We have in mind a situation where consumers repeatedly make use of a general purpose platform over a long period of time (e.g., downloading many categories of app on a smartphone). We therefore assume that the firms in any one category are too small for their decisions to affect consumer participation decision, and consumers do not observe their θ (which may be category-specific) until they have joined.

We solve for subgame perfect equilibria in pure strategies under the following assumption, which ensures that all participating consumers buy one unit in each market.[2]

Assumption 1. $v - c > k + \Delta/2$

3 Equilibrium analysis

We begin the analysis by taking the platform's tying decision as given and studying the resulting equilibrium in the ensuing subgame.

As a first observation, the sellers are undifferentiated Bertrand competitors when they both offer the ancillary service and they therefore set prices equal to their effective marginal cost, $p = c + f_A + f_B$. Likewise, if neither seller offers the service then they compete à la Bertrand over the base good only and $p = c + f_A$.

3.1 Case without tying

If the platform does not tie then sellers have free choice whether to offer the ancillary service or not. We focus on the case where $f_B < 2\Delta$, because otherwise no seller would want to adopt the service. If only one offers the service then the two sellers are vertically differentiated in the manner of Shaked and Sutton (1982). Adopting the convention that seller 1 offers the ancillary service and seller 2 does not, a consumer is indifferent between the two firms if

$$v + \theta\Delta - p_1 = v - p_2 \iff \theta = \theta^* \equiv \frac{p_1 - p_2}{\Delta}.$$

At an interior equilibrium, seller 2 serves consumers with $\theta < \theta^*$, while seller 1 serves those with $\theta \geq \theta^*$.[3] This implies expected seller profits per consumer on the platform are

$$\pi_1 = (p_1 - c - f_A - f_B)(1 - \theta^*),$$

[2] For our purposes it is not necessary that each consumer be active in each product market, but rather that each consumer who is interested in a given product market ends up buying a product, no matter his taste for the ancillary service θ.

[3] The condition for all consumers to buy one unit in this case of no tying is $v - c > \Delta - \frac{3\,(k-3\Delta)^2}{50\,\Delta}$, which is implied by Assumption 1.

$$\pi_2 = (p_1 - c - f_A)\theta^*.$$

Solving the first-order conditions, $\left\{\frac{\partial \pi_i}{\partial p_i} = 0\right\}_{i=1,2}$, yields equilibrium prices

$$p_1^{\mathrm{NT}} = c + f_A + \frac{2\Delta + 2f_B}{3}, \quad p_2^{\mathrm{NT}} = c + f_A + \frac{\Delta + f_B}{3}, \tag{1}$$

where the NT superscript denotes "no tying". As long as $f_B < 2\Delta$, we have $p_1^{\mathrm{NT}} > c + f_A + f_B$ and $p_2^{\mathrm{NT}} > c + f_A$: sellers earn positive profit by differentiating in their decision to adopt the ancillary service. Indeed, evaluating profits at the equilibrium prices yields

$$\pi_1^{\mathrm{NT}} = \frac{(2\Delta - f_B)^2}{9\Delta}, \quad \pi_2^{\mathrm{NT}} = \frac{(\Delta + f_B)^2}{9\Delta}. \tag{2}$$

It must therefore be the case that sellers differentiate in equilibrium, otherwise they would earn zero profit and one seller would wish to deviate in their decision (not) to offer the service.[4]

Anticipating the equilibrium prices, consumers' expected surplus from joining the platform is

$$\begin{aligned} Q^{\mathrm{NT}}(f_A, f_B) &= \int_0^{\theta^*} (v - p_2^{NT})\, d\theta + \int_{\theta^*}^1 (v + \theta\Delta - p_1^{NT})\, d\theta \\ &= v - c - f_A - \frac{1}{18}\left(10 f_B - \frac{(f_B)^2}{\Delta} - 2\Delta\right). \end{aligned} \tag{3}$$

Consumers participate if their outside option is worse than Q^{NT}. Because the outside option is uniformly distributed, the mass of participating consumers is simply Q^{NT}.

We now have the necessary ingredients to formulate the platform's fee-setting problem. It earns f_A from serving transactions to each of the Q^{NT} participating consumers, and an additional $f_B - k$ from providing the ancillary service to the $1 - \theta^*$ consumers who buy from seller 1:

$$\max_{f_A, f_B} \left[f_A + (f_B - k)(1 - \theta^*)\right] Q^{\mathrm{NT}}(f_A, f_B).$$

Solving the resulting pair of first-order conditions yields optimal fees

$$f_A^{\mathrm{NT}} = \frac{v - c}{2} - \frac{17\Delta^2 + 3k^2 + 2\Delta k}{100\Delta}, \quad f_B^{\mathrm{NT}} = \frac{1}{5}(\Delta + 3k),^{5} \tag{4}$$

[4] We focus on pure strategies. Adoption of the ancillary service is a coordination game and there is also a (symmetric) mixed strategy equilibrium where each seller offers the service with positive probability. Focusing on that mixed strategy rather than the asymmetric pure strategy considered here does not substantively alter our results.

[5] $f_B^{\mathrm{NT}} < 2\Delta$ as required.

and equilibrium platform profit

$$\Pi^{\mathrm{NT}} = \left(\frac{v-c}{2} - \frac{\Delta^2 - k^2 + 6\Delta k}{20\Delta}\right)^2. \tag{5}$$

The equilibrium prices and fees imply $\theta^* = \frac{2}{5} - \frac{k}{5\Delta}$, which is interior for $k \leq \Delta$. Full market coverage additionally requires that a consumer who buys from seller 2 gets non-negative utility, $v - p_2^{\mathrm{NT}} \geq 0$, which is indeed the case under Assumption 1.[6]

Lemma 1. *If the platform offers the ancillary service without tying, then only one seller per market adopts it. Sellers achieve positive profits, and the platform's profit is* $\Pi^{NT} = \left(\frac{v-c}{2} - \frac{\Delta^2-k^2+6\Delta k}{20\Delta}\right)^2$.

3.2 Case with a tied ancillary service

Next, suppose that the platform ties the ancillary service, meaning all sellers are forced to offer it. Since it is then only the aggregate fee that matters, write $f_{AB} = f_A + f_B$. As noted above, this leaves sellers competing à la Bertrand, with the resulting price being $p^{\mathrm{T}} = c + f_{AB}$, where a T superscript denotes the case of "tying". Consumer surplus (and participation) is therefore

$$Q^{\mathrm{T}}(f_{AB}) = \int_0^1 (v + \theta\Delta - p^T)\, d\theta = v + \frac{\Delta}{2} - c - f_{AB}.$$

The platform solves

$$\max_{f_{AB}} (f_{AB} - k) Q^{\mathrm{T}}(f_{AB}).$$

This implies the equilibrium fee and platform profit:

$$f_{AB}^{\mathrm{T}} = \frac{1}{2}(v - c + k) + \frac{\Delta}{4}, \tag{6}$$

$$\Pi^{\mathrm{T}} = \left(\frac{v-c}{2} + \frac{\Delta - 2k}{4}\right)^2. \tag{7}$$

Note that the platform could also choose a fee such that the lowest types do not buy any product. One can show that Assumption 1 is a necessary and sufficient condition for this not to be optimal.

Lemma 2. *When the platform ties its core and ancillary services, sellers compete à la Bertrand and make zero profit. The platform's profit is* $\Pi^T = \left(\frac{v-c}{2} + \frac{\Delta-2k}{4}\right)^2$.

[6] More precisely, this is the case when $v - c > \frac{23\Delta - 3k^2 + 18k\Delta}{50\Delta}$, which is implied by $v - c > k + \Delta/2$. It then follows that consumers get non-negative utility from seller 1 because a type θ^* consumer is indifferent between 1 and 2 and any $\theta > \theta^*$ strictly prefers seller 1.

3.3 Case with no ancillary service

The platform may choose to offer no ancillary service or, equivalently, to set f_B prohibitively high. Again, this leaves sellers undifferentiated, with the resulting price being $p^{\mathrm{NS}} = c + f_A$, where an NS superscript denotes "no service". Consumer surplus and participation is $Q^{\mathrm{NS}}(f_A) = v - c - f_A$. The platform maximizes $f_A Q^{\mathrm{NS}}(f_A)$, implying

$$f_A^{\mathrm{NS}} = \frac{v-c}{2},$$

$$\Pi^{\mathrm{NS}} = \left(\frac{v-c}{2}\right)^2. \tag{8}$$

3.4 Platform's tying decision

In the first period of the game, the platform chooses how to offer the ancillary good by comparing (5), (7), and (8).

Proposition 1. *If $k < \Delta/2$ the platform ties the ancillary service. If $k \geq \Delta/2$ the platform does not offer the ancillary service. The platform never chooses to offer the service without tying.*

Tying and "no service" both induce a kind of inefficiency. Tying forces the provision of the ancillary service to all consumers, even though those with $\theta < k/\Delta$ value it below the cost of production. Meanwhile, not offering the service sacrifices the surplus that it would create for consumers with $\theta > k/\Delta$. Nevertheless, the platform always prefers one of these options to offering the service without a tie. The reason is that the latter course of action allows the sellers to use the service to differentiate. This leads to increased prices, which deter consumers from participating on the platform. The platform internalizes these participation effects through its tying decision.

3.5 Comparison with consumer-side tying

In order to contrast seller-side tying with the more commonly studied situation of consumer-side tying, we now turn to a model where the decision of whether to buy the ancillary service lies with consumers.

Specifically, the platform charges the sellers a per-transaction fee f_A, and offers the ancillary service to consumers for a fee f_B.[7] If a consumer buys the service he gets an extra utility $\theta\Delta$, irrespective of which seller he picked. Under tying, all consumers must buy the ancillary service to complete a transaction.

[7] The fee f_A is perfectly passed-through to consumers, so it would be equivalent to assume that both f_A and f_B are charged to consumers.

In this scenario, the sellers are undifferentiated in all cases and charge prices $p_1 = p_2 = c + f_A$ due to Bertrand competition. They make zero profits.

First, consider the case in which the platform does not tie the ancillary service. A consumer buys the ancillary service if $f_B \leq \theta\Delta$, i.e. if $\theta \geq f_B/\Delta$. Total consumer participation is therefore

$$Q = v - (c + f_A) + \int_{f_B/\Delta}^{1} (\theta\Delta - f_B)\, d\theta = v - c - f_A + \frac{(\Delta - f_B)^2}{2\Delta}.$$

The platform's profit is the margin per consumer times total participation, that is

$$\Pi = \left(f_A + (f_B - k)\left(1 - \frac{f_B}{\Delta}\right)\right) Q.$$

To maximize this profit, the platform sets $f_B = k$ (efficient pricing of the ancillary service) and

$$f_A = \frac{v - c}{2} + \frac{(k - \Delta)^2}{4\Delta},$$

implying that

$$\Pi_C^{NT} = \left(\frac{v - c}{2} + \frac{(k - \Delta)^2}{4\Delta}\right)^2. \tag{9}$$

Observe that the profit Π_C^{NT} is greater than the profits Π^{NT}, Π^T and Π^{NS}. In fact, the profit Π_C^{NT} is identical to the profit that the platform can achieve in the integrated monopoly solution described in Section A.1 in the Appendix (the profit in which is the upper bound on the profit that the platform can achieve). It is immediate that consumer-side tying is not profitable under Assumption 1.[8] We therefore have the following result:

Proposition 2. *If the decision to buy the ancillary service is taken by consumers, tying is not optimal for the platform. Indeed, the platform can implement the fully optimal integrated monopoly profit without tying.*

Proposition 2 offers a stark contrast with the case of seller-side tying where, under the same parametric assumptions, tying can be profitable. This highlights the difference

[8]One can explicitly check this by solving the platform's problem under (consumer-side) tying. The price of a seller is $f_A + c$. A consumer buys the product if $c + f_A + f_B \leq v + \theta\Delta \implies \theta \geq (c + f_A + f_B - v)/\Delta$. Letting $f_{AB} = f_A + f_B$, the expected surplus of the consumer is

$$Q = \int_{\max[(c + f_{AB} - v)/\Delta, 0]}^{1} (v - c - f_{AB} + \theta\Delta)\, d\theta.$$

Under Assumption 1, the solution yields

$$f_{AB} = \frac{v - c}{2} + \frac{\Delta + 2k}{4}, \quad Q = \frac{v - c}{2} + \frac{\Delta - 2k}{4}, \quad \Pi^T = \left(\frac{v - c}{2} + \frac{\Delta - 2k}{4}\right)^2 < \Pi^{NT}.$$

between the two practices: seller-side tying prevents vertical differentiation, while consumer-side tying does not.

Given this result, one may wonder why the platform would ever resort to seller-side tying, as in our baseline model. We see two possible explanations. First, offering consumers a choice through partial adoption may be too costly for sellers. For instance, in the case of logistics, it may be inefficient for a seller to maintain some inventory in the platform's warehouse and the rest in its own facilities. Second, for the platform to implement the scheme described in this section, it must ensure that all sellers make its ancillary service available to consumers. Without a (non-exclusive) tying requirement obliging every seller to offer this option, some sellers would have an incentive to withhold it altogether in order to relax competition.

3.6 Charging consumers for the ancillary service

One of our main motivating examples is Amazon Marketplace, where Amazon has been accused of self-preferencing by favouring sellers who use its logistics service (FBA). A key difference with our baseline model is that, if one interprets the ancillary service as "one-day shipping", Amazon also charges consumers a yearly subscription fee (Prime), which entitles them to free one-day delivery from sellers relying on FBA.

Introducing this feature does not fundamentally change the results, in the sense that requiring sellers to buy the ancillary service results in fiercer price competition and higher consumer participation. To see this, consider the following timing:

1. The platform chooses whether to tie A and B (on the seller side), chooses fees f_A and f_B as well as a subscription price S.

2. Sellers choose whether to buy B (without tying).

3. Each seller i chooses a price p_i

4. Consumers choose whether to use the platform and, if so, whether to subscribe to the premium version.

5. For each market, consumers learn their θ and make their purchasing decision.

A consumer who has subscribed and buys from a seller using B obtains utility $v+\theta\Delta-p_i$, while a subscriber buying from a seller not using B gets $v-p_j$. A non-subscriber always gets $v-p_i$, irrespective of whether the seller uses B or not. Since the expected gain from subscribing is the same for all consumers ex ante, the subscription decision is a corner one: in equilibrium, either all participating consumers subscribe or none do.

If no consumer subscribes, the ancillary service yields no additional value on the demand side. With no tying, sellers then never adopt B, and the outcome coincides with the no-service benchmark in Section 3.3. With tying, forcing sellers to buy B only raises costs without increasing willingness to pay, so the platform never chooses this when it can instead set f_B prohibitively high and effectively not offer B.

If all participating consumers subscribe, the subscription fee S is sunk at the pricing and adoption stages. The ensuing subgames with and without tying are therefore isomorphic to those in Sections 3.1 and 3.2, once we interpret $f_A + S$ (or $f_{AB} + S$ under tying) as the effective access charge. In particular, with no tying, only one seller adopts B and sellers soften competition through vertical differentiation; with tying, both sellers use B and compete à la Bertrand on a homogeneous high-quality product. The platform's maximal profit in each regime and its tying decision are thus unchanged: it ties the ancillary service if $k < \Delta/2$, and does not offer it if $k \geq \Delta/2$. Allowing for a consumer subscription simply lets the platform reallocate its access charge between sellers and consumers, without affecting equilibrium prices, participation, or the comparison between tying and no tying.

Note that this extension is quite different from the analysis of Section 3.5, because here consumers pay for the right to get the ancillary service, but still need the sellers to adopt it, whereas in Section 3.5 the sellers have no say on the matter.

4 Policy

In this section we go back to our baseline model and discuss two interventions that have been proposed (see for instance Khan, 2016, for the Amazon case): a ban on tying and a structural separation of the core and ancillary service. The discussion takes place in the baseline setup where the platform is a monopolist on markets A and B. We show that neither intervention benefits consumers. We then revisit these questions in the presence of competition on the market for ancillary services, where the message is more nuanced, because the benefits of tying could be achieved through other vertical restraints.

4.1 A ban on tying

A policy-relevant question is whether it would ever be to consumers' benefit to ban tying of the ancillary service.[9] The answer to this question is negative:

Proposition 3. *A policy that bans the platform from tying the ancillary service leads to (i) the platform not offering the service, and (ii) weakly lower consumer surplus (strictly so if $k < \Delta/2$).*

To prove the proposition, first compare (5) and (8) to note that offering no service dominates offering the service without tying. For the second part, if $k < \Delta/2$ then the

[9] The platform can replicate tying by setting f_B sufficiently negative and $f_A + f_B = f_{AB}^T$, therefore a ban on tying should also rule out such a pricing scheme to be effective.

platform would choose to tie absent a ban and the ban's effect on consumer participation is

$$Q^{\mathrm{NS}} - Q^{\mathrm{T}} = \left(\frac{v-c}{2}\right) - \left(\frac{v-c}{2} + \frac{\Delta - 2k}{4}\right) < 0.$$

If $k \geq \Delta/2$ then the platform would not choose to tie anyway, so a ban is neutral.

Both with and without a ban, the platform eliminates seller market power (either by tying or by withdrawing the ancillary service). The effect of the ban is to ensure that the platform chooses the latter course of action. When the cost of the ancillary service k is lower than the average consumer willingness to pay, $\Delta/2$, the ban harms consumers.

At this stage it is useful to briefly discuss the robustness of Proposition 3 (we provide more details in Section 7). Part (i) of the proposition hinges on the assumption that types and outside options are uniformly distributed. In fact, one can find examples where a ban on tying results in the platform offering the ancillary service as an option (see Section 7). This is the case for instance if the distribution of consumer types is skewed towards high values of θ. Nevertheless, the broader point is that a ban on tying *may* reduce the incentives of the platform to offer the ancillary service altogether. Part (ii) of the proposition, which is arguably the more important result, also holds under non-uniform distributions of θ and ω, provided the c.d.f.'s are not too convex. The general idea is that the platform chooses to tie the two services only when this increases consumer participation, and as a consequence a ban on tying cannot benefit consumers.

Sellers' profits are zero both with and without the ban. Thus, the effect of a ban on 'total user surplus' (the joint surplus of sellers and consumers)[10] is the same as the effect on consumer surplus—i.e., negative. However, suppose the policy authority pairs a ban on tying with a requirement that the platform continues to offer the service (at the normal no-tying equilibrium price). Then total user surplus can increase. This is because the ban allows sellers to differentiate and increases their profits, offsetting the fall in consumer surplus. Indeed, given $k \leq \Delta/2$, the effect of a ban on total user surplus would then be

$$\mathcal{TUS}^{\mathrm{NT}} - \mathcal{TUS}^{\mathrm{T}} = \frac{[\Delta(10(v-c)-\Delta)+k^2-6\Delta k]\,[\Delta(50(v-c)+99\Delta)+21k^2-46\Delta k]}{4000\Delta^2} - \frac{1}{32}(2(v-c)+\Delta-2k)^2. \quad (10)$$

A sufficient condition for this to be positive is if the net social value of the base good is higher than that of the ancillary service for every consumer, $v - c > \Delta - k$.

[10]Total user surplus is

$$\mathcal{TUS} = \int_0^Q \left(\int_0^{\theta_0} (v - c - f_A - \omega)\, d\theta + \int_{\theta_0}^1 (v + \Delta\theta - c - f_A - f_B - \omega)\, d\theta\right) d\omega,$$

where Q is the mass of consumers who join the platform and θ_0 is the mass of platform users who buy from a firm that does not offer the service (meaning $\theta_0^{\mathrm{T}} = 0$ under tying and $\theta_0^{\mathrm{NS}} = 1$ under no service.

4.2 Divestiture

Since a ban on tying harms consumers by leading to withdrawal of the ancillary service, an alternative course of policy action would be to force the platform to divest the ancillary service. That would ensure the service continues to operate as an independent entity. An immediate problem with such an approach is the well-known double-marginalization effect: both the platform and the newly independent ancillary service provider would introduce their own layer of monopoly distortion when setting their respective fees. To eliminate this effect and give a break-up policy the best chance of success, we suppose that there is competitive entry into the supply of the ancillary service following divestiture. Thus, the post-divestiture ancillary service is supplied at marginal cost k.

Analysis of competition between sellers now follows the case without tying (after substituting $f_B = k$). If the sellers differentiate their adoption decision then prices are given by (1) and, in particular, are above marginal cost. Therefore we will have a situation of under-adoption of the ancillary service, as in the case of no tying. Consumer participation is then $Q^{\mathrm{D}}(f_A) := Q^{\mathrm{NT}}(f_A, k)$.

Post-divestiture, the platform no longer derives revenue from the ancillary service. It therefore solves for the optimal transaction fee

$$f_A^{\mathrm{D}} = \underset{f_A}{\operatorname{argmax}}\, f_A Q^{\mathrm{D}}(f_A) = \frac{2\Delta[9(v-c) - \Delta - 5k] + k^2}{36\Delta}.$$

Evaluating platform profits and consumer participation at the equilibrium fee levels yields

$$\Pi^D = \frac{\left(k^2 - 10\Delta k - 2\Delta(9c + \Delta - 9v)\right)^2}{1296\Delta^2}, \tag{11}$$

$$Q^{\mathrm{D}} = \frac{k^2 - 10\Delta k - 2\Delta(9c + \Delta - 9v)}{36\Delta}. \tag{12}$$

Suppose the integrated platform would choose to tie ($k < \Delta/2$). The effect of break-up on consumer participation is

$$Q^{\mathrm{D}}(f_A^{\mathrm{D}}) - Q^{\mathrm{T}}(f_{AB}^{T}) = \frac{k^2 + 8\Delta k - 11\Delta^2}{36\Delta} < 0.$$

In this case, divestiture harms consumers even in the absence of double marginalization. This happens because the break-up leads to under-adoption of the ancillary service and increases product market prices.

We could also consider a similar 'divestiture' policy in the case where $k \in [\Delta/2, \Delta)$ and the platform would choose to offer no service. Conceptually, this corresponds to a situation where a policy authority forces the platform to allow third-party ancillary service providers to access the platform even when it would choose not offer such services itself.

The effect on consumer surplus would be

$$Q^{\mathrm{D}}(f_A^{\mathrm{D}}) - Q^{\mathrm{NS}}(f_A) = \frac{k^2 - 10\Delta k - 2\Delta^2}{36\Delta} < 0.$$

Again, the resulting price increase on the product market means that break-up harms consumers. To summarize:

Proposition 4. *A policy that forces the platform to divest the ancillary service reduces consumer surplus.*

We can also consider the effects of break-up on total user surplus, where the harm to consumers is offset by an increase in sellers' profits. Suppose we are in the case where the platform would choose to tie ($k \leq \Delta/2$). The overall effect of divestiture on total user surplus is

$$\mathcal{TUS}^{\mathrm{D}} - \mathcal{TUS}^{\mathrm{T}} = \frac{[k^2 + 2\Delta(9(v-c) - \Delta) - 10\Delta k]\,[2\Delta(19\Delta + 9(v-c)) + 17k^2 - 26\Delta k]}{2592\Delta^2} - \frac{1}{32}(2(v-c) + \Delta - 2k)^2. \quad (13)$$

Assumption 1 implies that (13) is positive, so break-up increases total user surplus.

Minimum quality requirements The platform could mitigate the harms of divestiture by requiring sellers to buy the ancillary service from an independent supplier (e.g., forcing them to offer a fast shipping option). Does such a "minimum quality requirement" address the problems associated with divestiture? The answer is no.

First, if $k < \Delta/2$ the integrated platform would tie the ancillary service (recall that only the total fee, f_{AB}^T, then matters). After divestiture, the platform would impose a minimum quality requirement. This is formally equivalent to tying because it results in all sellers offering the ancillary service and the platform can replicate the same total fee with $f_A = f_{AB}^T - k$.

Second, if $k \geq \Delta/2$ the integrated platform would not offer the service, resulting in consumer surplus $Q^{\mathrm{NS}}(f_A^{\mathrm{NS}}) = \frac{v-c}{2}$. Assuming that the divested platform cannot ban the service completely, it would implement a minimum quality standard to minimize seller differentiation. Again, this is formally equivalent to tying and yields consumer surplus $Q^{\mathrm{T}}(f_{AB}^T) = \frac{v-c-k}{2} + \frac{\Delta}{4} < Q^{\mathrm{NS}}(f_A^{\mathrm{NS}})$. Divestiture is harmful even under a minimum quality requirement because forcing sellers to use the service is inefficient when $k \geq \Delta/2$.

4.3 Competition on the market for ancillary services

One concern associated with platform tying of services is that it might foreclose competition on the market for ancillary services. We investigate this issue by supposing that the ancillary service is supplied by both the platform and by a competitive fringe of independent providers. All providers of the service have the same marginal cost, k. To simplify the analysis, we assume that sellers need to subscribe to at least one ancillary service.[11]

Inferior rivals We start by assuming that the competing providers are less efficient than the platform: their quality is $\Delta_L < \Delta$.

We study two subgames, depending on whether the platform ties A and B or not. With tying, the analysis is as in Section 3, where profit is $\Pi^{\mathrm{T}} = \left(\frac{v-c}{2} + \frac{\Delta-2k}{4}\right)^2$ and consumer participation is $Q^{\mathrm{T}} = \frac{v-c}{2} + \frac{\Delta-2k}{4}$.

Suppose instead that the platform does not tie A and its own version of B. Rivals on the market B offer their service at a price equal to their marginal cost, k. By a similar argument to the baseline model, sellers will make asymmetric adoption decisions, leading to relaxed competition. The prices are then

$$p_1^{\mathrm{NT}} = c + f_A + \frac{2(\Delta - \Delta_L) + 2f_B + k}{3}, \quad p_2^{\mathrm{NT}} = c + f_A + \frac{(\Delta - \Delta_L) + f_B + 2k}{3},$$

where firms 1 and 2 respectively use the platform's and the fringe's version of B. The resulting consumer participation is

$$Q = v - c - f_A - \frac{5f_B}{9} - \frac{4k}{9} - \frac{2\Delta - 11\Delta_L}{18} + \frac{(f_B - k)^2}{18(\Delta - \Delta_L)}.$$

The platform maximizes $\Pi = (f_A + (f_B - k)s_1)Q$, where $s_1 = \frac{2}{3} - \frac{f_B-k}{3(\Delta-\Delta_L)}$ is seller 1's market share. The profit-maximizing fees are

$$f_A^{NT} = \frac{v-c-k}{2} - \frac{17}{100}\Delta + \frac{21}{50}\Delta_L \text{ and } f_B^{NT} = k + \frac{\Delta - \Delta_L}{5}.$$

Equilibrium profit and participation are then

$$\Pi^{\mathrm{NT}} = \left(\frac{v-c}{2} - \frac{10k + \Delta - 6\Delta_L}{20}\right)^2 \text{ and } Q^{\mathrm{NT}} = \frac{v-c}{2} - \frac{10k + \Delta - 6\Delta_L}{20}.$$

Superior rivals Suppose now that the rivals have a superior quality $\Delta_H > \Delta$. Tying delivers the same profit as above, Π^{T}. Absent tying, one seller (say seller 1) selects a high quality fringe provider, while seller 2 chooses the platform's ancillary service. The platform's profit is then $\Pi = (f_A + (f_B - k)s_2)Q$, where

$$s_2 = \frac{1}{3} - \frac{f_B - k}{\Delta_H - \Delta} \text{ and } Q = \frac{v-c-k}{2} + \frac{6\Delta - \Delta_H}{20}.$$

[11] Allowing sellers to not subscribe to the ancillary service would not make a big change to the analysis, but would require us to consider more configurations. The equilibrium would essentially be the same, as long as the gap between Δ and Δ_L is not too large compared to that between Δ_L and 0 (the quality without ancillary service).

The profit-maximizing fees are

$$f_A^{\mathrm{NT}} = \frac{v-c}{2} + \frac{22\Delta + 3\Delta_H - 50k}{100} \text{ and } f_B^{\mathrm{NT}} = k + \frac{\Delta - \Delta_H}{5},$$

resulting in a profit equal to $\Pi^{\mathrm{NT}} = \left(\frac{v-c}{2} + \frac{6\Delta - \Delta_H - 10k}{20}\right)^2$, which is always smaller than Π^{T}.

However, the platform can do better than tying, by requiring sellers to subscribe to the service offered by the fringe. Doing so forces sellers to compete fiercely ($p = c + f_A + k$), and, using QR to denote this "Quality Requirement", consumer participation is

$$Q^{\mathrm{QR}} = v + \frac{\Delta_H}{2} - (c + f_A + k).$$

The platform maximizes $f_A Q^{\mathrm{QR}}$ by setting

$$f_A^{\mathrm{QR}} = \frac{1}{4}[2(v - c - k) + \Delta_H]$$

and its resulting profit is $\Pi^{\mathrm{QR}} = \left(\frac{v-c}{2} + \frac{\Delta_H - 2k}{4}\right)^2$, which is greater than the profit under tying (because $\Delta_H > \Delta$).

Comparing the equilibrium expressions yields the following result:

Proposition 5. *When it faces competition from weaker rivals on the provision of ancillary services, the platform finds it optimal to practice tying. Consumer surplus is greater than under no tying.*

When it faces competition from stronger rivals on the provision of ancillary services, the platform's optimal strategy is to require sellers to subscribe to an ancillary provider of quality Δ_H. Consumer surplus is then higher than under tying.

Discussion In our model, the platform has no incentive to monopolize the ancillary service market (B). When tying is used, it is precisely because the platform is more efficient than rival providers, and tying in that case enhances consumer surplus by fostering adoption. The reason is that the platform can extract profits through pricing on the core market (A), which removes the motive to exclude ancillary rivals.

However, there may be environments where the platform does have incentives to exclude potentially more efficient entrants on the ancillary market. This could occur, for example, under imperfect rent extraction on the core market (Greenlee et al., 2008) or when the platform seeks to preserve its market power there (Carlton and Waldman, 2002). In such settings, tying could be motivated by exclusionary rather than efficiency considerations. This line of argument was used in various cases against Amazon (Italy, European Union, United States).[12] A possible remedy in these cases would be a minimum

[12]In its press release, the Italian authority states: "As a result of the abuse, competing marketplaces

quality requirement, which would ensure that more efficient entrants can compete in the ancillary market. A nice feature of this remedy is that it would not be harmful even in our baseline model, where the platform has no exclusionary motive.

5 Seller market power

A feature of our baseline analysis is that each product market is a Bertrand duopoly, which produces relatively stark competitive outcomes. Here we consider variations to this aspect of the model. First, we show that when sellers are intrinsically differentiated they will earn non-zero profit and may be made better-off by tying. Second, when there is only one seller per market, tying can still serve to profitably and efficiently promote platform participation, even if it does not intensify seller competition. Finally, a version of our results continues to hold with more than two sellers in the market.

5.1 Differentiated sellers

In our baseline model, sellers are homogenous and make zero profit both in the laissez-faire situation and under a ban on tying. Because they even benefit from divestiture, one might be tempted to interpret tying as harmful to sellers. By slightly enriching the baseline model, we show that this is not necessarily the case, and that sellers may actually benefit from tying by the platform.

Suppose that sellers are initially vertically differentiated: seller i has quality s_i, which is valued θs_i by a consumer of type θ.[13] Suppose that $s_1 \geq s_2$, and that $\Delta > s_1 - s_2$.[14] Let δ_i be seller i's quality taking into account the ancillary service. We have $\delta_i \equiv s_i + \Delta$ if seller i adopts the ancillary service, and $\delta_i \equiv s_i$ otherwise. The gross utility of a type θ consumer if he buys from seller i is $v + \theta\delta_i$. We provide the analysis of this model in Appendix A.2, and discuss the main insights below.

If both sellers adopt the ancillary service or if none do, their *per platform user* profits are $\pi_1 = \frac{4(s_1-s_2)}{9}$ and $\pi_2 = \frac{s_1-s_2}{9}$. If only seller i adopts the service, profits are $\pi_i = \left(\frac{2(s_i+\Delta-s_j)-f_B}{3(s_i+\Delta-s_j)}\right)^2$ and $\pi_j = \left(\frac{(s_i+\Delta-s_j)+f_B}{3(s_i+\Delta-s_j)}\right)^2$. Thanks to the initial differentiation, both sellers achieve positive profits in all cases.

Unlike the baseline model, we find that sellers can be harmed by a ban on tying. When the ban results in the platform not offering the ancillary service at all, the per platform user profit of sellers is the same as under tying, but the number of users goes down, so

have also been damaged: because of the cost of duplicating warehouses, sellers who adopt Amazon's logistics are discouraged from offering their products on other online platforms, at least with a product range as wide as that on Amazon.it.", https://en.agcm.it/en/media/press-releases/2021/12/A528

[13]Such perfect correlation between taste for quality and taste for the ancillary service is convenient analytically.

[14]Results would not change much if $\Delta < s_1 - s_2$, but there would be more cases to consider.

that sellers are necessarily worse-off. When the ban does not lead to the removal of the ancillary service, they can again be worse-off if many consumers exit the platform. This underlines tying's role in mitigating the competitive externality between sellers who all benefit when consumers expect to find low prices on the platform.

In this model, it is sometimes optimal for the platform to offer the ancillary service without tying, unlike in our baseline model. However, when the platform chooses to tie the services, consumers are better-off, so that a ban on tying harms consumers.

Proposition 6. *When sellers are initially differentiated, a ban on tying can (but need not) harm sellers. When this is the case, tying increases the surplus of the three groups of players (platform, consumers and sellers).*

5.2 Monopoly seller

In our primary analysis, we have assumed that there are competing sellers. In the appendix we study the situation with a monopoly downstream seller. As in the duopoly case, the seller fails to fully internalize the fact that adoption of the ancillary service can attract more consumers to the platform. We therefore find that the platform may want to compel the seller to adopt the service (either through tying, or by subsidizing the service and extracting the resulting profit via the transaction fee). Moreover, because consumers capture some of the surplus created by the service, consumer surplus increases whenever the platform chooses to tie. Thus, while tying no longer serves to intensify seller competition, it continues to fulfil the role of resolving under-adoption.

5.3 More than two sellers per-market

Suppose we have $n \geq 4$ sellers per market. If f_B is not too large, there are three types of equilibrium adoption patterns: (i) one seller adopts B, $n-1$ do not; (2) $n-1$ sellers adopt B, one does not; (3) $k \in [2, n-2]$ sellers adopt B, and $n-2$ do not. In these three cases, a unilateral deviation by a seller to adopt or not necessarily leads to that seller competing à la Bertrand against one or more sellers, and so cannot be profitable.

In case (3), the adopting sellers charge $p_1 = c + f_A + f_B$ while the non-adopting ones charge $p_2 = c + f_A$, and consumers choose a seller that uses the ancillary service if and only if $\theta\Delta \geq f_B$. This case is formally equivalent to the integrated monopoly case, as explained in Section 3.5, and so tying would not benefit the platform.

In cases (1) or (2), however, the one seller that does not behave like the others enjoys some degree of market power due to vertical differentiation, and tying may help the platform. To see this, let us focus on case (1), with only one seller adopting the ancillary service. In this case, the price charged by all non-adopting sellers is $p_2 = c + f_A$. The demand for seller 1 is $1 - \theta^*$ and for all other sellers combined is θ^*. Then $\pi_1 =$

$(p_1 - f_A - f_B - c)(1-\theta^*)$ and maximizing this w.r.t. p_1 gives $p_1 = c + f_A + (f_B + \Delta)/2$. Consumer participation is

$$Q = \int_0^{\theta^*} (v - p_2)\, d\theta + \int_{\theta^*}^1 (v + \Delta\theta - p_1)\, d\theta = v - c - f_A + \frac{(\Delta - f_B)^2}{8\Delta}.$$

The platform's profit is $\Pi = ((f_A + f_B - k)(1-\theta^*) + f_A\theta^*)Q$, which is maximized at

$$f_A = \frac{v-c}{2} - \frac{(\Delta - k)^2}{36\,\Delta}, \quad f_B = \frac{2k + \Delta}{3}.$$

The optimal platform profit is

$$\Pi^{NT} = \left(\frac{v-c}{2} + \frac{(\Delta - k)^2}{12\Delta}\right)^2.$$

Note that the profit without service is $\left(\frac{v-c}{2}\right)^2$. Therefore, offering no service is worse for the platform than offering the service without tying. This is different from the main model and the reason is that the non-adopting sellers compete intensely with each other. Under tying, the equilibrium is as in the baseline case, with $\Pi^T = \left(\frac{v-c}{2} + \frac{\Delta - 2k}{4}\right)^2$.

Comparing Π^{NT} and Π^T, we find that the tying is profitable for $k \leq (\sqrt{6}-2)\Delta$. When this is not the case, the platform offers the service without tying. A ban on tying harms consumers whenever tying is profitable, by leading to higher prices. The condition $k \leq (\sqrt{6}-2)\Delta$ is more stringent than in the case with two sellers (when tying was profitable when $k \leq \Delta/2$). So, introducing more competition reduces the scope for profitable tying, but increases the range of parameters such that the platform offers the ancillary service.

In case (2), that is when all but one seller use the ancillary service, one can show that tying is never profitable for the platform, because there is already enough competition among the high quality sellers.[15]

6 More general contracts

In this section we explore the limits of tying through the lens of the platform's contractual instruments. We show that allowing the platform to charge two-part tariffs results in the same profit level as that of a platform that is vertically integrated with all sellers (which is the upper bound on the profit that the platform can achieve), and therefore dominates tying.

However, tying can remain profitable and consumer-surplus enhancing when the

[15] Prices are $p_1 = c + f_A + f_B$ and $p_2 = c + f_A + f_B/2$, and the platform's profit is $\Pi^{NT} = \left(\frac{v-c}{2} - \frac{k}{2} + \frac{k^2 + 3\Delta^2}{12\Delta}\right)^2 > \Pi^T$.

platform uses ad valorem commissions.

6.1 Two-part tariffs

Our model with unit fees entails a restriction, in the sense that the platform could achieve higher profits with more general contracts, such as two-part tariffs. While in practice it might be difficult for a platform to extract sellers' profit through fixed fees because of moral hazard or risk aversion (see Calzolari et al. (2020) for a general discussion of this point, and Allain et al. (2025) for an application to platforms), it is still worth studying the extent to which our results depend on this restriction. In this subsection, we show that, if the platform could offer a menu of two part tariffs to sellers, it could replicate the integrated monopolist solution and achieve a higher profit than with tying. In a nutshell, inducing one seller only to use the ancillary service improves efficiency (by saving costs for consumers with a low θ), and two-part tariffs are rich enough to (i) control sellers' prices and (ii) extract sellers' profits.

Suppose that the platform can offer two-part tariff contracts, for both the main service and the ancillary service. We use F_A and f_A for the fixed and unit fees for the main service, and F_B and f_B for the fixed and unit fees for the ancillary service. There are three configurations: neither seller uses the ancillary service, one seller uses it, or both sellers use it. Consider the situation where seller 1 uses the ancillary service while seller 2 does not. Let $f_1 = f_A + f_B$ and $f_2 = f_A$ be the total unit fees faced by sellers 1 and 2, respectively, and $F_1 = F_A + F_B$ and $F_2 = F_A$ be the total fixed fees faced by sellers 1 and 2, respectively.

The sellers' expected profits, per participating platform user, are given by $\pi_1 = (p_1 - c - f_1)(1 - \theta^*)$ and $\pi_2 = (p_2 - c - f_2)\theta^*$. The equilibrium prices are given by $p_1 = c + (2f_1 + f_2 + 2\Delta)/3$ and $p_2 = c + (f_1 + 2f_2 + \Delta)/3$. Given that the platform can extract sellers' profit through the fixed fees $F_i = \pi_i Q$, it can use the unit fees to perfectly control prices (as it can implement any (p_1, p_2) by the appropriate choice of f_1 and f_2).[16] This implies that the platform can achieve the integrated monopoly solution described in Section A.1 in the Appendix (the profit in which is the upper bound on the profit that the platform can achieve). The following result is immediate.

Proposition 7. *Suppose the platform can charge two-part tariffs. Then it can implement the fully optimal integrated monopoly solution without tying and tying is not profitable.*

[16] In particular, setting

$$f_1 = \frac{k^2 + (2(v-c) - 3\Delta)}{4\Delta} + \frac{3k}{2}, \quad f_2 = \frac{k^2 + (2(v-c) - 3\Delta)}{4\Delta} - \frac{3k}{2}$$

implements the prices in (17).

6.2 Ad valorem fees

In practice, many platforms use ad valorem fees instead of unit fees. One reason why this instrument might affect the decision to tie the services is that, with ad valorem fees, the platform has more of an incentive to keep prices relatively high. The fierce competition induced by tying might then be suboptimal from the platform's standpoint.

In this subsection we assume that the platform charges ad valorem fees. The model is less tractable than our baseline model, and we therefore rely on numerical results. We find that indeed there are cases where the platform prefers not to tie the two services. However, as in the baseline model, a ban on tying does not benefit consumers. Figure 1 illustrates our findings, for $v = 1, c = 0.05$, and $\Delta = 0.5$. For small values of k, the platform prefers tying, and consumers have a higher surplus than under no tying or no service. When the cost of the ancillary service k is intermediate, the platform offers the ancillary service without tying, which harms consumers (because $Q^T > Q^{NT}$ in that region). For higher values of k, the platform does not offer the ancillary service. We have not found a combination of parameters such that profitable tying harms consumers (i.e. such that $\Pi^T > \max\{\Pi^{NT}, \Pi^{NS}\}$ and $Q^T < \max\{Q^{NT}, Q^{NS}\}$).

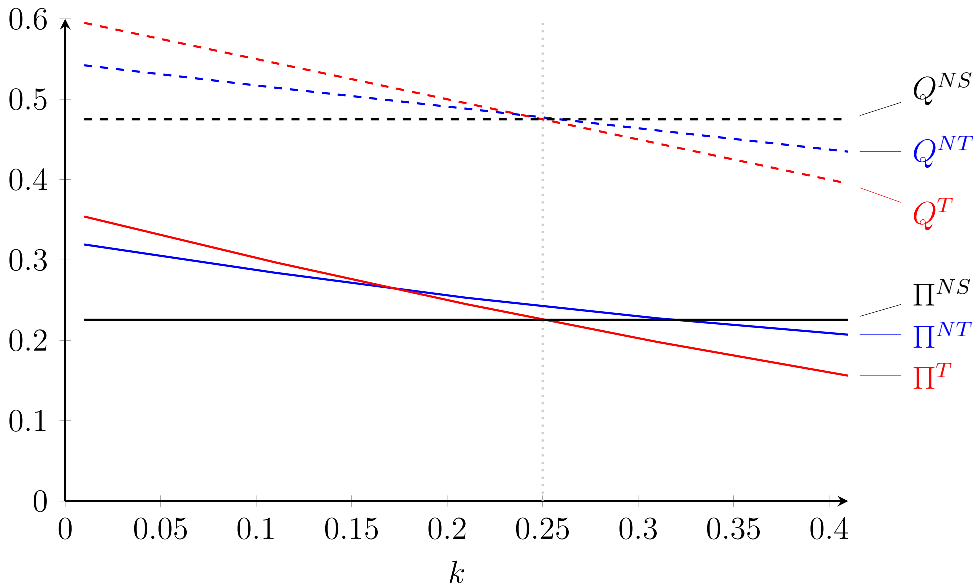

Figure 1: Platform profit (solid lines) and consumer participation (dashed lines) as a function of k with ad valorem fees.

7 Robustness to more general distributions

Our main results do not depend on the assumption that the consumers' outside options (ω) or their taste for service B (θ) are uniformly distributed. To see this, suppose that ω is drawn from some log-concave distribution, $G(\cdot)$, and that θ is drawn from $H(\cdot)$, with both G and H being twice differentiable.

Begin by studying product market competition. First, if there is no ancillary service then the distribution of θ is irrelevant and the solution is identical to our baseline model with prices $p_i = c + f_A$. Second, with tying sellers are again undifferentiated and set prices equal to their effective marginal cost, $p_i = c + f_A + f_B$. Lastly, when the service is offered without tying, sellers differentiate in their adoption decisions and their per-consumer profits are

$$\pi_1 = (p_1 - c - f_A - f_B)[1 - H(\theta^*)], \qquad \pi_2 = (p_2 - c - f_A)H(\theta^*),$$

where $\theta^* = (p_1 - p_2)/\Delta$ as before. Using the implicit function theorem, one can check that $\frac{\partial p_i}{\partial f_A} = 1$. In words: at the optimal prices the platform transaction fee gets passed perfectly through to consumers in all three regimes.

Thus, given regime $r \in \{\mathrm{NT}, \mathrm{T}, \mathrm{NS}\}$, we can write consumer surplus in the form $S^r(f_B) - f_A$. The mass of consumers who use the platform is $Pr[\omega \leq S^r(f_B) - f_A] = G(S^r(f_B) - f_A)$, meaning that the platform's profits have the form

$$\Pi^r = G\left(S^r(f_B) - f_A\right)\left[\hat{\Pi}^r(f_B) + f_A\right], \tag{14}$$

where $\hat{\Pi}^r$ is the average profit from the ancillary service per-platform-user in regime r. More precisely, in the no-tying regime we have $\hat{\Pi}^{\mathrm{NT}} = (f_B - k)(1 - H(\theta^*))$; with no ancillary service $\hat{\Pi}^{\mathrm{NS}} = 0$; and under tying $\hat{\Pi}^{\mathrm{T}} = f_B - k$.

At an interior solution given by the the first-order condition, the platform chooses f_A such that $\frac{\partial \Pi^r}{\partial f_A} = 0$, implying

$$f_A = \frac{G(S^r(f_B) - f_A)}{G'(S^r(f_B) - f_A)} - \hat{\Pi}^r(f_B). \tag{15}$$

Substituting the right-hand side of (15) into the square-bracketed term of (14) yields platform profit at the optimal f_A:

$$\Pi^r = \frac{G(Q^r)^2}{G'(Q^r)}, \tag{16}$$

where Q^r is consumer surplus at the opimal f_A, satisfying[17]

$$Q^r = S^r(f_B) - \underbrace{\left(\frac{G(Q^r)}{G'(Q^r)} - \hat{\Pi}^r(f_B)\right)}_{f_A}.$$

By log-concavity of G, the right-hand side of (16) is increasing in Q^r, meaning that

[17] When G is log-concave, $Q + G(Q)/G'(Q)$ is increasing in Q, so this equation has at most one solution.

$\Pi^r \geq \Pi^{r'}$ if and only if $Q^r \geq Q^{r'}$ for $(r, r') \in \{NT, T, NS\}^2$. In words, the regime that maximizes the platform's profit is also the one that leads to the highest consumer participation. A ban on tying can therefore only result in (weakly) lower consumer participation, as stated in part (ii) of Proposition 3.

One result that does depend on our assumption that $\theta \sim U[0,1]$ is part (i) of Proposition 3, namely that the platform would stop offering service B if tying was banned. An easy way to see this is to suppose that $\theta \sim U[a, a+1]$. Repeating the steps in Section 3, we obtain

$$\Pi^{\mathrm{NT}} = \left(\frac{v-c}{2} - \frac{\Delta^2[1 - a(a+6)] - k^2 + 2(3+a)\Delta k}{20\Delta} \right)^2 .$$

Of course, Π^{NS} does not depend on the distribution of θ and is given by (8). If $a > \sqrt{10} - 3 + \frac{k}{\Delta}$ we find $\Pi^{\mathrm{NT}} > \Pi^{\mathrm{NS}}$, so a ban on tying may lead the platform to offer the service without tying. This is intuitive: as a increases, the service becomes more valuable and this pushes the platform to continue offering it even when tying is banned. However, as shown above, this is not enough to overturn the result that tying is weakly beneficial for consumers.

8 Conclusion

Many platforms provide both a core transaction-enabling service and ancillary services that improve the perceived quality of a seller (e.g., efficient order fulfillment). This has raised concerns that platforms may tie the two types of service together in a harmful way. A distinctive, yet underexplored, feature of many such cases is that tying takes place on the seller side of the platform.

We have developed a model of such seller-side tying and presented a new efficiency theory of tying. Sellers under-adopt the ancillary service to soften competition through differentiation. This creates a negative participation externality because consumers expect lower surplus. The platform internalizes this effect and uses tying as a profitable means to mitigate under-adoption. Banning tying or breaking-up the platform would therefore be detrimental for consumers. Such a policy intervention may also be bad for sellers, even though tying intensifies competition. This is because sellers, too, are harmed when their rivals set high prices and drive potential customers from the platform. We can therefore find situations where the platform's, consumers', and sellers' interests are all aligned in preferring tying. Our findings highlight an efficiency argument that should be weighed against other potential effects of seller-side tying.

Equally, tying is one of several instruments that could be used to drive down prices, all of which are all likely to involve trade-offs. For example, the platform could use its search algorithm to punish high-price sellers, but at the potential cost of distorting search results to be less relevant. It could directly control sellers' prices, but is likely to have imperfect information about their marginal costs. Or it could enter the market itself as a first-party seller, but is unlikely to be able to do so for every one of millions of products. Thus, we expect that the platform will use a combination of tools to regulate price competition between sellers and have shown that tying can contribute to this effort.

We contrast our results with a more standard model of tying on the consumer side of the market. There we recover the familiar result that tying is not profitable, nor does it benefit consumers. Thus, seller-side tying differs from its more common buyer-side counterpart in economically important ways.

References

Abhishek, Vibhanshu, Kinshuk Jerath, and Siddharth Sharma (2025). "The impact of "retail media" on online marketplaces: Insights from a field experiment". *Information Systems Research* 36.1, pp. 456–473.

Abhishek, Vibhanshu, Kinshuk Jerath, and Z. John Zhang (2016). "Agency selling or reselling? Channel structures in electronic retailing". *Management Science* 62.8, pp. 2259–2280.

Allain, Marie-Laure, Marc Bourreau, and José Luis Moraga-González (2025). "The agency and wholesale models when a platform can charge entry fees". Working paper.

Amelio, Andrea and Bruno Jullien (2012). "Tying and freebies in two-sided markets". *International Journal of Industrial Organization* 30.5, pp. 436–446.

Anderson, Simon P., Susumu Sato, and Yusuke Zennyo (2025). "Economics of seller opt-out and the pricing of auxiliary services". Working paper.

Bakos, Yannis and Erik Brynjolfsson (1999). "Bundling information goods: Pricing, profits, and efficiency". *Management science* 45.12, pp. 1613–1630.

Belleflamme, Paul and Johannes Johnen (2023). "Non-price strategies of marketplaces". Working paper.

Belleflamme, Paul and Martin Peitz (2019). "Managing competition on a two-sided platform". *Journal of Economics & Management Strategy* 28.1, pp. 5–22.

Calzolari, Giacomo, Vincenzo Denicolo, and Piercarlo Zanchettin (2020). "The demand-boost theory of exclusive dealing". *The RAND Journal of Economics* 51.3, pp. 713–738.

Carlton, Dennis W and Michael Waldman (2002). "The strategic use of tying to preserve and create market power in evolving industries". *The RAND Journal of Economics* 33.2, p. 194.

Choi, Jay-Pil (2010). "Tying in two-sided markets with multi-homing". *Journal of Industrial Economics* LVIII.3, pp. 607–626.

Choi, Jay Pil and Doh-Shin Jeon (2021). "A leverage theory of tying in two-sided markets with nonnegative price constraints". *American Economic Journal: Microeconomics* 13.1, pp. 283–337.

Choi, Jay Pil, Doh-Shin Jeon, and Michael D Whinston (2024). "Tying with network effects". Working paper.

De Cornière, Alexandre (2016). "Search advertising". *American Economic Journal: Microeconomics* 8.3, pp. 156–188.

De Cornière, Alexandre and Greg Taylor (2021). "Upstream bundling and leverage of market power". *The Economic Journal* 131.640, pp. 3122–3144.

— (2024). "Anticompetitive bundling when buyers compete". *American Economic Journal: Microeconomics* 16.1, pp. 293–328.

Etro, Federico (2024). “e-Commerce platforms and self-preferencing”. *Journal of Economic Surveys* 38.4, pp. 1516–1543.

Fumagalli, Chiara, Massimo Motta, and Claudio Calcagno (2018). *Exclusionary practices: The economics of monopolisation and abuse of dominance*. Cambridge: Cambridge University Press.

Greenlee, Patrick, David Reitman, and David S Sibley (2008). “An antitrust analysis of bundled loyalty discounts”. *International Journal of Industrial Organization* 26.5, pp. 1132–1152.

Hagiu, Andrei (2009). “Two-sided platforms: Product variety and pricing structures”. *Journal of Economics & Management Strategy* 18.4, pp. 1011–1043.

Hagiu, Andrei and Julian Wright (2015). “Marketplace or reseller?” *Management Science* 61.1, pp. 184–203.

Iyengar, Garud, Yuanzhe Ma, Thomas Rivera, Fahad Saleh, and Jay Sethuraman (2023). “The distributional effects of “Fulfilled By Amazon” (FBA)”. Working paper.

Jiang, Baojun, Kinshuk Jerath, and Kannan Srinivasan (2011). “Firm strategies in the “mid tail” of platform-based retailing”. *Marketing Science* 30.5, pp. 757–775.

Khan, Lina M (2016). “Amazon’s antitrust paradox”. *Yale lJ* 126, p. 710.

Kittaka, Yuta, Susumu Sato, and Yusuke Zennyo (2023). “Self-preferencing by platforms: A literature review”. *Japan and the World Economy* 66, p. 101191.

Lai, Guoming, Huihui Liu, Wenqiang Xiao, and Xinyi Zhao (2022). ““Fulfilled by Amazon”: A strategic perspective of competition at the e-commerce platform”. *Manufacturing & Service Operations Management* 24.3, pp. 1406–1420.

Li, G., N. Chen, G. Gallego, P. Gao, and S. Kou (2024a). “Dealership or marketplace with fulfillment services: A dynamic comparison”. *Manufacturing & Service Operations Management* 26.5, pp. 1860–1877.

Li, J., W. Shen, Y. Liao, G. Cai, and X. Chen (2024b). “The fulfillment service in online marketplaces”. *European Journal of Operational Research* 315.3, pp. 1139–1152.

Li, Muxin (2024). “Dominating ancillary product markets via self-preferencing”. *Università Bocconi, working paper.*

Li, Y., L. X. Lu, J. A. Van Mieghem, and W. Xiao (2025). *“Fulfillment by Amazon” as a strategic lever: Anticompetitive or welfare enhancing?* `https://ssrn.com/abstract=5376166`. Available at SSRN.

Long, Fei and Wilfred Amaldoss (2024). “Self-preferencing: Role of private labels and sponsored advertising in e-commerce marketplaces”. *Marketing Science* 43.5, pp. 925–952.

Long, Fei, Kinshuk Jerath, and Miklos Sarvary (2022). “Designing an online retail marketplace: Leveraging information from sponsored advertising”. *Marketing Science* 41.1, pp. 115–138.

Long, Fei and Yunchuan Liu (2024). “Platform manipulation in online retail marketplace with sponsored advertising”. *Marketing Science* 43.2, pp. 317–345.

Shaked, Avner and John Sutton (1982). “Relaxing price competition through product differentiation”. *The Review of Economic Studies* 49.1, pp. 3–13.

Teh, Tat-How (2022). “Platform governance”. *American Economic Journal: Microeconomics* 14.3, pp. 213–254.

A Appendix

A.1 Integrated monopolist

As a benchmark, suppose that the industry is fully vertically integrated as a single platform firm that controls p_1 and p_2. There is no point offering the same product twice, so such a firm will differentiate, with only seller 1 offering the ancillary service. The resulting consumer surplus is

$$Q = \int_0^{\theta^*} (v - p_2)\, d\theta + \int_{\theta^*}^{1} (v + \theta\Delta - p_1)\, d\theta.$$

The integrated firm's profits are then

$$\Pi = [\theta^* p_2 + (1 - \theta^*)(p_1 - k) - c]Q.$$

Maximizing with respect to p_1 and p_2 yields

$$p_1^I = \frac{v+c}{2} + \frac{(\Delta + k)^2}{4\Delta}, \quad p_2^I = \frac{v+c}{2} + \frac{(\Delta - k)^2}{4\Delta}. \tag{17}$$

The resulting profit is

$$\Pi^I = \left(\frac{v-c}{2} + \frac{(\Delta - k)^2}{4\Delta}\right)^2. \tag{18}$$

One can check that $\Pi^I > \Pi^T$. Given these prices, a consumer buys from seller 1 if and only if $\theta > \theta^* = \frac{p_1 - p_2}{\Delta} = \frac{k}{\Delta}$. Thus, the prices are chosen to optimally sort consumers so that the ancillary service is consumed by precisely those consumers for whom it is efficient.

A.2 Differentiated sellers

Here we study the model in which sellers have initial quality s_i, which can be augmented by the ancillary service. We start by analyzing the subgame with product market competition.

A.2.1 Tying

First, suppose that the platform ties the ancillary service. A consumer prefers to buy from firm 1 if and only if

$$v + \theta(\Delta + \delta_1) - p_1 \geq v + \theta(\Delta + \delta_2) - p_2 \iff \theta \geq \theta^* = \frac{p_1 - p_2}{\delta}.$$

Only the total fee matters, so write $f_{AB} = f_A + f_B$. Profits are $\pi_1 = (p_1 - c - f_{AB})(1 - \theta^*)$

and $\pi_2 = (p_2 - c - f_{AB})\theta^*$. Solving for the equilibrium prices yields

$$p_1 = c + f_{AB} + \frac{2\delta}{3}, \quad p_2 = c + f_{AB} + \frac{\delta}{3}.$$

Thus, profits in the product market are

$$\pi_1 = \frac{4\delta}{9}, \quad \pi_2 = \frac{\delta}{9},$$

which are strictly positive for $\delta > 0$.

Consumer surplus (and participation) is given by

$$\begin{aligned} Q^{\mathrm{T}}(f_{AB}) &= \int_0^{\theta^*} (v + \theta(\Delta + \delta_2) - p_2)\, d\theta + \int_{\theta^*}^1 (v + \theta(\Delta + \delta_1) - p_1)\, d\theta \\ &= v - c - f_{AB} + \frac{\Delta}{2} + \frac{11\delta_2 - 2\delta_1}{18}. \end{aligned}$$

The platform solves

$$\max_{f_{AB}} (f_{AB} - k) Q^{\mathrm{T}} \implies f_{AB}^{\mathrm{T}} = \frac{v + k - c}{2} + \frac{\Delta}{4} + \frac{11\delta_2 - 2\delta_1}{36}.$$

Using this fee, we obtain the equilibrium platform profit and consumer participation:

$$\Pi^{\mathrm{T}} = \frac{[18(v - c - k) + 9\Delta + 11\delta_2 - 2\delta_1]^2}{1296} = \left[Q^{\mathrm{T}}(f_{AB}^{\mathrm{T}})\right]^2.$$

One can check that at the equilibrium $\theta^* = 1/3$ is interior as required. Moreover, consumer participation is positive for $v - c$ large enough.

A.2.2 No tying

Now suppose the platform offers the service without tying. We focus on the case where firm 1 buys the service (qualitatively similar results obtain if firm 2 does). A consumer prefers to buy from firm 1 if and only if

$$v + \theta(\Delta + \delta_1) - p_1 \geq v + \theta\delta_2 - p_2 \iff \theta \geq \theta^* = \frac{p_1 - p_2}{\Delta + \delta}.$$

Profits are $\pi_1 = (p_1 - c - f_A - f_B)(1 - \theta^*)$ and $\pi_2 = (p_2 - c - f_A)\theta^*$. Solving for the equilibrium prices yields

$$p_1 = c + f_A + \frac{2(\Delta + \delta + f_B)}{3}, \quad p_2 = c + f_A + \frac{\Delta + \delta + f_B}{3}.$$

Thus, profits in the product market are

$$\pi_1 = \frac{[2(\Delta+\delta) - f_B]^2}{9(\Delta+\delta)}, \quad \pi_2 = \frac{[\Delta+\delta+f_B]^2}{9(\Delta+\delta)}.$$

Consumer surplus (and participation) is given by

$$\begin{aligned} Q^{\mathrm{NT}}(f_A, f_B) &= \int_0^{\theta^*} (v + \theta\delta_2 - p_2)\, d\theta + \int_{\theta^*}^1 (v + \theta(\Delta+\delta_1) - p_1)\, d\theta \\ &= v - c - f_A + \frac{1}{18}\left[11\delta_2 - 2(\Delta+\delta_1) - 10 f_B + \frac{f_B^2}{\Delta+\delta}\right]. \end{aligned}$$

The platform solves

$$\max_{f_A, f_B} [f_A + (1-\theta^*)(f_B - k)] Q^{\mathrm{NT}}.$$

The solution is

$$f_A^{\mathrm{NT}} = \frac{v-c}{2} + \frac{1}{100}\left[42\delta_2 - 17(\Delta+\delta_1) - k\left(2 + \frac{3k}{\Delta+\delta}\right)\right],$$

$$f_B^{\mathrm{NT}} = \frac{3k + \Delta + \delta}{5}.$$

Using these fees, we obtain the equilibrium platform profit and consumer participation:

$$\Pi^{\mathrm{NT}} = \frac{\{(\Delta+\delta)\left[10(v-c) - \Delta - \delta_1 + 6(\delta_2 - k)\right] + k^2\}^2}{400(\Delta+\delta)^2} = \left[Q^{\mathrm{NT}}(f_A^{\mathrm{NT}}, f_B^{\mathrm{NT}})\right]^2.$$

One can check that at the equilibrium θ^* is interior as required. Moreover, consumer participation is positive for $v - c$ large enough. Lastly, using the equilibrium fees to evaluate seller profits reveals them to be positive.

A.2.3 No service

Lastly, suppose the platform does not offer the ancillary service. This is equivalent to the tying case after replacing $\Delta = k = 0$ and $f_{AB} = f_A$. We thus obtain Π^{NS} and Q^{NS} accordingly.

A.2.4 Tying decision and policy implications

The platform finds it optimal to tie when Δ is sufficiently large. Indeed, we have

$$\Pi^T > \Pi^{NS} \iff \Delta > 2k,$$

$$\Pi^T > \Pi^{NT} \iff \frac{1}{180}\left[54\Delta - \delta - 9k\left(4 + \frac{k}{\Delta+\delta}\right)\right] > 0.$$

The left-hand side of both inequalities is increasing in Δ.

Lastly, notice that $\Pi = Q^2$ in all three cases. Therefore, if the platform finds it optimal to tie ($\Pi^T > \max\{\Pi^{NT}, \Pi^{NS}\}$) then tying also maximizes consumer surplus, $Q^T > \max\{Q^{NT}, Q^{NS}\}$. It follows that whenever the platform would choose to tie, a ban on tying or divestiture would leave consumers worse-off.

B Monopoly seller

In our primary analysis, we have assumed that there are competing sellers. We now investigate the case in which there is a monopoly seller on each market.

First, consider the case in which the platform offers the service without tying and the seller uses the service. The consumer will purchase if $v + \theta\Delta - p \geq 0$ where p is the price of the seller, which gives demand as $1 - (p - v)/\Delta$. The seller's profit is given by $(p - c - f_A - f_B)(1 - (p - v)/\Delta)Q$. Maximizing this w.r.t. the price p gives the optimal price as $p^M = (c + f_A + f_B + v + \Delta)/2$, and the seller's optimal profit as $\pi^M = (c + f_A + f_B - v - \Delta)^2/(4\Delta)Q$. The expected consumer surplus is $Q^M = \int_{(p-v)/\Delta}^{1} (v + \theta\Delta - p)\, d\theta = (c + f_A + f_B - v - \Delta)^2/(8\Delta)$.

On the other hand, if the platform offers the service without tying and the seller does not use the service, the consumer's utility is simply $v - p$, the seller will price at $p = v$ and make profit $v - c - f_A$. In this case, there will be no consumer participation, which the platform does not want.

Therefore, the condition that the platform will impose to induce the seller to use the service is $(c + f_A + f_B - v - \Delta)^2/(4\Delta) \geq v - c - f_A$. This gives

$$f_B \leq v + \Delta - c - f_A - 2\sqrt{\Delta(v - c - f_A)} \equiv f_{B,\max}.$$ [18]

The platform therefore solves

$$\max_{f_A, f_B} (f_A + f_B - k)\left(1 - \frac{p - v}{\Delta}\right) Q^M \text{ s.t. } f_B \leq f_{B,\max}.$$

The profit of the platform depends on $f_A + f_B$, and the platform will always be able to induce adoption of the service. We can show that the solution is

$$f_A + f_B = \frac{v + \Delta + 3k - c}{4} \text{ and } f_B < f_{B,\max}.$$

If $f_{B,\max} < k$, then the platform is essentially subsidizing adoption of the service. Indeed, such cases arise (though we can rule out $f_B < 0$).

Overall, in the case of a monopoly seller, this monopoly seller does not internalize that not adopting the service can reduce overall participation. The platform then has to ensure

[18] $f_B \geq v + \Delta - c - f_A + 2\sqrt{\Delta(v - c - f_A)}$ is not in the relevant domain.

adoption, in some cases by charging a fee for the ancillary service that is lower than the cost of the service. This may appear predatory but it actually increases consumer surplus. Note that under tying the profit of the platform would be the same as in the analysis above but there would only be a single fee f_{AB}. In this sense, in the monopoly seller case, as in the competitive sellers case, the platform induces adoption of the service either by limiting the service fee or by tying, but this is beneficial for consumers.