# Lowering the Garden Wall: Marketplace Leakage and Quality Curation

Ben Casner*

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**Abstract**

What are the unintended effects of policies that reduce the cost of disintermediating from market platforms? I show that it may be profitable for a platform to reduce the intensity with which it screens sellers while simultaneously offering a robust refund policy to insure consumers against possible transactions with low-quality sellers. This reduces the incentive to disintermediate by shrinking consumer confidence in sellers who steer consumers to direct transactions, reducing consumers' willingness to pay for off-platform transactions. The refund policy encourages low-quality sellers to only offer direct transactions while maintaining consumer willingness to pay for products sold through the platform. Introducing a rival platform increases seller welfare and eliminates this unintended effect by deterring platforms from allowing low-quality sellers to join their marketplaces for fear of losing consumers to their rival.

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# 1 Introduction

Platform design choices can have a huge impact on how easy it is for sellers to steer consumers to off-platform transactions. For example, in Apple's app store ecosystem Spotify allows existing users to sign in to their accounts and stream media, but does not have options to use Apple's payment system to sign up for services. Until recently apps like Spotify did not include links steering users to their firms' online sign up flow because doing so was specifically forbidden by app store, so while the music streaming service was steering consumers toward signing up with it directly, it was limited in how easily it could do so. These terms of service allow platforms to leverage their market power to generate immense revenue, with Apple earning nearly US$81bn in revenue from its app store alone in 2021 (Ceci 2023). However, in recent years regulatory pressure—and in the United States court rulings such as *Epic games, inc. v. apple inc.* (2021) and *Epic games, inc. v. google inc.* (2023)—have begun to threaten this power by requiring these firms to allow for easier off-platform transactions.[1] More generally, there has been a broad push to ban anti-steering clauses, with South Korea passing a law in 2021 requiring app stores to allow alternative payment systems, and the recent Digital Markets Act in the EU includes a clause specifically forbidding dominant platforms from including anti-steering provisions. This creates an avenue for platform leakage (Hagiu and Wright 2023) which constrains the platform's commissions. With direct anti-steering clauses forbidden, these platform may want to find indirect methods to reduce the appeal of steering, which in turn may require additional remedies on the part of a regulator.

Here I study one such strategy: a reduction in screening effort by the platform. This results in more low-quality sellers on the platform, increasing the importance of the implicit warranty offered by the platform's refund policy, and so reduces the relative appeal of transacting directly with sellers. To motivate this consider Apple's response to the Epic ruling's required permission of direct payment links: Apple directs users to a warning screen before opening the app's browser sign-up flow (see Figure 1 below). This warning screen highlights the fact that users cannot request a refund through the Apple app store, which implies that if the user is dissatisfied or encounters a dishonest developer then they would be unable to get a refund (or would need to engage in a troublesome credit card charge-back) if the developer refuses to provide one. This warning could be an effective leakage prevention strategy if consumers find the threat credible and are therefore unwilling to be steered toward direct transactions by app developers. This credibility requires that there must be a sufficient presence of unsatisfactory apps whose developers refuse to provide refunds, which raises the question of whether this decision creates an incentive for Apple to

[1]The *Epic v. Apple* ruling specifically required that Apple allow apps on its store to direct users to external payment options In mid 2024 Apple responded to this ruling by changing its terms of service to only allow the links with restrictive conditions and taking a high commission on those sales. Epic has stated it plans to sue over this change, saying that it does not conform to the intent of the original ruling.

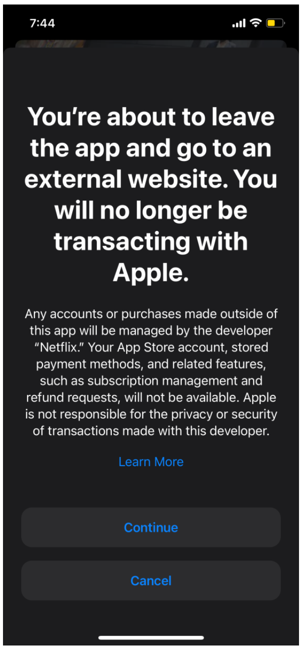


Figure 1: Warning displayed by Apple upon users leaving the app store through an external payment link

be less diligent in curating the quality of apps on its store.

One possible response that a regulator could take in addition to or instead of banning anti-steering clauses is to facilitate the entry of a competing platform.[2] But it seems likely that consumers will single-home while app developers multi-home in this environment, leading to the competitive bottleneck setup of Armstrong (2006), in which consumers benefit from competition but sellers do not. However, if we consider the curation incentives above, we might wonder whether competition could benefit sellers in addition to consumers by encouraging platforms to police the quality of sellers they host more diligently.

To answer these questions I develop a model where consumers search for sellers to transact with via a platform's search portal. The sellers can decide to either transact via the platform, or steer consumers toward direct transactions. If the sellers allow on-platform purchases then they must pay a commission to the platform, but if they steer consumers to direct transactions then they compensate consumers for a switching cost which represents both the inconvenience to consumers and the difficulty of notifying consumers about the existence of a direct option. The platform's revenue comes from charging an entrance fee to consumers and an ad valorem commission to sellers.

In the benchmark model, the platform charges a commission which makes sellers indifferent about steering and an entrance fee which makes consumers indifferent about participating on the platform. The platform can introduce low-quality sellers whose products provide negative utility but who are ex ante and interim (from the perspective of the market

[2]For example, in *Epic games, inc. v. google inc.* (2023), Epic has proposed requiring easy installation of competing app stores on Android phones as a remedy to the finding that Google has excess monopoly power.

game) indistinguishable to consumers from high-quality sellers. If a consumer purchases from a low-quality seller via the platform they can seek an ex post refund, in which case the consumer receives 0 utility and the seller receives no revenue from that transaction. Therefore the low-quality seller can only make positive profit by steering consumers to direct transactions. The presence of these low-quality sellers reduces consumers' confidence in the quality of sellers steering to direct transactions, which reduces their willingness to pay and thus reduces the profitability of steering relative to allowing on-platform transactions and hence allows the platform to charge a higher commission. If the proportion of low-quality sellers is sufficiently high then consumers will only transact via the platform and the platform can extract all surplus from sellers. The platform controls the proportion of low-quality sellers, and the proportion of low-quality sellers that it allows is decreasing in both the switching cost and consumers' search costs. If the switching cost is sufficiently high, then the platform does not need to discourage direct transactions so the platform does not admit low-quality sellers. If the switching cost is low but the search cost is not, then the platform admits some low-quality sellers to discourage sellers from steering, but not so many that consumers are willing to to engage in additional search required to avoid transacting directly with sellers. If the switching and search cost are both low, then the platform admits just enough sellers such that consumers are only willing to transact through the platform. We can think of the policy measures outlined above as a reduction in the switching cost, which from these results implies that implementing them will indeed cause the platform to screen less than it otherwise would.

In Section 5 I assume that regulators have required the platform holder to allow for a competing marketplace to be installed on the same device. This platform does not charge a separate entrance fee, but does take a commission on seller revenue. I assume that sellers can multi-home freely, while consumers single-home on one platform. This competitive bottleneck setup (Armstrong 2006) leads to intense competition for consumers, forcing the platforms to engage in a high level of screening or risk losing all transaction revenue. The reduced presence of low-quality sellers makes steering consumers more attractive for sellers, which leads to a lower commission, meaning that sellers are benefiting from competition *despite the fact that the competitive bottleneck setup means that platforms are not directly competing for their participation.* Further, because competition prevents the platforms from reducing their screening effort (i.e. admitting low-quality sellers), the tradeoffs from policies which reduce switching costs are eliminated.

In Section 6 I describe two extensions to the model. In the first I hold the proportion of low-quality sellers fixed, but allow the consumers to detect low-quality sellers with a positive probability which is controlled by the platform. Similar to the previous section, the platform will reduce consumers' ability to distinguish high- and low-quality sellers if the switching cost is sufficiently low, but unlike the previous section the platform's strategy is binary. If the switching cost is very low and consumers do not retain too much surplus from trade (gross of the entrance fee charged by the platform), then the platform will set the probability sufficiently low such that consumers are unwilling to engage in direct transactions. On the other hand, if the switching cost is relatively high and/or consumers share of gains from trade is sufficiently high, the equilibrium detection probability is independent of the switching cost. This is because the detection probability and switching cost both influence sellers' *per-transaction* revenue in an additive fashion, but do not have an extensive impact on the number of transactions occurring on the platform.

In the second extension I allow for endogenous price-setting by the sellers. I find that including low-quality sellers reduces consumer search intensity similar to Casner (2020) and Eliaz and Spiegler (2011), but the essential logic of the monopoly model is unchanged. If the switching cost is low and search cost is not too high, the platform will admit a positive proportion of low-quality sellers to deter direct transactions.

# 2 Related Literature

## 2.1 Disintermediation and Marketplace Leakage

Much of the extant literature on platform disintermediation (which I will henceforth interchangeably refer to as marketplace leakage) has focused on the limitations that disintermediation poses on platforms' pricing power and various policy decisions such as showrooming and price parity clauses (Wang and Wright 2020), investment in transaction benefits (Lin, Nian, and Foutz 2022), provision of product information to consumers (Bar-Isaac and Shelegia 2023), seller/buyer communication, and intra-platform competition (Hagiu and Wright 2023). Jing (2018) adopts a similar model to mine but is closer to Wang and Wright (2020) in that his model focuses on the interaction between search costs, information externalities between various sales channels, and the effect of price parity clauses. Chang and Miller (2024) study the effects of a South Korean law requiring smart phone platform holders to allow app developers to permit alternative payment options, but find little effect from the policy, which they attribute partly to the small size of the Korean market and partly due to consumer mistrust of direct transactions. One of the closest papers to mine is Gu and Zhu (2021), who find that as sellers build trust with consumers, they can more easily convince them to transact directly and avoid platform fees, however they examine this empirically in the context of a labor platform with repeated interactions. In contrast my model considers one-shot interactions and the implications of a platform refund policy when consumers have limited information about seller trustworthiness and no way to gain more confidence pre-purchase.

## 2.2 Quality Curation of Sellers and Platform governance

This article also fits into the literature on quality control in platforms and other non-price policies (Eliaz and Spiegler 2011; Teh 2022; Choi and Jeon 2023). The focus on inclusion of low-quality sellers and their effect on consumer search is similar to that of Casner (2020) and the search obfuscation literature (Ellison and Ellison 2009; Hagiu and Jullien 2011; Heresi 2023). Most of the those articles focus on the impact of platform design decisions on intra-platform competition, while here I focus specifically on the presence of low-quality sellers causing consumers to value the platform's implicit warranty more. Ershov (2024) takes an empirical look at app store marketplacees and finds that congestion effects increase consumer search costs, but his paper does not specifically consider removing low-quality apps and instead focuses on how congestion impacts product discovery while my primary focus is on consumer trust.

Etro (2021) looks at the effects of platform business models on pricing incentives, quality curation of app stores, and the incentives of app stores to acquire developers in order to secure exclusives for their own platforms. However his focus is primarily the comparison of platforms which monetize consumers through an entry fee as opposed to simply taking commissions from sellers and how it affects inter-platform competition. His approach to modeling curation is highly reduced form to maintain tractability and because it is not the focus of his model.

One paper very closely related to mine is Teh and Wright (2024), who consider the impact of various platform policies in a competitive bottleneck context and find that platforms engage in excessive shrouding of sellers' direct sales channels even in a context with competing platforms. They find that banning Apple's anti-steering policies are unambiguously total-welfare enhancing, but their model considers a much broader set of platform policies which necessarily means their mechanism for preventing disintermediation is more reduced form than that which I consider here and does not involve reducing consumer trust in direct transactions. I show that with quality curation in the mix of disintermediation prevention strategies, eliminating anti-steering clauses is only an unambiguous good in the presence of a sufficiently competitive rival platform.

# 3 Benchmark Model

To analyze the questions posed in the introduction, I develop a model with a monopoly platform, continuum of consumers with mass 1, and a continuum of sellers which also has mass 1. The platform sets a percentage commission $\xi$ that it takes from the sellers' gross revenue and a participation price $\rho$ that it charges consumers for access to the platform. The sellers can choose to allow transactions through the platform in which case they receive gross revenue $\mu < V$ where $V$ is the total value of trade that is homogeneous across both sellers and consumers (assuming a taste match, see below), and $\mu$ is the proportion of that value captured by sellers (with consumers receiving the remaining $V - \mu$). Given the platforms commission this leads to net revenue $(1 - \xi)\mu$ per transaction when trade occurs through the platform. Alternately sellers can disallow on-platform transactions and instead steer consumers to direct transactions. If they do so, this imposes a switching cost $t$ reflecting the difficulty of finding the alternative payment, the additional hassle costs of entering new payment information and any foregone convenience benefits of transacting on the platform. This switching cost is fully borne by the sellers, but sellers pay no commission to the platform for direct transactions, meaning they receive revenue $\mu - t$ per customer when they steer when there are no low-quality sellers.[3][4] Consumers have access to an outside option whose value is normalized to 0, and they must search on the platform to find sellers following a Wolinsky (1986) style undirected search process. They pay a search cost $s$ for each observation, and with probability $\sigma$ the seller they observe is a taste match, in which case the value of trade is $V$, and with probability $1 - \sigma$ the seller's product does not match the consumer's taste, in which case the value of trade is 0.

One of the advantages of transacting through the platform instead of directly is that the platform provides a sort of warranty in that consumers who are dissatisfied with their purchase can seek a refund through the platform. One way that a platform could indirectly raise the switching cost in response to an external force imposing direct reductions in $t$ would be to highlight this guarantee. Apple's warning to consumers as highlighted in Figure 1 is an example of exactly this. Of course, this warning will have little effect when consumers are transacting with large companies that have an established reputation, therefore in order for this threat to be credible the platform would need to relax the intensity with which it screens the quality of sellers on its store. By allowing these apps into its previously strictly walled garden, the platform increases consumers' uncertainty about the trustworthiness of direct transactions and which reduces their appeal despite the lack of switching cost.

To model this strategy, I suppose the platform allows a proportion $\alpha$ of lower quality apps onto its marketplace who provide negative utility $-\ell$. Note $-\ell$ is not inclusive of any

[3]This assumption that the steering cost is borne fully by sellers is primarily for tractability. Incidence of the steering cost is endogenous when I allow for endogenous seller pricing in section 6 and does not meaningfully change results.

[4]The steering payoff is somewhat lower when the proportion of low-quality sellers is greater than 0. I save that explanation for later in the paper.

payment made by consumers.[5] The distribution of gross payoffs from trade is now

$$\begin{cases} V & \text{with probability } \sigma \text{ if seller is high-quality} \\ 0 & \text{with probability } 1-\sigma \text{ if the seller is high-quality} \\ -\ell & \text{seller is low-quality} \end{cases}$$

However consumers cannot observe their true match value draw until after they have made a purchase. Instead they observe a signal that is equal to their true value if they encounter a high-quality seller, and randomly drawn with probability $\sigma$ of being positive if they encounter a low-quality seller and their true match value is $-\ell$.

$$\text{Signal Value} = \begin{cases} V & \text{with probability } \sigma \text{ if seller is low-quality} \\ & \text{or probability 1 if seller is high-quality and } V \text{ is the true match value} \\ 0 & \text{with probability } 1-\sigma \text{ if seller is low-quality} \\ & \text{or probability 1 if seller is high-quality and 0 is the true match value} \end{cases}$$

Once a consumer has purchased from a seller and observed a null match value, they have the option to seek a refund of the price they paid. This refund will be successful if they purchased through the platform, but will be denied if they purchased directly. Upon receiving a successful refund the consumers' payoff is 0, but if the refund is denied their net payoff remains $-\ell$.[6] Regardless of the outcome of their request I assume consumers do not search for and purchase a different product after purchasing from an unsatisfactory seller.[7] Given the refund policy, the low-quality sellers only make a positive profit if they make a sale through the direct channel, so they will only offer direct purchases.

If no high-quality seller steers consumers to direct purchases then observing a direct transaction fully reveals a seller as low-quality and so no consumer will purchase directly. The low-quality sellers make 0 profit through both channels so they are indifferent between allowing direct purchases and not. As a tie breaking rule I assume that agents will make the decision most favorable to the platform, so when indifferent low-quality sellers offer direct

[5] $\ell$ is a catchall for the negative utility from receiving an unsatisfactory product and no refund. It can be thought of as incorporating bad feelings from the interaction or the possibility of getting a refund through the payment mechanism (e.g. chargebacks on a credit card). I could in theory allow $\ell < 0$ by a small margin to model a situation where a consumer is able to conveniently secure a chargeback such that their negative utility from the unsatisfactory transaction is smaller than if they had simply paid for the item and received a useless good. This would not change my results so long as the net payoff from transacting with a low-quality seller is negative.

[6] In principle the post-refund payoff might be negative if monetary relief does not alleviate all of a consumer's dissatisfaction, but I set it to 0 here to avoid unnecessary notation as a more general payoff would not make a difference to my results.

[7] In practice I would expect that some proportion of consumers would search for a replacement product after receiving a refund, or possibly even after failing to receive a refund. Stationarity of the search problem implies that this would increase the value of consumer participation and limit the negative impacts of allowing these low quality sellers on the platform, which would only strengthen the results of this section, so I omit that possibility to aid tractability and exposition.

transactions, high-quality sellers transact through the platform, and consumers participate on the platform.

The timing of the model is as follows:

1. The platform sets commission $\xi$ and price $\rho$ as well as the proportion $\alpha$ of low-quality sellers.

2. Sellers make steering decisions.

3. Consumers make participation decisions and search

## 3.1 Modeling Decisions

**Sequential Search Framework**: The framing of competition in a sequential search framework is primarily for the sake of tractability. Arranging sellers along a Salop circle or even a Hotelling line would likely lead to similar results, but the conditional expectations in those cases end up being quite unwieldy while the sequential search framework ends up being quite tractable. Additionally, with sequential search I can draw on results from elsewhere in the literature to check the sensibility of my findings (Eliaz and Spiegler 2011; Yang 2013; Casner 2020).

**Low-quality sellers**: The low-quality sellers in this model should be thought of as "bad" products that are unsatisfactory, rather than actively malicious products which would e.g. steal personal information, as the latter would have a far more deleterious impact on the reputation of the platform. We should also think of the sellers in these model as being small firms without a well established reputation. Larger firms (such as Epic Games) would have known quality and also do not need the platform's search functionality for product discovery, unlike the sellers in this model.

**Reduced form trade and pricing**: The reduced form search and trade formulation in this paper is broadly similar to Casner and Teh (2024). Adopting a reduced form trade formulation instead of allowing endogenous pricing is obviously quite a strong assumption, but it has the benefit of eliminating price effects from the benchmark model. This isolates the warranty effect which is the main focus of the paper instead of mixing that effect with the search obfuscation effect from low quality sellers which is explored more thoroughly elsewhere in the literature.[8] In the appendix I solve a richer model allowing endogenous pricing and show that the the main effect is robust to this extension. See Section 6 for details.

**Ad valorem commissions**: I choose to focus on ad valorem commissions as this is an institutional feature of the motivating market (and indeed part of the impetus for the *Apple v. Epic* lawsuit). Changing to a flat fee per-transaction would not significantly change the main results as the limitation on the platform's ability to extract seller value is the sellers'

[8]See for example Eliaz and Spiegler (2011) and Casner (2020)

ability to steer consumers to direct transactions. If the platform were instead to charge an entry fee for sellers, then it would be able to extract all of the sellers' expected surplus, but this is largely an artifact of the simplifying assumptions in my model and would not hold true in the face of significant seller heterogeneity.

**Consumer participation fee $\rho$**: Many of the platforms that form motivating examples for this paper are associated with specific hardware. Therefore it is important to acknowledge that platforms which derive significant revenue from device sales have different incentives than those which are entirely monetized through on-platform interactions. I include $\rho$ as a stand in for these device sales, so for example in the case of Apple $\rho$ would represent the price of an iPhone. By including this entrance fee from the beginning, I show that my results are robust even in the face of device funded platforms (to use Etro's (2021) terminology).

**The platform's direct control of $\alpha$**: Allowing the platform to directly chose the proportion of low-quality sellers it admits on the platform is obviously a significant abstraction. A richer model of screening might include a base rate of low-quality sellers arriving at the marketplace, which the platform can then engage in costly effort to screen out. This does not significantly change the results of the model, but does matter for the interpretation. My results that the platform sets higher $\alpha$ in the face of lower $t$ should be thought of as a reduction in the marginal benefit to the platform of engaging in screening effort, rather than the platform intentionally recruiting low-quality sellers to its marketplace.

# 4 Benchmark Equilibrium: Preventing Leakage via Low Quality-Sellers

## 4.1 Consumer Utility and Demand

Let $\beta$ represent the proportion of high-quality sellers who steer consumers to direct transactions and $\alpha$ be the proportion of low-quality sellers admitted by the platform. Then the probability a seller is high-quality conditional on a consumer observing that they are steering to direct transactions is

$$\frac{\beta(1-\alpha)}{\beta(1-\alpha)+\alpha} \equiv \psi$$

With this notation defined, consumers' search and purchase decision process is shown visually in Figure 2.

Consumers search, and with probability $(1-\alpha)(1-\beta)$ they encounter a seller transacting through the platform. They know this seller is high quality, and so the signal of whether they are a taste match is accurate. If it is not a match they will search again, and if

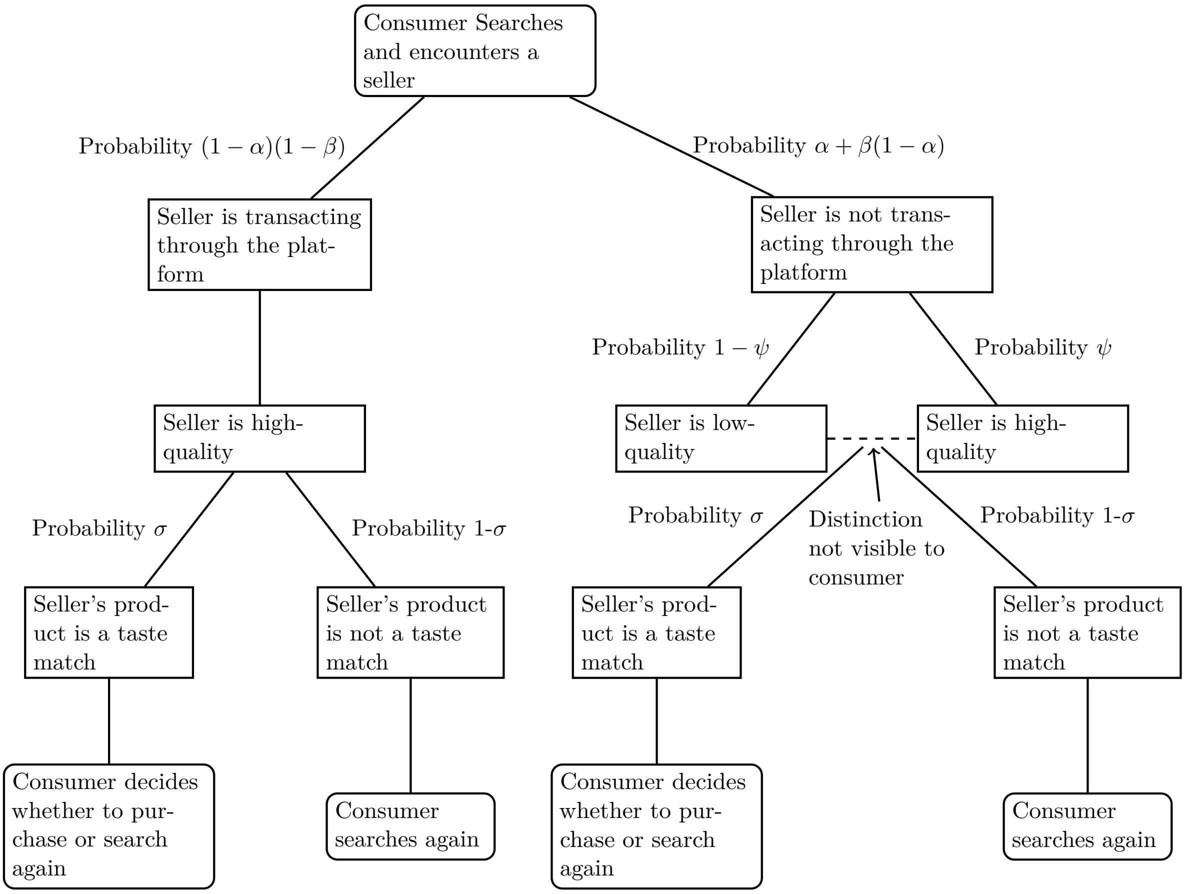


Figure 2: Consumers' search and purchasing process. Right angled box nodes indicate events. Boxes with rounded corners indicate decisions.

it is a match they decide whether to purchase or continue searching.[9] With probability $\alpha + \beta(1-\alpha)$ they encounter a seller steering to direct transactions. Conditional on this, the probability that they encounter a low quality seller is $1-\psi$, and with the remaining probability they encounter a high-quality seller, but given the signal structure they cannot differentiate between these events. They will then decide whether to purchase or search again if the signal indicates a positive match value, and search again if it indicates a taste mismatch.[10]

I am now ready to state Lemma 1

**Lemma 1.** *(Benchmark Consumer Search Behavior) There exist cutoffs of the proportion of low-quality sellers $\tilde{\alpha}$ and $\bar{\alpha}$ such that*

- *If $\alpha > \bar{\alpha}$ consumers do not search*
- *If $\tilde{\alpha} \leq \alpha \leq \bar{\alpha}$ Consumers will search, but will only transact through the platform*
- *If $\alpha < \tilde{\alpha}$ Consumers search and will transact with the first seller with whom they have a taste match.*

[9] In equilibrium consumers will always purchase if they reach this event.

[10] In equilibrium the purchase decision will depend on the value of $\alpha$, see below.

*Consumers will participate on the platform if the participation fee $\rho$ satisfies*

$$\rho \leq \max\left\{V - \mu - \frac{s}{\sigma(1-\alpha)(1-\beta)}, (1-\alpha)(V-\mu) - \alpha\ell - \frac{s}{\sigma}\right\}$$

The remainder of this subsection serves as the proof of this Lemma.

I assume that when the proportion of low-quality sellers is positive, the exogenous price charged by sellers steering to direct transactions is $\psi\mu - t$.[11] With the steering cost being absorbed by sellers this means consumers pay a net $\psi\mu$ with probability 1 for a direct transactions. The expected value to a consumer of trading with a seller offering direct transactions is therefore

$$\psi(V-\mu) - (1-\psi)\ell$$

Given ex ante symmetry of sellers, a consumer cannot benefit from searching again if they are willing to stop at another seller offering direct transactions, therefore the consumer will be willing to stop and accept this offer if the value of doing so is greater than the value of searching and only purchasing from a seller through the platform. Denote the value of searching and only purchasing through the platform by $\mathbb{V}^p$. That value is given by the recursive formulation

$$\mathbb{V}^p = \sigma(1-\alpha-\beta(1-\alpha))(V-\mu) - s + (1-\sigma+\sigma\alpha+\sigma\beta(1-\alpha))\mathbb{V}^p$$

Which simplifies to

$$\mathbb{V}^p = V - \mu - \frac{s}{\sigma(1-\alpha)(1-\beta)}$$

So a consumer will never stop and purchase from a seller offering direct transactions so long as

$$V - \mu - \frac{s}{\sigma(1-\alpha)(1-\beta)} \geq \psi(V-\mu) - (1-\psi)\ell$$

Which, after some algebra, is equivalent to

$$V - \mu + \ell \geq \left(\frac{s}{\sigma(1-\alpha)(1-\beta)}\right)\frac{\beta(1-\alpha)+\alpha}{\alpha} \tag{1}$$

The right hand side is a convex function that approaches infinity as $\alpha$ approaches 0 or 1. The intuition is that if $\alpha$ is close to 0, then it is not worth searching again as the likelihood of encountering a low-quality product is very low, while if $\alpha$ is close to 1 it takes so long to find a seller transacting through the platform that it is not worth searching for one. I assume that $V$ is sufficiently large such that there is some range of $\alpha$ where (1) is satisfied. Following similar steps as above, the value of search when a consumer is willing to purchase

[11] I discuss the reasoning for setting the price at this level in Section 4.2.

from any seller is

$$\mathbb{V}^{all} = (1-\alpha)(V-\mu) - \alpha\ell - \frac{s}{\sigma} \tag{2}$$

Comparing with $\mathbb{V}^p$, we can easily show that $\mathbb{V}^p \geq \mathbb{V}^{all}$ is the exact same cutoff as (1), so it is rational for a consumer to search only for sellers transacting on the platform when this inequality is satisfied.

Denote the minimum value of $\alpha$ such that (1) is satisfied by $\tilde{\alpha}$. Denote by $\bar{\alpha}$ the $\alpha$ which solves

$$\sigma(1-\beta)(1-\alpha)(V-\mu) = s \tag{3}$$

When $\alpha > \tilde{\alpha}$, consumers will only purchase through the platform, so their expected value of a single search is $\mathbb{V}^p$. For $\alpha$ below $\bar{\alpha}$ $\mathbb{V}^p$—consumers' expected value of participating in the platform gross of $\rho$—is positive. For any $\alpha > \bar{\alpha}$, no consumer will participate in the platform for any $\rho > 0$. When $\beta$ is not too large, it is simple to show that $\bar{\alpha} > \tilde{\alpha}$.[12]
The platform has no reason to set $\alpha > \bar{\alpha}$, so I henceforth ignore that case. Consumers' value of participation (gross of $\rho$) in the two remaining cases is summarized in Table 1

| | Value |
|---|---|
| $\tilde{\alpha} \leq \alpha \leq \bar{\alpha}$ | $\mathbb{V}^p = V - \mu - \frac{s}{\sigma(1-\alpha)(1-\beta)}$ |
| $\alpha < \tilde{\alpha}$ | $\mathbb{V}^{all} = (1-\alpha)(V-\mu) - \alpha\ell - \frac{s}{\sigma}$ |

Table 1: Consumers' value of participation at different levels of $\alpha$

When consumers are willing to purchase on seeing any positive value signal, they risk transacting with a low-quality seller, however if they only purchase through the platform, they must pay an additional expected search cost. $\tilde{\alpha}$ represents the risk of an unsatisfactory transaction such that the additional expected search cost is worth avoiding a potentially low-quality seller. Consumers will all participate on the platform if $\rho \leq \max\{\mathbb{V}^p, \mathbb{V}^{all}\}$ and no consumer will participate if that inequality is not satisfied.

## 4.2 Seller Steering Decisions and Profit

Given a mass 1 of consumers and mass 1 of sellers, the number of consumers who will stop at a given seller on their first visit is $\sigma$ (assuming $\alpha < \tilde{\alpha}$). The remaining $1-\sigma$ consumers will search a second time, so the expected number of consumers who will visit a seller on their second visit is $1-\sigma$, they too will stop with probability $\sigma$, so the mass of consumers searching three times is $(1-\sigma)^2$ and so on. This implies that each sellers' demand is $\sum_{j=0}^{\infty}(1-\sigma)^j\sigma = \frac{\sigma}{1-(1-\sigma)} = 1$. If $\alpha \geq \tilde{\alpha}$, then consumers only buy through the platform, so the mass 1 of consumers will be divided equally among the mass $(1-\alpha)(1-\beta)$ of sellers allowing on-platform transactions.

[12] For details see the proof of Proposition 1.

Given a proportion $\beta$ of high-quality sellers steering consumers to direct transactions, a seller's profit if they allow on-platform transactions is

$$\pi = \begin{cases} \mu(1-\xi) & \alpha < \tilde{\alpha} \\ \frac{\mu(1-\xi)}{(1-\alpha)(1-\beta)} & \tilde{\alpha} \leq \alpha \leq \bar{\alpha} \end{cases}$$

For the sellers who do steer to direct transactions, I assume that consumers diminished trust in their quality reduces their payoff, such the price they charge is $\psi\mu - t$ as discussed above. This exogenous price is somewhat ad-hoc, but captures the important tradeoff from reduced consumer trust while allowing for appealingly simple derivations. I find similar results when I assume the price charged keeps the division of expected surplus the same (i.e. when the price is $\frac{\psi V-(1-\psi)\ell}{V}\mu$), but the derivation of consumer values becomes much more involved and yields no new insights relative to this model. Additionally, in Section 6 I allow for endogenous pricing and find a similar result where increasing $\alpha$ reduces the surplus of steering sellers, so again this simple price helps keep the model tractable while capturing the essential economic forces.[13] Sellers' profit from steering consumers to direct transactions is then

$$\pi = \begin{cases} \psi\mu - t & \alpha < \tilde{\alpha} \\ 0 & \tilde{\alpha} \leq \alpha \leq \bar{\alpha} \end{cases}$$

When $\beta = 0$ we have the following result:

**Proposition 1.** *(Individual Seller Deviation Constraints) If no high-quality sellers steer to direct transactions ($\beta = 0$), no seller will individually deviate to steering consumers to direct transactions for any commission rate $\xi < 1$ when the proportion of low-quality sellers $\alpha > 0$.*

Unless otherwise noted all proofs are relegated to the appendix. Proposition 1 says that no matter how high $\xi$ gets, no individual seller can profitably begin steering consumers to direct transactions because consumers will have no confidence that the seller is not a low-quality seller, so steering leads to no demand and 0 profit.[14] This result clearly demonstrates the mechanism this model was intended to highlight, but the starkness of the result depends on $\beta = 0$. If consumers believe that a positive mass of high-quality sellers are not allowing on-platform transactions then there exists an interior $\xi$ where sellers can make more profit from selling through the direct channel. Therefore for the rest of this section I assume that a minimum proportion $\underline{\beta}$ of the high quality sellers will steer consumers to the direct channel regardless of the platform's commission.[15]

[13]This setup is also consistent with the empirical literature, Chang and Miller (2024) find evidence suggesting that app store users in South Korea appear to be less trustful of direct payments than of payments through the App Store.

[14]Note that this is true even when the consumer has a positive probability of distinguishing a low-quality seller. See Section 6 for details.

[15]This assumption of "behavioral" sellers is necessary to avoid multiplicity of equilibria. Because in the

With this assumption in place,

**Lemma 2.** *(Benchmark Seller Behavior)*

- *If the proportion of low-quality sellers* $\alpha < \tilde{\alpha}$ *then high quality sellers making an active decision will transact through the platform for any commission rate* $\xi$ *satisfying* $\xi \leq 1 - \psi + \frac{t}{\mu}$
- *If* $\alpha \geq \tilde{\alpha}$ *then high quality sellers making an active decision will transact through the platform for any* $\xi \leq 1$.

*Proof.* If $\alpha < \tilde{\alpha}$ the $1 - \underline{\beta}$ proportion of high-quality sellers who make an active steering decision will prefer to transact through the platform so long as

$$\psi\mu - t \leq \mu(1 - \xi)$$

Solving for $\xi$

$$\xi \leq 1 - \psi + \frac{t}{\mu} \tag{4}$$

Sellers' profit from steering is reduced by the diminished confidence consumers have in the quality of steering sellers, which means they will tolerate a higher commission before steering consumers off the platform as $\psi$ decreases. Alternatively, if $\alpha \geq \tilde{\alpha}$, then the profit for any seller who steers consumers to direct transactions is 0, so sellers will be willing to transact through the platform so long as

$$0 \leq \frac{\mu(1 - \xi)}{(1 - \alpha)(1 - \underline{\beta})}$$

Which is true for any $\xi \leq 1$. ■

### 4.3 Platform Decisions and Profit

The platform only takes commission on transactions that it handles directly. If consumers are purchasing from any seller, then some of those transactions happen off-platform, while if $\alpha \geq \tilde{\alpha}$ the platform is handling all transactions. Conditional on consumers participating on the platform and high-quality sellers making an active decision not steering consumers

equilibrium of the current model the platform makes sellers indifferent about their choice to steer, I could instead look for a mixed strategy equilibrium where sellers choose to steer with probability $\beta$, however the commission in equilibrium depends on $\beta$ through $\psi$, so in this alternative version of the model there would be infinitely many equilibria, one for each value of $\beta$. The behavioral types assumption also does not seem particularly unrealistic, possible motivations include include: desire to keep sensitive commercial data away from the large platform, idiosyncratic business models or software design which does not mesh well with the platform's payment system, or even small businesses with taste based aversion to transacting through the platform.

to direct transactions, we get the following conditional profit function

$$\Pi = \begin{cases} \rho + (1-\alpha)(1-\underline{\beta})\xi\mu & \alpha < \tilde{\alpha} \\ \rho + \xi\mu & \tilde{\alpha} \leq \alpha \leq \bar{\alpha} \end{cases} \tag{5}$$

**Lemma 3.** *(Benchmark Platform Fees) The platform sets participation fee*

$$\rho = \max\{\mathbb{V}^p, \mathbb{V}^{all}\}$$

*and commission*

$$\xi = \begin{cases} 1 - \psi + \frac{t}{\mu} & \alpha < \tilde{\alpha} \\ 1 & \tilde{\alpha} \leq \alpha \leq \bar{\alpha} \end{cases}$$

*Proof.* From (5), the platform's profit is increasing in $\rho$ so long as consumers continue to participate. From Lemma 1, consumers continue to participate so long as $\rho \leq \max\{\mathbb{V}^p, \mathbb{V}^{all}\}$, meaning that in equilibrium that expression must hold with equality. $\xi$ follows from similar logic about seller steering decisions using Lemma 2. ■

Given consumer and seller behavior derived in the previous subsections, the platform will set participation fee $\rho$ such that consumers are just indifferent between participating and not, and commission $\xi$ such that sellers are just indifferent between steering and not. Substituting the values of $\xi$ and $\rho$ from Lemma 3 gives platform profit

$$\Pi = \begin{cases} (1-\alpha)(V-\mu) - \alpha\ell - \frac{s}{\sigma} + (1-\alpha)(1-\underline{\beta})\left[1 - \psi + \frac{t}{\mu}\right]\mu & \alpha < \tilde{\alpha} \\ V - \frac{s}{(1-\alpha)(1-\beta)\sigma} & \tilde{\alpha} \leq \alpha \leq \bar{\alpha} \end{cases} \tag{6}$$

Recall that $\psi$ is decreasing in the proportion of low-quality sellers $\alpha$, so for $\alpha < \tilde{\alpha}$, the platform is trading off reduced consumer participation value and more off-platform trades against an increase in $\xi$. When $\alpha \geq \tilde{\alpha}$ platform profit is strictly decreasing in $\alpha$ as the platform captures all seller surplus and increased $\alpha$ only reduces consumer surplus by making search more difficult, therefore the platform will never set $\alpha > \tilde{\alpha}$. If $s$ is sufficiently small, it is obvious from inspection that the platform's profit is greater when $\alpha = \tilde{\alpha}$ than when $\alpha < \tilde{\alpha}$ as all trade will flow through the platform rather than some of the trades happening through direct transactions. Denote the platform-profit maximizing proportion of low-quality sellers by $\alpha^*$.

**Proposition 2.** *(Reducing Steering Costs Reduces Curation) For any value of trade $V$ there exists a cutoff $\tilde{s}$ such that profit maximizing proportion of low-quality sellers $\alpha^* = \tilde{\alpha}$ if the search cost $s$ is below $\tilde{s}$. In this case $\alpha^*$ is constant in $t$*

*In all other cases $\alpha^*$ is positive if $\mu$ is sufficiently large relative to $t$ and $\ell$. In these cases $\alpha^*$ is decreasing in $t$ so long as $0 < \alpha^* < \tilde{\alpha}$.*

If $s$ is sufficiently small, then the direct cost to consumers from being steered by the platform to on-platform transactions is relatively small, so the platform sets $\alpha = \tilde{\alpha}$ and captures all of the surplus in the market. In this case the willingness of sellers to switch over to direct transactions is irrelevant as no consumer will be willing to take a direct transaction if offered. Because $t$ is fully borne by sellers, $\tilde{\alpha}$ is constant in $t$ and so the proportion of low-quality sellers does not change with the switching cost.[16] On the other hand, if $s$ is sufficiently large such that $\alpha^* < \tilde{\alpha}$, then the platform is trading off an increased commission against a worsened consumer experience (and hence lower entry fee) and more transactions happening directly. As $t$ increases sellers are less willing to steer consumers to direct transactions, so the marginal benefit of including low-quality sellers decreases and so does $\alpha^*$. If $\mu$ is too small then sellers do not capture enough surplus for the platform to find extracting more from them worth the cost of degrading the consumer experience and the concomitant lowered consumer fee $\rho$, so $\alpha^* = 0$. Similarly, if $\ell$ is too large then even if $\mu$ is relatively high the reduction in consumer willingess to pay for entry to the marketplace outweighs any increase in commission and $\alpha^* = 0$.[17]

One of the major implications of Proposition 2 is that a policy change which reduces $t$ (such as the decision in *Epic v. Apple*) would create an incentive for the platform to engage in leakage prevention strategies, and consequently one of the impacts we might expect from this decision is either less incentive for Apple to screen the quality of apps on its store and/or efforts such as the warning screen in Figure 1 to increase the salience to consumers of the possibility they might be scammed.

# 5 Introducing a Competing Platform can Increase the Incentive to Screen

The results of the previous section suggest that policies which encourage steering when implemented alone can backfire. Here I explore an alternative policy measure that can achieve similar goals when implemented instead of (or alongside) policies which reduce the switching cost. Inspired by one of Epic's proposals as a remedy for anti-competitive behavior in its win against Google: requiring easy installation of app stores to complete with Google Play on Android phones (*Epic games, inc. v. google inc.* 2023), one could conceive of a regulation requiring providers of hardware to allow easy loading of competing software platforms on to their devices. To evaluate this policy proposal I introduce a competing platform which operates on the same hardware as the original, but which does not charge an

[16] If we were to allow partial incidence of the switching cost on consumers, then as $t$ increases consumers would be less willing to engage in direct transactions and $\tilde{\alpha}$ would decrease in $t$.

[17] We might expect $\ell$ and $\mu$ to be very closely related, as both relate to sellers' ability to extract surplus from the consumers. However, I show that my main results are robust to endogenous pricing in the appendix and so I leave both variables in reduced form here to simplify exposition and avoid taking a stand on the exact relationship between $\ell$ and $\mu$.

entrance fee. I index the two platforms by $k \in \{0,1\}$ and without loss of generality I choose 0 to be the integrated platform which also charges the entrance fee $\rho$. Both platforms are free to choose their ad-valorem commissions $\xi_k$ and screening intensity $\alpha_k$. The sellers can make steering decisions independently for each platform, but can multi-home freely. Recall that $\rho$ is meant as a stand in for the price of hardware, so consumers single-home on one platform, but pay the entrance fee $\rho$ to the vertically integrated platform 0 regardless of which platform they choose to join.[18] One way to think of this setup is that consumers need a phone in order to install software, but a competing marketplace is unlikely to charge a fee to consumers who want to side-load it onto their hardware, so consumers will pay the entrance fee (price of phone) to one vertically integrated platform, but do not need to pay a second fee to access a second platform should they wish to side-load. Crucially, both platforms will provide refunds, so they still provide a warranty relative to direct transactions. Their locus of competition for consumers is over the quality of this warranty and the more generally the search and purchasing experience.

The timing of the model is

1. Platform 0 sets entry fee $\rho$
2. 0 and 1 set $\xi_k$ and $\alpha_k$
3. Sellers make steering decisions
4. Consumers decide whether to pay $\rho$ and choose which platform to participate on if they do
5. Participating consumers search and transact.

## 5.1 Consumer behavior

For the sake of tractability, I assume $s$ is large enough such that $\max\{\alpha_k\} < \tilde{\alpha}$ and consumers will search and stop at their first positive match. A consumer's expected value of participation is therefore $\max\{\mathbb{V}_0^{all}, \mathbb{V}_1^{all}\}$ (for simplicity I will henceforth drop the superscript from the gross value of participation).[19] Consumers will participate on the platform which provides the highest expected value, and I assume that they randomize if indifferent.

[18] This is the "competitive bottleneck" setup of Armstrong (2006). Sellers have more reason to multi-home than consumers—especially given that consumers in this model have unit demand—so similar to Casner and Teh (2024), even if I were to allow multi-homing by consumers it would not make much difference to my results as consumers would simply search exclusively on the platform where they have the highest expected payoff.

[19] I assume undifferentiated platforms here to maintain comparability with the monopoly framework. If I were to assume, e.g. Hotelling competition then the comparison to previous sections would not be direct because even a monopolist would face a continuous consumer-side demand function in that context. That said, I expect that my results would generalize so long as the transport cost is not too high.

## 5.2 The Seller Steering Logic is Unchanged

Sellers make steering decisions independently for each platform. All sellers participate on both platforms given the lack of multi-homing costs and non-negative profits on each, so given a mass $m_k$ of consumers participating on platform $k$, each seller will transact $\frac{m_k}{1}$ times, and so the profit from allowing on-platform transactions is

$$\pi_k = m_k \mu (1 - \xi_k)$$

and from steering

$$\pi_k^{steer} = m_k \left( \psi_k \mu - t \right)$$

Where $\psi_k$ is defined equivalently to $\psi$ but using $\alpha_k$ and $\beta_k$. Comparing $\pi_k$ and $\pi_k^{steer}$ to find the $\xi_k$ which makes sellers indifferent yields (4). So the seller problem is essentially unchanged from the monopoly model.

## 5.3 Platform Competition Leads to More Curation and Lower Commissions

Given the assumption that $\max_k \alpha_k < \tilde{\alpha}$, profit for each platform is given by

$$\begin{aligned} \Pi_0 =& (m_0 + m_1)\rho + m_0(1 - \alpha_0)(1 - \underline{\beta})\xi_0 \mu \\ \Pi_1 =& m_1 (1 - \alpha_1)(1 - \underline{\beta})\xi_1 \mu \end{aligned}$$

Where the mass of participating consumers is given by

$$m_k = \begin{cases} 1 & \mathbb{V}_k > \mathbb{V}_{-k} \\ \frac{1}{2} & \mathbb{V}_k = \mathbb{V}_{-k} \\ 0 & \mathbb{V}_k < \mathbb{V}_{-k} \end{cases}$$

With consumer participation defined I can now state Proposition 3

**Proposition 3.** *(Competition Lowers Fees and Increases Curation) In equilibrium of the model with platform competition both platforms will set their proportion of low-quality sellers* $\alpha_k$ *such that* $\alpha_0 = \alpha_1 = 0$*, and they will charge commissions* $\xi_0 = \xi_1 = \frac{t}{\mu}$*. High-quality seller profit and consumer value of participation are both higher under competition than in the benchmark model.*

*Proof.* From (2), $\mathbb{V}_k$ is strictly decreasing in $\alpha$, so for any positive $\alpha_k$, $-k$ can win the entire market by setting $\alpha_{-k} = \alpha_k - \iota$ where $\iota$ is some infinitesimal reduction in the proportion of low-quality sellers. Competition will thus drive both $\alpha_k$ to 0 as the only equilibrium, which from (4) means that

$$\xi_0 = \xi_1 = \frac{t}{\mu}$$

With the decreased commission sellers' profit increases under competition compared to the monopoly, and consumers are no worse off, while from (2) consumer value of participation (gross of $\rho$) increases. ■

Note that the welfare statement in Proposition 3 ignores the sellers who are excluded from the market, but given that in this case that group comprises low-quality sellers this is likely not too concerning for policy makers. Interestingly, sellers are benefiting from competition despite the fact that the multi-homing paradigm is that of a competitive bottleneck. The reason is that the intense competition for consumers increases consumer confidence in the quality of sellers who choose to steer to direct transactions. This increases the value of the outside option for sellers for any given $t$. It also means that, unlike in section 4, policies which decrease $t$ do not result in higher $\alpha$ so competition enhancing policies are complementary with those which reduce steering costs in terms of enhancing seller welfare.

# 6 Extensions

## 6.1 Changing Consumers' Ability to Detect Low-Quality Sellers Can Prevent Leakage

Another strategy that the platform could consider instead of curating the proportion of low-quality sellers is changing the degree to which they are detectable by consumers. For example, changing the salience of reviews on a product's display page or just showing averages and making the consumer go to more effort to look at detailed written reviews, or changing the strictness with which it polices review manipulation. In Section 4 I abstracted from this process by assuming that consumers had no ability to distinguish high- and low-quality sellers. In section B of the Online Appendix I show that changing consumers' information structure can have a similar effect at preventing leakage and also presents similar tradeoffs for the platform.

In contrast to the base model, I assume that consumers who encounter a seller receive a signal as to that seller's quality. With probability $\gamma$ the signal accurately reports the seller's quality, and with probability $1 - \gamma$ the consumer receives a signal that the seller is high quality, meaning that consumers face a "fully revealing bad news" information structure.[20]

For this extension I assume the proportion of low-quality sellers $\alpha$ is fixed, and instead allow the platform to vary the signal informativeness $\gamma$, and I assume that the platform sets

[20] I could consider a more general garbled structure a la Lewis and Sappington (1994), but doing so would be less tractable, and the literature on review manipulation (e.g. Smirnov and Starkov (2022)) has not found that generic information structures lead to drastically different results.

$\gamma$ before buyers and sellers have a chance to act. The rest of the agents' decision variables and timing are unchanged.

For consumers' value of participation we can go through a similar derivation as for $\mathbb{V}^{all}$ to get

$$\hat{\mathbb{V}}^{all} = \frac{[(1-\alpha)(V-\mu)-(1-\gamma)\alpha\ell] - \frac{s}{\sigma}}{1-\gamma\alpha}$$

$\hat{\mathbb{V}}^{all}$ is increasing as $\gamma$ increases because the probability of purchasing from a low-quality seller approaches 0.

The refund policy means that only high-quality sellers will offer transactions through the platform, so the value of searching and transacting only through the platform $\mathbb{V}^p$ is unchanged and is constant in $\gamma$. There exists a critical value $\bar{\gamma} \geq 0$ such that consumers will stop and purchase at their first match with a positive signal for all $\gamma > \bar{\gamma}$. Further, if $\bar{\gamma} > 0$ then consumers are indifferent between the two search strategies when $\gamma = \bar{\gamma}$ and strictly prefer transacting through the platform when $\gamma < \bar{\gamma}$. I assume $\alpha$ is large enough that $\bar{\gamma} > 0$, such that consumers will transact directly only if $\gamma > \bar{\gamma}$.

The seller problem is not substantially different from Section 4, meaning that the limitations on $\xi$ are essentially unchanged. Proposition 4 (proved in the online appendix) summarizes the platform's optimal strategy with regard to $\gamma$.

**Proposition 4.** *(Reducing Steering Costs Weakly Reduces Equilibrium Consumer Information) There exists a critical value of steering cost $t$—denoted $\bar{t}$—such that the platform sets the detection probability $\gamma^* > \bar{\gamma}$ if $t > \bar{t}$ and $\gamma = \bar{\gamma}$ for $t \leq \bar{t}$ so long as the seller share of gains from trade $\mu$ is not too small. $\bar{t}$ is increasing in the proportion of low-quality sellers $\alpha$ and behavioral sellers $\underline{\beta}$. $\gamma^* < 1$ if $\mu$ is not too small and loss from transacting with low-quality sellers $\ell$ are not too large. $\gamma^*$ is independent of $t$ if $\gamma > \bar{\gamma}$ and increasing in $\alpha$.*

Similar to Section 4, the platform is trading off reduced value extraction from sellers against an increased participation fee from consumers as $\gamma$ increases. Interestingly, the profit maximizing level of $\gamma$ does not depend on $t$ so long as the level of $t$ is large enough such that $\gamma > \bar{\gamma}$. This is because a change in $\gamma$ does not impact the proportion of sellers steering consumers toward direct transactions and so $\gamma$ provides a purely infra-marginal change in platform profits which is independent of $t$. Nevertheless the main intuition from Section 4 that the platform will increase the salience of low-quality sellers in response to a decrease in $t$ does survive if that reduction lowers $t$ below the cutoff $\bar{t}$.

## 6.2 Allowing Endogenous Pricing Yields Similar Results to the Base Model

In section C of the Online Appendix I allow the sellers to price their product endogenously. The price is denoted by $\mu$ and competition on the platform takes place via Wolinsky (1986) style search with match values $\epsilon$ following an unbounded log-concave distribution $F(\cdot)$ with associated PDF $f(\cdot)$. The switching cost $t$ is subtracted from consumer utility and sellers compensate consumers for the inconvenience endogenously by lowering their price for direct transactions rather than being assumed to fully absorb it. Low-quality sellers must set the same price as high-quality sellers otherwise consumers could distinguish them easily. Finally, for the sake of tractability I assume that the platform does not charge an entrance fee to consumers and makes all revenue through transaction commissions. Otherwise the model is essentially the same as in the previous sections. For a given proportion $\alpha$ of low-quality sellers and proportion $\beta$ of high-quality sellers steering to direct transactions consumers will stop search if they encounter a match value greater than or equal to a reservation value $U$ determined by

$$s = (1-\beta)(1-\alpha)\int_{U+\mu}^{\infty}[(\epsilon-\mu)-U]f(\epsilon)d\epsilon+(\beta(1-\alpha)+\alpha)\int_{\frac{U+\mu^{steer}+t}{\psi}}^{\infty}[\psi\epsilon-\mu^{steer}-t-U]f(\epsilon)d\epsilon \tag{7}$$

which implies that a consumer will stop and purchase from a seller allowing on-platform transactions and charging price $\mu_j$ if

$$\epsilon_{ij} - \mu_j > U$$

which leads to demand

$$1 - F(U + \mu_j)$$

Equivalently, demand for a steering seller is

$$1 - F(\frac{U + \mu_j^{steer} + t}{\psi}) \tag{8}$$

.

Plugging these into seller profit functions, we get the on-platform price

$$\mu_j = \frac{1 - F(U + \mu_j)}{f(U + \mu_j)} \tag{9}$$

and the steering price

$$\mu^{steer} = \psi\frac{1 - F(\frac{U+\mu_j^{steer}+t}{\psi})}{f(\frac{U+\mu_j^{steer}+t}{\psi})} \tag{10}$$

Similar to the base model, the lower $\psi$, the lower the price that a seller can charge. Unlike the base model, seller profit does not change multiplicatively with $\psi$, but this change does not influence results enough to affect my conclusions.

The platform's problem is broadly similar to the base model, with essentially the same tradeoffs. Its profit maximizing curation strategy is summarized in Proposition 5

**Proposition 5.** *(Reducing Steering Costs Under Endogenous Pricing Reduces Curation) There is a profit maximizing proportion of low-quality sellers $\alpha$ denoted $\alpha^*$ which is decreasing in $t$. $\alpha^* > 0$ if the steering cost $t$ and search cost $s$ are sufficiently small.*

The proof for this proposition is located in the online appendix. The main conclusions of the base model are replicated with endogenous pricing. If steering consumers to direct transactions is too easy, it can be profitable for the platform to reduce leakage by reducing consumer trust in the quality of steering sellers by admitting more low-quality sellers on to the platform.

# 7 Conclusion

I have explored the implications of policies which make it easier for sellers on a market platform to steer consumers toward direct transactions. The more the platform can limit sellers' ability to steer, the more it can charge in commissions as this limitation reduces the value to sellers of transacting outside the platform. If the platform's ability to impose this limitation is taken away, then it will seek alternative methods to discourage consumers from transacting directly with sellers.

One avenue available to it is reducing screening efforts and allowing more low-quality sellers to participate while simultaneously offering refunds to consumers that request them. The refund discourages low-quality sellers from offering transactions through the platform, while the presence of low-quality sellers reduces consumers' confidence that a seller offering direct transactions is high-quality. The more low-quality sellers the platform admits, the more this warranty through refunds becomes salient to consumers' decision making and the more the sellers have to discount direct transactions if they are to attract any customers.

It is profitable for the platform to admit these low-quality sellers if it is otherwise easy for sellers to steer consumers toward direct transactions and if the sellers share of surplus is sufficiently high. This happens even though the platform is device funded (using the terminology of Etro (2021)) through an entrance fee paid by consumers. This result suggests that policy makers should be careful in designing regulations forbidding anti-steering policies as the platforms may engage in indirect strategies to to eliminate platform leakage.

One way for policy makers to mitigate these alternative strategies is to encourage platform competition. If the competition for consumers is sufficiently intense, then platforms are deterred from engaging in policies which reduce consumer welfare in order to extract more surplus from sellers.

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# A Omitted Proofs

## A.1 Proof of Proposition 1

*Proof.* When $\beta = 0$, then the right hand side of (1) is strictly increasing in $\alpha$. Given the assumption that $V$ is sufficiently large that there is some range of $\alpha$ where (1) is satisfied, this implies that the inequality must be satisfied when there are no low-quality sellers, meaning $\tilde{\alpha} = 0$. Therefore, any seller who deviates individually to steering consumers will make zero profit, while for any $\xi \leq 1$ profit from on-platform transactions is non-negative. ∎

## A.2 Proof of Proposition 2

*Proof.* If $s$ is sufficiently small, then $\alpha^* = \tilde{\alpha}$, which by definition is the minimum $\alpha$ such that (1) is satisfied. Because the switching cost is borne fully by sellers, (1) is invariant to $t$ and so $\alpha^*$ is constant in $t$ in this case.

If $0 < \alpha^* < \tilde{\alpha}$, then it is determined by the first order condition derived from taking the derivative of (6) with regard to $\alpha$:

$$-(V-\mu) - \ell - (1-\underline{\beta})\left[1 - \psi + \frac{t}{\mu}\right]\mu + \frac{\underline{\beta}(1-\alpha)}{[\underline{\beta}(1-\alpha)+\alpha]^2}(1-\underline{\beta})\mu = 0$$

$\psi$ and $\frac{\underline{\beta}(1-\alpha)}{[\underline{\beta}(1-\alpha)+\alpha]^2}$ are decreasing in $\alpha$ so the second derivative is negative and platform profit is concave in $\alpha$, meaning the second order condition for maximization is satisfied.

For any value of $\alpha$, this derivative is decreasing in $t$, therefore the $\alpha$ at which it crosses from positive to negative must also decrease, and hence so does $\alpha^*$ for any $0 < \alpha^* < \tilde{\alpha}$.

$\alpha^* > 0$ while $s$ is large only if the derivative of platform profit is positive at $\alpha = 0$, i.e.

$$(1-\underline{\beta})\mu - (1-\underline{\beta})t - (V-\mu) - \ell > 0$$

This is positive if $\mu$ is sufficiently large relative to $t$ and $\ell$. ■

# B Online Appendix: Changing Consumers' Ability to Detect Low-Quality Sellers Can Prevent Leakage

Another strategy that the platform could consider instead of curating the proportion of low-quality sellers is changing the degree to which they are detectable by consumers. For example, changing the salience of reviews on a product's display page or just showing averages and making the consumer go to more effort to look at detailed written reviews, or changing the strictness with which it polices review manipulation. In Section 4 I abstracted from this process by assuming that consumers had no ability to distinguish high- and low-quality sellers. Here I show that changing consumers' information structure can have a similar effect at preventing leakage and also presents similar tradeoffs for the platform.

In contrast to the base model, I assume that consumers who encounter a seller receive a signal as to that seller's quality. With probability $\gamma$ the signal accurately reports the seller's quality, and with probability $1-\gamma$ the consumer receives a signal that the seller is high quality, meaning that consumers face a "fully revealing bad news" information structure.[21]

For this section I assume the proportion of low-quality sellers $\alpha$ is fixed, and instead allow the platform to vary the signal informativeness $\gamma$, and I assume that the platform sets

[21] I could consider a more general garbled structure a la Lewis and Sappington (1994), but doing so would be less tractable, and the literature on review manipulation (e.g. Smirnov and Starkov (2022)) has not found that generic information structures lead to drastically different results.

$\gamma$ before buyers and sellers have a chance to act. The rest of the agents' decision variables and timing are unchanged.

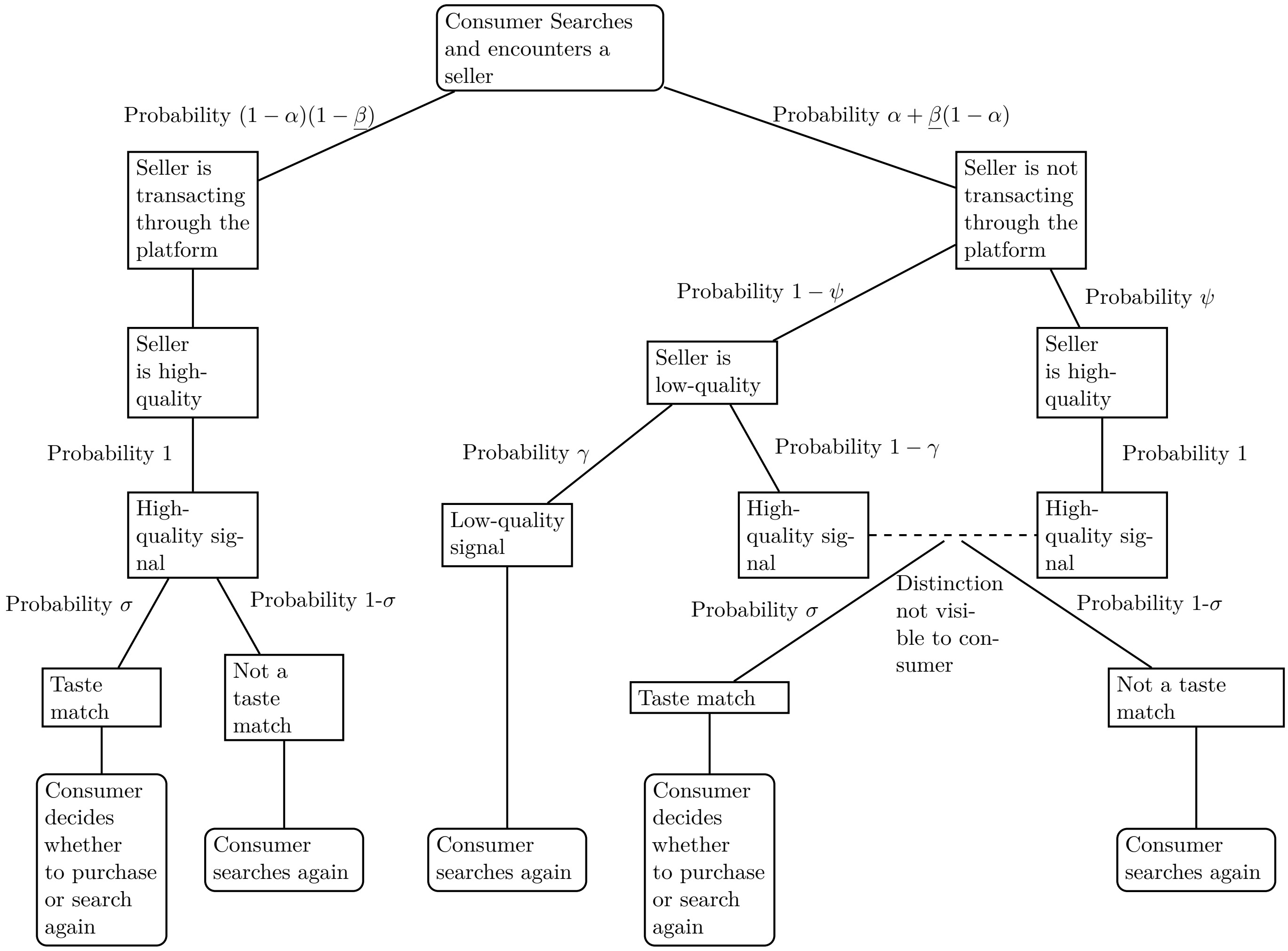


Figure 3: Consumers' search and purchasing process with a probability of detecting low-quality sellers. Right angled box nodes indicate events. Boxes with rounded corners indicate decisions.

## B.1 Consumers

Because low-quality sellers are only making a profit on off-platform transactions, any seller offering transactions through the platform is—as in previous sections—known to be high quality, meaning that the change in information does not make a difference to consumers' beliefs. On the other hand, if the consumer encounters a seller offering off-platform transactions and receives a positive signal, then from Bayes' rule the probability that this seller is high-quality is

$$\hat{\psi} \equiv \frac{\psi}{\psi + (1-\psi)(1-\gamma)} = \frac{(1-\alpha)\beta}{(1-\alpha)\beta + \alpha(1-\gamma)}$$

$\hat{\psi}$ is consumers' *signal adjusted* belief that a seller steering transactions off-platform is high-quality. The more informative (higher) $\gamma$ is, the more consumers trust the high-quality signal. Because consumers never encounter a low-quality signal at a high-quality seller, they will always believe a low-quality signal is accurate.

Taking this into account, we can go through a similar derivation as for $\mathbb{V}^{all}$ to get

$$\hat{\mathbb{V}}^{all} = \frac{[(1-\alpha)(V-\mu) - (1-\gamma)\alpha\ell] - \frac{s}{\sigma}}{1-\gamma\alpha}$$

$\hat{\mathbb{V}}^{all}$ is increasing as $\gamma$ increases because the probability of purchasing from a low-quality seller approaches 0.[22] When $\gamma = 1$, the threat of purchasing from low-quality sellers is completely eliminated and the only effect of their presence is as a form of search obfuscation (Ellison and Ellison 2009; Eliaz and Spiegler 2011; Casner 2020).

Because only high-quality sellers will offer transactions through the platform, the value $\mathbb{V}^p$ of searching and only transacting via the platform is unchanged relative to the benchmark. Consumers will therefore search and purchase from the first seller they match and have a positive signal with if $\hat{\mathbb{V}}^{all} \geq \mathbb{V}^p$ and will instead only transact through the platform if that inequality is not satisfied. Expanding, that inequality is equivalent to:

$$\frac{[(1-\alpha)(V-\mu) - (1-\gamma)\alpha\ell] - \frac{s}{\sigma}}{1-\gamma\alpha} \geq V - \mu - \frac{s}{\sigma(1-\alpha)(1-\beta)}$$

The left hand side is increasing in $\gamma$, and approaches $\mathbb{V}^{all}$ from above as $\gamma$ approaches 0. If $\alpha$ is small enough that $\mathbb{V}^{all} > \mathbb{V}^p$, then $\hat{\mathbb{V}}^{all} \geq \mathbb{V}^p$ for all $\gamma$. Note however that with $\gamma = 1$ $\hat{\mathbb{V}}^{all} > \mathbb{V}^p$ even if $\mathbb{V}^{all} < \mathbb{V}^p$. Therefore there exists a critical value $\bar{\gamma} \geq 0$ such that consumers will stop and purchase at their first match with a positive signal for all $\gamma > \bar{\gamma}$. Further, if $\bar{\gamma} > 0$ then consumers are indifferent between the two search strategies when $\gamma = \bar{\gamma}$ and strictly prefer transacting through the platform when $\gamma < \bar{\gamma}$. For the remainder of this section I assume $\alpha$ is large enough that $\bar{\gamma} > 0$, such that consumers will only transact directly if $\gamma > \bar{\gamma}$.

[22]There exist values of $s$ such that it could be decreasing, but those values would require $\frac{s}{\sigma} > (1-\alpha)(V-\mu)$, which implies that a buyer would never search even if they could perfectly distinguish high- and low-quality sellers

## B.2 Sellers

Similar to Section 4, a seller's profit if they allow transactions through the platform is given by

$$\pi = \begin{cases} \mu(1-\xi) & \gamma > \bar{\gamma} \\ \frac{\mu(1-\xi)}{(1-\alpha)(1-\beta)} & \gamma \leq \bar{\gamma} \end{cases}$$

While their profit if they steer to off-platform transactions is

$$\pi = \begin{cases} \hat{\psi}\mu - t & \gamma > \bar{\gamma} \\ 0 & \gamma \leq \bar{\gamma} \end{cases}$$

The main difference from Section 4—apart from the cutoffs—is that the steering sellers' profit is scaled down by $\hat{\psi} \geq \psi$. Consumers greater ability to distinguish high- and low-quality sellers gives them greater confidence in sellers' product when transacting off platform, which increases their willingness to pay. For $\gamma \leq \bar{\gamma}$, sellers will transact on the platform even if $\xi = 1$, while if that inequality is reversed the cutoff $\xi$ at which they are indifferent is

$$\xi \leq 1 - \hat{\psi} + \frac{t}{\mu} \tag{11}$$

Again, the main difference is that $\gamma$ increases the appeal of direct sales relative to transacting on the platform. Notably, the logic behind Proposition 1 remains valid. If $\beta = 0$ then the probability of having encountered a high-quality seller conditional on having encountered a seller steering to direct transactions is 0, so $\hat{\psi} = 0$ even if consumers know one seller has deviated to steering.[23] Therefore, for consistency I continue to assume that a proportion $\underline{\beta}$ of sellers exogenously choose to steer consumers to direct transactions. Finally, if $\gamma \leq \bar{\gamma}$ then sellers will not endogenously choose to steer to direct transactions even if $\xi = 1$.

## B.3 Platform

Once again similar to Section 4, the platform's profit is given by

$$\Pi = \begin{cases} \rho + (1-\alpha)(1-\underline{\beta})\xi\mu & \gamma > \gamma^* \\ \rho + \xi\mu & \gamma \leq \gamma^* \end{cases} \tag{12}$$

The platform will set prices such that consumers are indifferent about participation and sellers are indifferent about steering:

$$\Pi = \begin{cases} \frac{[(1-\alpha)(1-\mu)V-(1-\gamma)\alpha\ell]-\frac{s}{\sigma}}{1-\gamma\alpha} + (1-\alpha)(1-\underline{\beta})\left(1-\hat{\psi}+\frac{t}{\mu}\right)\mu & \gamma > \gamma^* \\ (1-\mu)V - \frac{s}{\sigma(1-\alpha)(1-\beta)} + \mu & \gamma \leq \gamma^* \end{cases} \tag{13}$$

[23]This remains true for any generic information structure short of fully informative good news, where consumers get a signal that fully reveals a seller as high-quality.

The platform has no reason to set $\gamma < \bar{\gamma}$ as its profit is constant in consumers' ability to distinguish high- and low-quality sellers once they will never transact outside the platform. Denote the platform-profit maximizing level of $\gamma$ by $\gamma^*$. Taking the derivative of $\Pi$ with regard to $\gamma$ gives the rest of Proposition 4:

**Proposition B.1.** *There exists a critical value of $t$ denoted $t$ such that $\gamma^* > \bar{\gamma}$ if $t > \bar{t}$ and $\gamma = \bar{\gamma}$ for $t \leq \bar{t}$ so long as $\mu$ is not too small. $\bar{t}$ is increasing in $\alpha$ and $\underline{\beta}$. $\gamma^* < 1$ if $\mu$ is not too small and $\ell$ not too large. $\gamma^*$ is independent of $t$ if $\gamma > \bar{\gamma}$ and increasing in $\alpha$.*

*Proof.* From (13), platform profits are increasing and unbounded in $t$ if $\gamma > \bar{\gamma}$ but constant in $t$ otherwise. Therefore there must exist $t$ sufficiently large such that the platform's profit is greater with $\gamma > \bar{\gamma}$. On the other hand, from the definition of $\bar{\gamma}$, $\hat{\mathbb{V}} = \mathbb{V}^{all}$ and so $\frac{[(1-\alpha)(1-\mu)V-(1-\gamma)\alpha\ell]-\frac{s}{\sigma}}{1-\gamma\alpha} = (1-\mu)V - \frac{s}{\sigma(1-\alpha)(1-\beta)}$. Meanwhile $(1-\alpha)(1-\underline{\beta})\left(1-\hat{\psi}\right) < 1$, so for $t$ sufficiently small platform profit is strictly greater with $\gamma = \bar{\gamma}$ so long as $\mu$ is sufficiently large that the decrease in seller fees is not compensated for and surmounted by an increase in $\rho$ as $\gamma$ increases.

For any $\gamma > \bar{\gamma}$, the derivative of platform profit is

$$\alpha \left[ \underbrace{\frac{(1-\alpha)(1-\mu)V-(1-\gamma)\alpha\ell-\frac{s}{\sigma}}{(1-\gamma\alpha)^2} + \frac{\alpha\ell}{1-\gamma\alpha}}_{\text{Change in } \rho} - \underbrace{\frac{(1-\alpha)^2(1-\underline{\beta})\underline{\beta}\mu}{[(1-\alpha)\underline{\beta}+\alpha(1-\gamma)]^2}}_{\text{Change in } \xi} \right]$$

This derivative is negative at $\gamma = 1$ if $\mu$ is not too small and $\ell$ not too large, and it is increasing in $\alpha$, meaning that any interior maximum must increase in $\alpha$ also. ■

Similar to Section 4, the platform is trading off reduced value extraction from sellers against an increased participation fee from consumers as $\gamma$ increases. Interestingly, the profit maximizing level of $\gamma$ does not depend on $t$ so long as the level of $t$ is large enough such that $\gamma > \bar{\gamma}$. This is because a change in $\gamma$ does not impact the proportion of sellers steering consumers toward direct transactions and so $\gamma$ provides a purely infra-marginal change in platform profits which is independent of $t$.[24] Nevertheless the main intuition from Section 4 that the platform will increase the salience of low-quality sellers in response to a decrease in $t$ does survive if that reduction lowers $t$ below the cutoff $\bar{t}$.

# C Online Appendix: Endogenous Seller Pricing.

In this section I extend the benchmark model to allow for sellers to set prices endogenously. Given the additional complexity involved I first build out the model with no

[24]This result likely would not be robust to a more complex model with e.g. a continuum of $t$. It would also not be true of the model with endogenous pricing as both $t$ and $\psi$ influence sellers' price elasticity with regard to platform policy changes.

low-quality sellers, then add them back in. Similar to the benchmark, the model includes a monopoly platform, a continuum of consumers with mass 1 who search on the platform and pay a search cost $s$ for each observation, and a continuum of sellers competing via a Wolinsky (1986) search process with full recall. The platform sets a percentage commission $\xi$ that it takes from the developers' gross revenue. The developers set prices $\mu_j$ in response to the platform's fee, and they also have the ability to set a price for off-platform transactions denoted $\mu_j^\theta$. Consumers on the platform can choose to transact directly with sellers rather than on the platform, but they incur the switching cost $t$ if they do so. The timing of the model is as follows:

1. The platform sets commission $\xi$
2. Sellers set prices
3. Consumers search and make purchasing decisions

## C.1 Consumer utility and demand

If consumer $i$ searches and observes seller $j$ receives an idiosyncratic match value draw $\epsilon_{ij} \sim F[\underline{\epsilon}, \infty)$ where $F$ is a differentiable log-concave CDF with corresponding PDF $f(\epsilon)$. If they choose to search again they can recall any previous observation at no cost. Their utility from purchasing seller $j$'s product (gross of search costs) is

$$\epsilon_{ij} - \mu_j$$

The consumer expects that sellers on the platform are charging the symmetric price $\mu$. As is standard in the literature I assume passive beliefs such that observing a deviation does not change consumers' expectations. Given a current observation $U \equiv \epsilon_{ij} - \mu_j$ If the consumer chooses to search once more paying the search cost $s$ then their expected utility from doing so is

$$\int_{\underline{\epsilon}}^{\infty} \max\{U, \epsilon - \mu\} d\epsilon - s$$

Setting these two utilities equal and simplifying, $i$ is indifferent about searching if

$$s = \int_{U+\mu}^{\infty} (\epsilon - \mu - U) d\epsilon$$

which then implies that $j$ faces demand

$$1 - F(U + \mu_j) \tag{14}$$

Once aware of a seller, the consumer can choose to transact with them directly and pay the direct transaction price $\mu_j^\theta$ instead of the on-platform price $\mu_j$, but they also incur the switching cost $t$ when they do so. Their match value does not change if they engage in this showrooming behavior, so a consumer will choose this direct channel only if

$$\mu_j - \mu_j^\theta > t$$

This cutoff is common to all consumers, so all consumers participating on the platform who buy from $j$ will transact directly with the seller or they will all purchase through the platform.

## C.2 Seller profit and prices

A seller setting price $\mu_j$ against expected price $\mu$ and commission $\xi$ (and choosing to set $\mu_j - \mu_j^\theta \leq t$) faces demand given by (14) which yields profit

$$\pi_j = (1-\xi)\mu_j \left[1 - F(U + \mu_j)\right] \tag{15}$$

For the benchmark model, I focus on symmetric pricing, so taking the first order condition for $\mu_j$ and then imposing symmetry in on platform prices yields

$$\mu_j = \frac{1 - F(U + \mu_j)}{f(U + \mu_j)} \tag{16}$$

Log-concavity ensures sufficiency of the FOCs for profit maximization, this price gives profit

$$\pi_j = (1-\xi)\frac{(1 - F(U + \mu_j))^2}{f(U + \mu_j)} \tag{17}$$

The reservation match value $U + \mu_j$ does not depend on the equilibrium price as long as prices on the platform are symmetric, so this price is increasing in $\xi$ while on-platform profit is decreasing. A seller could instead induce all consumers who purchase from it to transact directly (e.g. by setting $\mu_j$ arbitrarily high) and transacting with all its consumers via a single pooled price $\mu_j^{steer}$. In this case its profit is

$$\mu_j^{steer}\left[1 - F(U + t + \mu_j^{steer})\right]$$

Where $t$ enters on-platform demand because requiring consumers to incur the switching cost is equivalent to raising price by that cost. Taking the FOC

$$\mu_j^{steer} = \frac{1 - F(U + t + \mu_j^{steer})}{f(U + t + \mu_j^{steer})} \tag{18}$$

Again, log concavity ensures sufficiency for this to be profit maximization, so the seller's profit from an individual deviation to selling off-platform is

$$\pi_j^{steer} = \frac{(1 - F(U + t + \mu_j^{steer}))^2}{f(U + t + \mu_j^{steer})} \tag{19}$$

The RHS of (18) is decreasing in $t$ for any value of $\mu_j^{steer}$, which implies that the value of $\mu_j^{steer}$ which solves (18) is decreasing in $t$ and so it must be the case that $t + \mu_j^{steer}$ is increasing in $t$ and $1 - F(U + t + \mu_j^{steer})$ is decreasing in $t$ so $\pi_j^{steer}$ is also decreasing in $t$. Further, given the similarity between (18) and (16), $\mu_j$ is equivalent to $\mu^{steer}$ with $t = 0$, which implies $\mu^{steer} + t > \mu_j$ for any $U$. This observation on $t$ completes the proof of Lemma C.1.

**Lemma C.1.** *$\mu_j$ is increasing in $\xi$ and $\pi_j$ is decreasing in $\xi$. Both are constant in $t$. $\mu_j^{steer}$ and $\pi_j^{steer}$ are both decreasing in $t$ and constant in $\xi$. For any $U$ $\mu^{steer} + t > \mu_j$ when $\xi = 0$.*

Note that these are the prices and profits of an *individual* seller deviating to inducing showrooming by consumers. If proportion $\beta$ of sellers induce direct transactions then similar to Bar-Isaac, Caruana, and Cuñat (2012) the value of an additional search is

$$s = \beta \int_{U+\mu^{steer}+t}^{\infty} (\epsilon - \mu^{steer} - t - U) f(\epsilon) d\epsilon + (1 - \beta) \int_{U+\mu}^{\infty} (\epsilon - \mu - U) f(\epsilon) d\epsilon \tag{20}$$

The demand and pricing equations are unchanged from an individual deviation, except that from Lemma C.1, for any value of $U$, $U + \mu^{steer} + t > U + \mu$, meaning that the RHS of (20) is decreasing in $\beta$, and therefore so is $U$, meaning that prices and profits for both deviating and non-deviating sellers' profits are increasing in $\beta$. Lemma C.2 compares the rate of change for the two seller types

**Lemma C.2.** *In equilibrium $\beta \in \{0, 1\}$*

*Proof.* Taking the derivative of (16) with regard to $U$

$$\frac{d\mu}{dU} = \frac{-(1 - F(U + \mu))f'(U + \mu) - f(U + \mu)^2}{f(U + \mu)^2}(1 + \frac{d\mu}{dU}) \tag{21}$$

solving

$$\frac{d\mu}{dU} = \frac{-(1 - F(U + \mu))f'(U + \mu) - f(U + \mu)^2}{2f(U + \mu)^2 + (1 - F(U + \mu))f'(U + \mu)} \tag{22}$$

Now taking the derivative of (17)

$$\frac{d\pi_j}{dU} = (1 - \xi)(1 + \frac{d\mu}{dU})\frac{-(1 - F(U + \mu))^2 f'(U + \mu) - 2(1 - F(U + \mu))f(U + \mu)^2}{f(U + \mu)^2}$$

Using (22) and solving

$$\frac{d\pi_j}{dU} = -(1 - \xi)(1 - F(U + \mu_j)) \tag{23}$$

Following identical logic

$$\frac{d\pi_j^{steer}}{dU} = -(1 - F(U + \mu_j^{steer} + t)) \tag{24}$$

As Lemma C.1 implies $\mu_j^{steer} + t > \mu_j$ for $\xi = 0$, $\frac{d\pi_j}{dU} < \frac{d\pi_j^{steer}}{dU}$, while for $\xi \approx 1$ that inequality is reversed. However, if $(1-\xi)(1 - F(U + \mu_j)) \geq (1 - F(U + \mu_j^{steer} + t))$ then log concavity and Lemma C.1 imply that $\pi_j > \pi_j^{steer}$ because

$$\begin{aligned}
\pi_j =& (1-\xi)\frac{(1 - F(U + \mu_j))^2}{f(U + \mu_j)} \\
\geq& (1 - F(U + \mu_j^{steer} + t))\frac{(1 - F(U + \mu_j))}{f(U + \mu_j)} \\
>& \frac{(1 - F(U + \mu_j^{steer} + t))^2}{f(U + \mu_j^{steer} + t)} = \pi_j^{steer}
\end{aligned}$$

Where the first inequality comes from the assumption that $(1-\xi)(1 - F(U + \mu_j)) \geq (1 - F(U + \mu_j^{steer} + t))$, and the second comes from the fact that $1 - \xi < 1$ and so it must be the case that $U + \mu_j^{steer} + t > U + \mu_j$ if $(1-\xi)(1 - F(U + \mu_j)) \geq (1 - F(U + \mu_j^{steer} + t))$. From the contra-positive $\pi_j < \pi_j^{steer}$ then implies $(1-\xi)(1 - F(U + \mu_j)) < (1 - F(U + \mu_j^{steer} + t))$.

$\frac{d\pi_j}{d\beta} = \frac{d\pi_j}{dU}\frac{dU}{d\beta}$ and we know $\frac{dU}{d\beta} < 0$, so we can simply reverse the signs on $\frac{d\pi_j}{dU}$ and $\frac{d\pi_j^{steer}}{dU}$ above when considering the impact of $\beta$ on seller profits. This then implies that $\pi_j - \pi_j^{steer}$ is decreasing in $\beta$ whenever $\pi_j < \pi_j^{steer}$, so in the equilibrium of the market sub-game $\beta = 0$ or $\beta = 1$. ■

The intuition behind this lemma is that an increase in $\xi$ reduces the benefits that sellers who transact on the platform get from a reduction in search intensity. If $\xi$ is sufficiently large that sellers are willing to leave the platform, then it is also large enough that sellers who steer consumers off platform capture a larger proportion of the gain in surplus from the resulting increase in search intensity than do those who allow on-platform transactions. This pattern reinforces the incentives to steer consumers and so all of the sellers will begin steering consumers as soon as $\xi$ is large enough that one seller would find it profitable to do so. This implies that there is a region of $\xi$ where $\beta = 0$ and $\beta = 1$ are both equilibria of the market sub-game, but I assume that sellers coordinate on selling on-platform whenever this is the case.

Given these assumptions there must be some cutoff where all sellers switch from allowing transactions on the platform to steering consumers off-platform. I formalize this in Proposition C.1

**Proposition C.1.** *There exists a cutoff commission $\xi^*$ such that no seller will deviate to steering consumers off-platform and $\beta = 0$ for $\xi \leq \xi^*$. While $\beta = 1$ for $\xi > \xi^*$. $\xi^*$ is increasing in $t$*

*Proof.* From Lemma C.1, when $\xi = 0$, $\pi_j > \pi_j^{steer}$. Further $\pi_j$ is decreasing in $\xi$ and approaches 0 as $\xi \to 1$, while $\pi_j^{steer}$ is constant in $\xi$ for $\beta = 0$. Therefore from the intermediate value theorem there must be some value of $\xi$ such that $\pi_j = \pi_j^{steer}$, and $\pi_j < \pi_j^{steer}$ for $\xi$ above this cutoff. This cutoff is $\beta^*$. From Lemma C.2 it then must be the case that $\beta = 1$ for $\xi > \xi^*$. ■

## C.3 Platform Profit and Commission

Every consumer will make a purchase eventually, so from Proposition C.1 the platform's profit is given by

$$\Pi(\xi) = \begin{cases} \xi \left[\frac{1-F(U+\mu_j)}{f(U+\mu_j)}\right] & \xi \leq \xi^* \\ 0 & \xi > \xi^* \end{cases}$$

Profit in the first case is positive and increasing in $\xi$, therefore the platform will set $\xi = \xi^*$. Meaning that $\xi$ in equilibrium is always the commission that leaves sellers indifferent about allowing on-platform transactions when all other sellers do so. i.e.

$$(1 - \xi^*)\frac{(1 - F(U + \mu))^2}{f(U + \mu)} = \frac{(1 - F(U + t + \mu^{steer}))^2}{f(U + t + \mu^{steer})}$$

Which means $\xi$ is given implicitly by

$$\xi^* = 1 - \frac{\frac{(1-F(U+t+\mu^{steer}))^2}{f(U+t+\mu^{steer})}}{\frac{(1-F(U+\mu))^2}{f(U+\mu)}} \tag{25}$$

The fraction on the right hand side is decreasing in $t$, therefore $\xi^*$ is increasing in $t$. This proves Proposition C.2

**Proposition C.2.** *Platform profits are increasing in the switching cost.* $\frac{d\Pi}{dt} > 0$

As will become relevant later, this proposition and the commission in (25) remain valid if some proportion $\underline{\beta}$ of sellers choose to steer consumers to direct transactions for exogenous reasons. An increase in $\underline{\beta}$ will lower the equilibrium commission, but will not qualitatively change any of the results in this section.

Intuitively, proposition C.2 says that any policy (such as the Epic vs. Apple ruling) which reduces the friction for sellers who want to steer consumers off platform will reduce the platform's profit. Therefore the platform has an incentive to increase this switching cost as much as possible. This could take the form of welfare enhancing investments in the quality of transactions on the platform, but may also create an incentive to engage in other conduct that is less consumer friendly.

# D Preventing Leakage via Low Quality-Sellers

To model this strategy, I suppose the platform allows a proportion $\alpha$ of lower quality apps onto its marketplace who provide 0 utility. The distribution of match values is now

$$\begin{cases} 0 & \text{seller is low quality} \\ \epsilon_{ij} \sim F[\underline{\epsilon}, \infty) & \text{seller is high quality} \end{cases}$$

However consumers cannot observe their true match value draw until after they have made a purchase. Instead they observe a signal that is equal to the value of $\epsilon$ they receive if their actual match value is positive, and randomly drawn from $F(\cdot)$ if they encounter a low-quality seller and their true match value is 0. Once a consumer has purchased from a seller and observed a null match value, they have the option to seek a refund of the price they paid. This refund will be successful if they purchased through the platform, but will be denied if they purchased directly. Regardless of the outcome of their request I assume consumers do not search for and purchase a different product after purchasing from an unsatisfactory seller.[25] Given the refund policy, the low-quality sellers only make a positive profit if they make a sale through the direct channel, so they will only offer direct purchases. If no honest seller steers consumers to direct purchases then the low-quality sellers make 0 profit through both channels so they are indifferent between allowing direct purchases and not.

## D.1 Consumer Search Behavior and Utility

In this paradigm the interim expected utility of an observed prospect is

$$\epsilon_{ij} - \mu_j$$

If purchasing through the platform and

$$\frac{\beta(1-\alpha)}{\beta(1-\alpha)+\alpha}\epsilon_{ij} - \mu_j - t$$

If purchasing directly, where $\frac{\beta(1-\alpha)}{\beta(1-\alpha)+\alpha} \equiv \psi$ is the probability that a randomly encountered seller is a normal seller conditional on encountering a seller inducing direct transactions. The expected value of an additional search (given a proportion $\beta$) of high-quality sellers

[25] In practice I would expect that some proportion of consumers would search for a replacement product after receiving a refund, or possibly even after failing to receive a refund. Stationarity of the search problem implies that this would increase the value of consumer participation and limit the negative impacts of allowing these low quality sellers on the platform, which would only strengthen the results of this section, so I omit that possibility to aid tractability and exposition.

inducing direct transactions is

$$(1-\beta)(1-\alpha)\int_{\underline{\epsilon}}^{\infty}(\epsilon-\mu)f(\epsilon)d\epsilon+(\beta(1-\alpha)+\alpha)\int_{\underline{\epsilon}}^{\infty}[\psi\epsilon-\mu^{steer}-t]f(\epsilon)d\epsilon-s$$

Therefore, given an expected utility in hand $U$ equalizes the incremental value of an additional search with the search cost if

$$s=(1-\beta)(1-\alpha)\int_{U+\mu}^{\infty}[(\epsilon-\mu)-U]f(\epsilon)d\epsilon+(\beta(1-\alpha)+\alpha)\int_{\frac{U+\mu^{steer}+t}{\psi}}^{\infty}[\psi\epsilon-\mu^{steer}-t-U]f(\epsilon)d\epsilon \tag{26}$$

which implies that a consumer will stop and purchase from a seller allowing on-platform transactions and charging price $p_j$ if

$$\epsilon_{ij}-\mu_j>U$$

which leads to demand

$$1-F(U+\mu_j)$$

Equivalently, demand for a steering seller is

$$1-F(\frac{U+\mu_j^{steer}+t}{\psi}) \tag{27}$$

## D.2 Seller pricing and profit

(27) and the definition of $\psi$ immediately imply

**Proposition D.1.** *If $\beta=0$, no individual high quality seller will deviate to steering consumers to direct transactions for any $\xi<1$.*

*Proof.* If $\beta=0$, then $\psi=0$, meaning that no consumer will purchase from a steering seller as there is 0 probability that the seller they encounter is high-quality. Given that each seller represents an infinitesimal mass, a single high-quality seller deviating to steering consumers does not change this, so that consumer would acheive 0 demand and hence 0 profit compared to a positive profit on the platform. ■

Sellers allowing transactions on the platform price similarly to the on-platform price in section C, except that $U$ is determined by (26). Therefore their profit is

$$(1-\xi)\frac{(1-F(U+\mu))^2}{f(U+\mu)}>0$$

Proposition D.1 says that no matter how high $\xi$ gets, no individual seller can profitably begin steering consumers to direct transactions because consumers will have no confidence that the seller is not a low-quality seller, so steering leads to no demand and 0 profit. This result clearly demonstrates the mechanism this model was intended to highlight, but the starkness of the result depends on $\beta = 0$. If consumers believe that a positive mass of high-quality sellers are not allowing on-platform transactions then there exists an interior $\xi$ where sellers can make more profit from selling through the direct channel. Therefore just as in the benchmark, I assume that a minimum proportion $\underline{\beta}$ of the high quality sellers will steer consumers to the direct channel regardless of the platform's commission.

With this stipulation, profit for sellers who steer consumers off the platform is

$$\mu_j^{steer}\left(1 - F(\frac{U + \mu_j^{steer} + t}{\psi})\right) \tag{28}$$

This problem is identical for the low- and high-quality sellers. Taking the first order condition (and noting that log-concavity of $F$ ensures sufficiency of the FOC) we get price

$$\mu^{steer} = \psi\frac{1 - F(\frac{U+\mu_j^{steer}+t}{\psi})}{f(\frac{U+\mu_j^{steer}+t}{\psi})} \tag{29}$$

and profit

$$\pi^{steer} = \psi\frac{\left(1 - F(\frac{U+\mu_j^{steer}+t}{\psi})\right)^2}{f(\frac{U+\mu_j^{steer}+t}{\psi})} \tag{30}$$

This profit is greater than 0, so it remains to demonstrate that there is no interior $\beta \in (\underline{\beta}, 1)$ as established in Lemma D.1

**Lemma D.1.** *$U + \mu < \frac{U+\mu^{steer}+t}{\psi}$; $U$ is decreasing in $\beta$, $\alpha$, and $\xi$; $\frac{U+\mu^{steer}+t}{\psi}$ is increasing in $t$ and $\alpha$; and in equilibrium $\beta \in \{\underline{\beta}, 1\}$*

*Proof.* First, suppose by contradiction that $U + \mu > \frac{U+\mu^{steer}+t}{\psi}$. Then from (29) this would imply

$$U + c + \frac{1 - F(U + \mu)}{f(u + \mu)} > \frac{U + c + t}{\psi} + \frac{1 - F(\frac{U+\mu^{steer}+t}{\psi})}{f(\frac{U+\mu^{steer}+t}{\psi})}$$

but $U, c$, and $t$ are all positive, $\psi < 1$, $F(\cdot)$ is log concave, so $U + \mu > \frac{U+\mu^{steer}+t}{\psi}$ implies $\frac{1-F(U+\mu)}{f(u+\mu)} < \frac{1-F(\frac{U+\mu^{steer}+t}{\psi})}{f(\frac{U+\mu^{steer}+t}{\psi})}$ which means that the right hand side of the above inequality must be greater than the left, which contradicts the assumption that $U + \mu > \frac{U+\mu^{steer}+t}{\psi}$. Next, from the definition of $\psi$

$$(\beta(1-\alpha)+\alpha)\int_{\frac{U+\mu^{steer}+t}{\psi}}^{\infty}[\psi\epsilon-\mu^{steer}-t-U]f(\epsilon)d\epsilon = \beta(1-\alpha)\int_{\frac{U+\mu^{steer}+t}{\psi}}^{\infty}[\epsilon-\frac{p^{steer}+t+U}{\psi}]f(\epsilon)d\epsilon \tag{31}$$

which combined with the fact that $U + \mu < \frac{U+\mu^{steer}+t}{\psi}$ implies that, if we hold $U$ constant, the right hand side of (26) is decreasing in $\beta$, meaning that $U$ must decrease in $\beta$ to maintain equality with the search cost. The logic for $U$ decreasing in $\alpha$ is essentially identical. The logic for $U$ decreasing in $\xi$ is essentially similar, but focuses on the first integral in (26) decreasing in $\xi$ as $p$ increases.

Now suppose $\frac{U+\mu^{steer}+t}{\psi}$ were decreasing or constant in $t$, this would imply that $U$ is decreasing in $t$, which means the first integral on the RHS of (26) would be increasing, while the second integral is non-decreasing, but this creates a contradiction as (26) could then no longer be satisfied. Therefore $\frac{U+\mu^{steer}+t}{\psi}$ must be increasing in $t$. The logic for the fraction increasing in $\alpha$ is essentially identical.

Turning to the second part of the lemma: by identical logic as in the proof of Lemma C.2, we have that

$$\frac{d\pi_j}{d\beta} = -\frac{dU}{d\beta}(1-\xi)\left(1-F(U+\mu_j)\right)$$

While from (28)

$$\frac{d\pi^{steer}}{d\beta} = \frac{\partial\pi^{steer}}{\partial U}\frac{dU}{d\beta} + \frac{\partial\pi^{steer}}{\partial\beta} + \frac{\partial\pi^{steer}}{\partial p_j^{steer}}\frac{dp_j^{steer}}{d\beta}$$

From the envelope theorem $\frac{\partial\pi^{steer}}{\partial p_j^{steer}} = 0$ so we can treat price as a constant when evaluating this derivative. Taking the derivative of (28) with regard to beta shows $\frac{\partial\pi^{steer}}{\partial\beta} > 0$, while $\frac{\partial\pi^{steer}}{\partial U}\frac{dU}{d\beta}$ which from (28) is equal to $-f(\frac{U+\mu_j^{steer}+t}{\psi})\frac{dU}{d\beta}(p_j^{steer}-c) = -\frac{dU}{d\beta}\psi\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right)$. Noting that this implies $\frac{d\pi^{steer}}{d\beta} > -\frac{dU}{d\beta}\psi\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right)$. Noting that $\frac{dU}{d\beta} < 0$ we can then repeat the rest of the logic from Lemma C.2 to show that $\pi_j < \pi^{steer}$ implies $\frac{d\pi_j}{d\beta} < \frac{d\pi^{steer}}{d\beta}$, which by the same logic as in Lemma C.2 completes the proof. ■

The logic behind the lack of interior $\beta$ is similar to that in the benchmark, except that the self-reinforcing increased profitability of inducing direct transactions is enhanced by the fact that as more sellers deviate to doing so, $\psi$ increases, which increases consumer confidence in the quality of sellers who induce direct transactions but reduces search intensity. We can then state Proposition D.2

**Proposition D.2.** *There exists a cutoff $\xi^*$ such that $\beta = \underline{\beta}$ for $\xi \leq \xi^*$ and $\beta = 1$ for $\xi > \xi^*$. $\xi^*$ is increasing in $\alpha$ and $t$*

*Proof.* Taking the derivative of $\pi_j$ with regard to $\xi$.

$$\begin{aligned}\frac{d\pi_j}{d\xi} =& \frac{\partial\pi_j}{\partial U}\frac{dU}{d\xi} + \frac{\partial\pi_j}{\partial\xi} \\ =& -(1-\xi)(1-F(U+\mu))\frac{dU}{d\xi} - \frac{(1-F(U+\mu))^2}{f(U+\mu)}\end{aligned}$$

Note that the envelope theorem once again implies that we can treat $p_j$ as a constant for this derivative. Similarly

$$\begin{aligned}\frac{d\pi^{steer}}{d\xi} =& \frac{\partial \pi^{steer}}{\partial U}\frac{dU}{d\xi} \\ =& -\psi(1 - F(\frac{U + \mu_j^{steer} + t}{\psi}))\frac{dU}{d\xi}\end{aligned}$$

By the same logic as in Lemma D.1, $pi^{steer} > \pi_j$ implies $-\psi(1 - F(\frac{U+\mu_j^{steer}+t}{\psi}))\frac{dU}{d\xi} > -(1-\xi)(1 - F(U+\mu))\frac{dU}{d\xi}$, and $-\frac{(1-F(U+\mu))^2}{f(U+\mu)} < 0$, so $\pi^{steer} - \pi_j$ is increasing in $\xi$ when it is non-negative, so it can cross from negative to positive at most once. Further this crossing point must exist because from Lemma D.1 $U + \mu < \frac{U+\mu_j^{steer}+t}{\psi}$, which implies that $\pi_j > \pi^{steer}$ when $\xi = 0$, while $\pi_j \to 0$ as $\xi \to 1$, while $\pi^{steer}$ is positive and always increasing in $\xi$. Define this crossing point as $\xi^*$.

Similarly

$$\begin{aligned}\frac{d\pi^{steer}}{d\alpha} =& \frac{\partial \pi^{steer}}{\partial U}\frac{dU}{d\alpha} + \frac{\partial \pi^{steer}}{\partial \alpha} \\ =& -\psi(1 - F(\frac{U + \mu_j^{steer} + t}{\psi}))\frac{dU}{d\alpha} + \frac{\partial \pi^{steer}}{\partial \alpha}\end{aligned}$$

and

$$\begin{aligned}\frac{d\pi_j}{d\alpha} =& \frac{\partial \pi_j}{\partial U}\frac{dU}{d\alpha} \\ =& -\psi(1 - F(\frac{U + \mu_j^{steer} + t}{\psi}))\frac{dU}{d\alpha}\end{aligned}$$

Which by similar logic as above implies $\pi_j - \pi^{steer}$ is increasing in $\alpha$ for any $\xi$ when it is non-negative. Therefore $\xi^*$ is increasing in $\alpha$. We can repeat this argument again with $t$ to show that $\xi^*$ is increasing in $t$.

■

## D.3 Platform Commission and Profit

The probability that a consumer purchases through the platform is

$$\frac{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu))}{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu)) + (\underline{\beta}(1-\alpha)+\alpha)\left(1 - F(\frac{U+\mu_j^{steer}+t}{\psi})\right)}$$

$$\Pi = \begin{cases} \frac{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu))}{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu)) + (\underline{\beta}(1-\alpha)+\alpha)\left(1 - F(\frac{U+\mu_j^{steer}+t}{\psi})\right)}\xi p & \xi \leq \xi^* \\ 0 & \xi > \xi^* \end{cases}$$

Let

$$\omega \equiv \frac{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu))}{(1-\underline{\beta})(1-\alpha)(1-F(U+\mu)) + (\underline{\beta}(1-\alpha)+\alpha)\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right)}$$

$p$ is increasing in $\xi$, so $\Pi$ is increasing in $\xi$ for $\xi < \xi^*$, which implies that $\xi^*$ equalizes $\pi_j$ and $\pi^{steer}$, so we can find

$$\xi^* = 1 - \psi \frac{\frac{\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right)^2}{f(\frac{U+\mu_j^{steer}+t}{\psi})}}{\frac{(1-F(U+\mu_j))^2}{f(U+\mu_j)}} \tag{32}$$

and in equilibrium

$$\Pi = \omega \xi^* p \tag{33}$$

**Proposition D.3.** *There is a profit maximizing level of $\alpha$ denoted $\alpha^*$ which is decreasing in $t$. $\alpha^* > 0$ if $t$ and $s$ are sufficiently small.*

Proposition D.3 says that including the low quality sellers is more profitable the lower the switching cost is. In other words, when a policy change lowers the switching cost, the platform will respond by screening the quality of sellers on its marketplace less intensively in order to reduce the appeal of transacting off the platform.

*Proof.* $\xi^*$ equalizes $\pi_j$ and $\pi^{steer}$, which from the proof of Lemma D.1 implies $\psi\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right) = (1-\xi^*)(1-F(U+\mu))$ so we can find,

$$\begin{aligned}
\omega =& \frac{(1-\underline{\beta})(1-\alpha)}{(1-\underline{\beta})(1-\alpha) + (\underline{\beta}(1-\alpha)+\alpha)\frac{1-\xi^*}{\psi}} \\
=& \frac{(1-\underline{\beta})(1-\alpha)}{(1-\underline{\beta})(1-\alpha) + (\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi^*}{\underline{\beta}(1-\alpha)}} \\
=& \frac{(1-\underline{\beta})(1-\alpha)^2}{(1-\underline{\beta})(1-\alpha)^2 + (\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi^*}{\underline{\beta}}}
\end{aligned}$$

Which gives

$$\omega = \frac{(1-\underline{\beta})(1-\alpha)^2}{(1-\underline{\beta})(1-\alpha)^2 + (\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi^*}{\underline{\beta}}} \tag{34}$$

Which goes to 0 as $\alpha \to 1$ so long as $\xi$ does not approach 1 too quickly (which from (32) will be true so long as $\ln(F(\cdot))$ is not too concave (i.e. the rate of change of the hazard ratio $\frac{1-F(x)}{f(x)}$ is not too large).

$\underline{\beta}$ is a constant, $\xi$ and $p$ are increasing in $\alpha$ (the latter because $U$ is decreasing), so the platform's choice of $\alpha$ trades off increased margin against more consumers transacting off platform. The first order condition for $\alpha$ is

$$0 = \frac{d\omega}{d\alpha}\xi^*\mu + \omega\left(\frac{d\xi^*}{d\alpha}\mu + \xi^*\frac{d\mu}{d\alpha}\right) \tag{35}$$

The following identities will thus be useful:

From (16) (recall that the pricing problem for sellers allowing on-platform transactions is qualitatively unchanged from the hetero benchmark)

$$\frac{d\mu}{d\alpha} = -\frac{(1-F(U+\mu)f'(U+\mu)+f(U+\mu)^2}{(1-F(U+\mu)f'(U+\mu)+2f(U+\mu)^2}\frac{dU}{d\alpha} \tag{36}$$

Which we can then use to find

$$\frac{dU}{d\alpha}+\frac{d\mu}{d\alpha} = \frac{f(U+\mu)^2}{(1-F(U+\mu)f'(U+\mu)+2f(U+\mu)^2}\frac{dU}{d\alpha} \tag{37}$$

Next, from (30) we can restate $\xi^*$

$$\xi^* = 1 - \frac{\pi^{steer}}{\frac{(1-F(U+\mu_j))^2}{f(U+\mu_j)}} \tag{38}$$

.

$\xi^*$ is the only place $p^{steer}$ appears in $\Pi$, so (34), (38), and the envelope theorem together imply that the platform will treat $p^{steer}$ as a constant when setting $\alpha$.[26]

We can state the platform's maximization problem using a Lagrangian multiplier $\lambda$

$$\max_{\xi,\alpha} \omega\xi p + \lambda\left(\xi - 1 + \psi\frac{\frac{\left(1-F(\frac{U+\mu_j^{steer}+t}{\psi})\right)^2}{f(\frac{U+\mu_j^{steer}+t}{\psi})}}{\frac{(1-F(U+\mu_j))^2}{f(U+\mu_j)}}\right)$$

Taking the FOC with regard to $\xi$:

$$\frac{(1-\underline{\beta})^2(1-\alpha)^2\frac{(\underline{\beta}(1-\alpha)+\alpha)}{\underline{\beta}}}{\left[(1-\underline{\beta})(1-\alpha)^2+(\beta(1-\alpha)+\alpha)^2\frac{1-\xi}{\underline{\beta}}\right]}\xi p + \omega p + \lambda = 0$$
$$p\left[\frac{(1-\underline{\beta})^2(1-\alpha)^2\frac{(\underline{\beta}(1-\alpha)+\alpha)}{\underline{\beta}}}{\left[(1-\underline{\beta})(1-\alpha)^2+(\beta(1-\alpha)+\alpha)^2\frac{1-\xi}{\underline{\beta}}\right]}\xi + \omega\right] = -\lambda \tag{39}$$

Where the first term in the derivative on the first line comes from (34). Now taking the FOC with regard to $\alpha$

[26] Deviations by the infinitesimal sellers don't affect search behavior, which combined with Wolinsky search causing each seller to act as a local monopolist means we can apply the envelope theorem despite the fact that sellers are not actual monopolists.

$$
\begin{aligned}
0 =& \frac{-2(1-\underline{\beta})(1-\alpha) - \left[-2(1-\underline{\beta})(1-\alpha) + 2(\underline{\beta}(1-\alpha)+\alpha)(1-\underline{\beta})\frac{1-\xi}{\underline{\beta}}\right]}{\left[(1-\underline{\beta})(1-\alpha)^2 + (\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi}{\underline{\beta}}\right]^2}\xi p \\
&-\omega\xi \frac{f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}{2f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}\frac{dU}{d\alpha} \\
&+\lambda\Bigg(\frac{\frac{\partial\psi}{\partial\alpha}}{\frac{(1-F(U+\mu))}{f(U+\mu)}}\Bigg[\frac{(1-F(\frac{U+\mu^{steer}+t}{\psi})^2)}{f(\frac{U+\mu^{steer}+t}{\psi})} \\
&\quad + \frac{U+\mu^{steer}+t}{\psi}\frac{2(1-F(\frac{U+\mu^{steer}+t}{\psi}))f(\frac{U+\mu^{steer}+t}{\psi})^2+(1-F(\frac{U+\mu^{steer}+t}{\psi}))^2 f'(\frac{U+\mu^{steer}+t}{\psi})}{f(\frac{U+\mu^{steer}+t}{\psi})^2}\Bigg]\Bigg)
\end{aligned}
$$

Pulling out common terms and substituting in (39)

$$
\begin{aligned}
&\left[\omega + \frac{(1-\underline{\beta})(1-\alpha)^2\frac{(\underline{\beta}(1-\alpha)+\alpha)^2}{\underline{\beta}}}{\left((1-\underline{\beta})(1-\alpha)^2+(\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi}{\underline{\beta}}\right)^2}\right]\frac{\frac{1-F(\frac{U+\mu_j^{steer}+t}{\psi})}{f(\frac{U+\mu_j^{steer}+t}{\psi})}}{1-F(U+\mu)} \\
&\times\Bigg(\left(\frac{\beta}{\underline{\beta}(1-\alpha)+\alpha}\right)\left[(1-F(\frac{U+\mu_j^{steer}+t}{\psi}))+\frac{U+\mu_j^{steer}+t}{\psi}\frac{2f(\frac{U+\mu_j^{steer}+t}{\psi})+(1-F(\frac{U+\mu_j^{steer}+t}{\psi})f'(\frac{U+\mu_j^{steer}+t}{\psi}))}{f(\frac{U+\mu_j^{steer}+t}{\psi})}\right] \\
&+\frac{dU}{d\alpha}\left[\frac{2f(\frac{U+\mu_j^{steer}+t}{\psi})^2+(1-F(\frac{U+\mu_j^{steer}+t}{\psi}))f'(\frac{U+\mu_j^{steer}+t}{\psi})}{f(\frac{U+\mu_j^{steer}+t}{\psi})} - \frac{\psi(1-F(\frac{U+\mu_j^{steer}+t}{\psi}))\frac{f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}{2f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}\frac{dU}{d\alpha}}{\frac{1-F(U+\mu)}{f(U+\mu)}}\right]\Bigg) \\
=&\xi\left[\frac{2(1-\underline{\beta})(1-\alpha)+\left[2(\underline{\beta}(1-\alpha)+\alpha)(1-\underline{\beta})\frac{1-\xi}{\underline{\beta}}-2(1-\underline{\beta})(1-\alpha)\right]}{\left[(1-\underline{\beta})(1-\alpha)^2+(\underline{\beta}(1-\alpha)+\alpha)^2\frac{1-\xi}{\underline{\beta}}\right]^2}p - \omega\frac{f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}{2f(U+\mu)^2+(1-F(U+\mu))f'(U+\mu)}\frac{dU}{d\alpha}\right]
\end{aligned}
$$

The derivative is positive when the LHS is greater than the RHS. When $t=0$ and $\alpha=0$, $\xi=0$, meaning that the RHS of this equation is 0, while the LHS is positive. Therefore $\alpha>0$ for $t$ below some cutoff. ∎