Abstract

Marketplace platforms make a profit by skimming some of the trade surplus from each side of the transactions that occur on them. If a policy change reduces the friction that users face to shifting their transaction off the platform once they have used its interface to find one another, this threatens the platform’s profit. I show in this paper that a platform can profitably respond to such a change by reducing the intensity with which it screens sellers while simultaneously offering a robust refund policy. This reduces the appeal of transacting off the platform and reduces the incentive of sellers to steer consumers to direct transactions.

*JEL classification:*

Keywords: app stores, platform governance, marketplace leakage
1 Introduction

Many apps in mobile app stores avoid paying commissions by not allowing users to pay for services or sign up for subscriptions directly through the app store’s payment system. For example, in Apple’s app store ecosystem both Netflix and Spotify allow existing users to sign in to their accounts and stream media, but they do not have options to use Apple’s payment system to sign up for services. Until recently these apps did not include links directing users to their firms’ online sign up flow because doing so was specifically forbidden by app store. However, in recent years Apple began allowing external links as a response to regulatory pressure, and in the United States the ruling in Apple vs. Epic Games specifically required that Apple allow apps on its store to direct users to external payment options.\(^1\) This creates an avenue for platform leakage (Hagiu and Wright 2023) which may create a constraint on Apple’s commissions. As a part of this change in policy, when a user opens these links, Apple directs them to a warning screen before opening the app’s browser sign-up flow (see figure 1).

![Warning screen](image)

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

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 chargeback through their credit card company) 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 to 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 be
less diligent in curating the quality of apps on its store so that sellers who have a choice between
paying a commission on transactions through the App store or a cheaper direct payment will have
incentive to transact through the store.

2 Benchmark Model

To analyze these questions, I develop a model with a monopoly platform, continuum of
consumers with mass 1, and a continuum of sellers. 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, and $\mu$ is the proportion of that value captured by sellers.
Given the platform’s commission this leads to net revenue $(1 - \xi)\mu V$ 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 $\mu V - t$ per customer when they steer. 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. The timing of the model is as follows:

1. The platform sets commission $\xi$ and price $\rho$
2. Sellers make steering decisions.
3. Consumers make participation decisions and search

2.1 Modeling Decisions

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. In
the appendix I solve a richer model allowing endogenous pricing and show that the main effect
is robust to this extension.

\[2\text{See for example Eliaz and Spiegler (2011) and Casner (2020)}\]
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 would not significantly change the main results as the limitation on the platform’s ability to extract seller value is the sellers’ ability to steer consumers to direct transactions.

3 Benchmark Equilibrium

3.1 Consumer Utility and Demand

The expected value to a consumer of searching once is

$$\sigma \times (1 - \mu)V + (1 - \sigma) \times 0 - s$$

Note that because the switching cost $t$ is borne fully by sellers, the proportion of sellers who steer vs. those who do not does not affect this value of search. We assume the value of consumers’ outside option is 0, so consumers will choose to search so long as $\sigma \times (1 - \mu)V > s$ (which I henceforth assume to be the case). Further, it is obviously the case that $(1 - \mu)V > \sigma \times (1 - \mu)V - s$, so a consumer who has searched and found a taste match will stop searching and trade rather than search again. Therefore consumers will stop as soon as they find a match, which means the expected number of searches is $\frac{1}{\sigma}$ and consumers’ ex ante expected utility from participating in the platform is

$$(1 - \mu)V - \frac{s}{\sigma} - \rho$$

Assume consumers will participate if indifferent. Then given homogeneity of consumers, they will all participate if the following inequality is satisfied

$$\rho \leq (1 - \mu)V - \frac{s}{\sigma} \quad (1)$$

3.2 Seller Steering Decisions and Profit

Given a mass 1 of consumers, the number of consumers who will stop at a given seller on their first visit is $\sigma$. 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 $\sum_{j=0}^{\infty}(1 - \sigma)^{j}\sigma = \frac{\sigma}{1 - (1 - \sigma)} = 1$, and so sellers’ profit if they allow transactions through the platform is

$$\pi = (1 - \xi)\mu V \quad (2)$$

Because the switching cost is borne entirely by sellers, their profit if they steer consumers to direct transactions is

$$\pi^{\text{steer}} = \mu V - t \quad (3)$$

Sellers will prefer on-platform transactions if
\[
\begin{align*}
\pi & \geq \pi^{steer} \\
(1 - \xi)\mu V & \geq \mu V - t \\
\frac{t}{\mu V} & \geq \xi
\end{align*}
\] (4)

Again assuming participation on the platform when indifferent, seller homogeneity implies that all sellers will allow on-platform transactions or all sellers will steer depending on the value of \( \xi \).

### 3.3 Platform Decisions and Profit

If all consumers participate and no seller steers consumers to direct transactions, then the mass of transactions will be equal to 1, so the platform’s profit is given by

\[
\Pi = \begin{cases} 
\rho + \xi \mu V & \xi \leq \frac{t}{\mu V} \text{ and } \rho \leq (1 - \mu)V - \frac{s}{\sigma} \\
0 & \xi > \frac{t}{\mu V} \text{ or } \rho > (1 - \mu)V - \frac{s}{\sigma}
\end{cases}
\]

The platform’s profit is increasing in both \( \rho \) and \( \xi \) so long as neither of them violates their relevant participation inequalities, so both 1 and 4 will bind and in equilibrium

\[
\xi = \frac{t}{\mu V}
\] (5)

and

\[
\rho = (1 - \mu)V - \frac{s}{\sigma}
\] (6)

Which gives equilibrium platform profit

\[
\Pi = (1 - \mu)V - \frac{s}{\sigma} + t
\] (7)

The following proposition follows directly from inspection of 7

**Proposition 1.** Platform profit is decreasing in sellers’ ability to capture surplus (\( \mu \)) and increasing in the switching cost (\( t \)).

The platform is able to capture all consumer surplus, while it only captures part of seller surplus, so as \( \mu \) increases the platform is less able to capture the value of trade in on its platform. Second as more value is allocated to sellers, their benefit from steering transactions off platform increases, which in turn reduces the proportion of seller surplus that the platform is able to capture. This additional effect cancels out the upward platform-profit effect of seller revenue increasing in \( \mu \). The first effect depends on part on homogeneity of consumers, if the platform were only able to capture a small proportion of consumer surplus and the sellers’ value of steering consumers were then the marginal effect of shifting surplus allocation from consumers to sellers could instead be positive, but the steering option effect would still remain, and so platform profit would decrease in \( \mu \) regardless.
The impact of $t$ is more straightforward. Platform profit is increasing in $t$ because this reduces the value of the steering option for sellers, allowing the platform to capture additional surplus while maintaining seller participation. Together, the results of Proposition 1 imply that the platform wants to shift as much surplus as it can to consumers in order to better extract it, and it also wants to make it as difficult as possible for sellers to steer consumers to direct transactions. Calling back to the motivating example of the Epic v Apple ruling, we would expect that forcing Apple to allow app developers to link directly to outside payment options (effectively lowering $t$) would decrease profits from the App store, which would motivate Apple to engage in policies that shift surplus from sellers to consumers, and also could lead to more extreme responses as I will outline in the next section.

4 Preventing Leakage via Low Quality-Sellers

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 lower price and 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 0 utility but who still charge a positive price $p < (1 - \mu)V$. The distribution of payoffs from trade is now

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

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 $V$ if their actual match value is positive, and randomly drawn with probability $\sigma$ of being positive 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. Upon receiving a successful refund the consumers’ payoff is 0, but if the refund is denied their net payoff remains $-p$. 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.\(^3\) Given the

\(^3\)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
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 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.

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

\[
\frac{\beta(1-\alpha)}{\beta(1-\alpha)+\alpha} = \psi
\]

In this case, the expected value to a consumer of trading directly transacting with a seller (recall that the switching cost \( t \) is fully absorbed by sellers) is

\[
\psi(1-\mu)V - (1-\psi)p
\]

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 \( \mathcal{V}^p \). That value of search is given by the recursive formulation

\[
\mathcal{V}^p = \sigma(1-\alpha - \beta(1-\alpha))(1-\mu)V - s + (1-\sigma + \sigma\alpha + \beta(1-\alpha))\mathcal{V}^p
\]

Which simplifies to

\[
\mathcal{V}^p = (1-\mu)V - \frac{s}{\sigma(1-\alpha)(1-\beta)}
\]

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

\[
(1-\mu)V - \frac{s}{\sigma(1-\alpha)(1-\beta)} \geq \psi(1-\mu)V - (1-\psi)p
\]

Which, after some algebra, is equivalent to

\[
(1-\mu)V + p \geq \left( \frac{s}{\sigma(1-\alpha)(1-\beta)} \right) \frac{\beta(1-\alpha) + \alpha}{\alpha}
\]

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 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.
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 $8$ is satisfied. Following similar steps as above, the value of search when a consumer is willing to purchase from any seller is

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

Comparing with $V^p$, we can easily show that $V^p \geq V^{all}$ is the exact same cutoff as $8$, 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 $8$ is satisfied by $\tilde{\alpha}$.

Denote by $\bar{\alpha}$ the $\alpha$ which solves

$$\sigma(1 - \beta)(1 - \alpha)(1 - \mu)V = s$$

(9)

When $\alpha > \tilde{\alpha}$, consumers will only purchase through the platform, so their expected value of a single search is $V^p$. For $\alpha$ below $\tilde{\alpha}$, $V^p$ which is consumers expected value of participating in the platform gross of $\rho$ is positive. For any $\alpha > \tilde{\alpha}$, no consumer will participate in the platform for any $\rho > 0$. When $\beta$ is not too large, it is simple to show that $\tilde{\alpha} > \bar{\alpha}$. Consumer search behavior can therefore be summarized as follows:

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha &gt; \bar{\alpha}$</td>
<td>Consumers do not search</td>
</tr>
<tr>
<td>$\tilde{\alpha} \leq \alpha \leq \bar{\alpha}$</td>
<td>Consumers search but only buy through the platform</td>
</tr>
<tr>
<td>$\alpha &lt; \tilde{\alpha}$</td>
<td>Consumers search and purchase upon seeing any positive value signal</td>
</tr>
</tbody>
</table>

Table 1: Consumer search behavior at different levels of $\alpha$

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 2

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tilde{\alpha} \leq \alpha \leq \bar{\alpha}$</td>
<td>$(1 - \mu)V - \frac{s}{\sigma(1 - \alpha)(1 - \beta)}$</td>
</tr>
<tr>
<td>$\alpha &lt; \tilde{\alpha}$</td>
<td>$(1 - \alpha)(1 - \mu)V - \alpha p - \frac{s}{\sigma}$</td>
</tr>
</tbody>
</table>

Table 2: Consumers’ value of participation at different levels of $\alpha$

When consumers are willing to purchase on seeing any positive value signal, they risk being scammed, 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 search cost is worth avoiding a potentially low-quality seller.

4For details see the proof of Proposition 2.
4.2 Seller Steering Decisions and Profit

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

$$
\pi = \begin{cases} 
\mu(1 - \xi)V & \alpha < \hat{\alpha} \\
\mu(1 - \xi)V / \left( (1 - \alpha)(1 - \beta) \right) & \hat{\alpha} \leq \alpha \leq \bar{\alpha}
\end{cases}
$$

Where the second case arises because 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.

For the sellers who do steer to direct transactions, I assume that consumers diminished trust in their quality reduces their payoff, such that the division of expected surplus (gross of switching cost) is the same, even though the total expected gains from trade are smaller.\(^5\) The sellers’ profit from steering consumers to direct transactions is then

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

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

**Proposition 2.** If $\beta = 0$, no seller will individually deviate to steering consumers to direct transactions for any $\xi < 1$ when $\alpha > 0$.

**Proof.** When $\beta = 0$, then the right hand side of 8 is strictly increasing in $\alpha$. Given the assumption that $V$ is sufficiently large that there is some range of $\alpha$ where 8 is satisfied, this implies that the inequality must be satisfied when there are no low-quality sellers, meaning $\hat{\alpha} = 0$. Therefore, any seller who deviates individually to steering consumers will make zero profit, while for any $\xi < 1$ profit from on-platform transactions is positive. \( \blacksquare \)

Proposition 2 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 for the rest of this section I assume that a minimum proportion $\beta$ of the high quality sellers will steer consumers to the direct channel regardless of the platform’s commission.\(^6\)

With this assumption in place, and assuming $\alpha \leq \hat{\alpha}$ the remaining $1 - \beta$ high-quality sellers

\(^5\)This could be microfounded with e.g. a Nash bargaining process with negotiation weights $\mu$ and $1 - \mu$. However the extension in the appendix with endogenous pricing produces a similar result where increasing $\alpha$ reduces the surplus of steering sellers, so this assumption helps this more tractable model capture the same dynamics.

\(^6\)There are multiple possible motivations for this assumption. Examples include: strategic trembles, desire to keep sensitive commercial data away from the large platform, or small businesses with taste based aversion to transacting through the platform.
will transact through the platform so long as
\[ \psi \mu V - t \leq \mu (1 - \xi) V \]

Solving for \( \xi \)
\[ \xi \leq 1 - \psi + \frac{t}{\mu V} \]  

Comparing to 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. Alternatively, if \( \alpha > \tilde{\alpha} \), the platform can set \( \xi = 1 \) and sellers will still not steer as they earn 0 profit with either option.

### 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 commissions happen off-platform, while if \( \alpha > \tilde{\alpha} \) the platform is handling all transactions. This gives the following conditional profit function

\[
\Pi = \begin{cases} 
\rho + (1 - \alpha)(1 - \beta)\xi \mu V & \alpha < \tilde{\alpha} \\
\rho + \xi \mu V & \tilde{\alpha} \leq \alpha \leq \bar{\alpha}
\end{cases}
\]  

(11)

Given consumer and seller behavior derived in the previous subsections, the platform will set \( \rho \) such that consumers are just indifferent between participating and not, and \( \xi \) such that sellers are just indifferent between steering and not. We can substitute the values of \( \xi \) and \( \rho \) that achieve this indifference to get

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

(12)

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 it is less as all trade will flow through the platform rather than some of the trades happening through direct transactions. Denote the profit maximizing proportion of \( \alpha \) set by the platform as \( \alpha^* \).

**Proposition 3.** \( \alpha^* \) is positive if \( s \) is sufficiently small or of \( \mu \) is not too small and \( \frac{1 - \beta}{\tau} \mu V \) is sufficiently large relative to \( t \) and \( p \). \( \alpha^* \) is weakly decreasing in \( t \).

**Proof.** If \( s \) is sufficiently small, then \( \alpha^* = \tilde{\alpha} \), which by definition is the maximum of the minimum \( \alpha \) such that 8 is satisfied and 0. Because the switching cost is borne fully by sellers, 8 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 12 with regard to $\alpha$:

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

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

$$\frac{1 - \beta}{\beta} \mu V - (1 - \beta) t - (1 - \mu)V - p > 0$$

This can only be positive if $\mu$ is not too small, and $\frac{1 - \beta}{\beta} \mu V$ is sufficiently large relative to $t$ and $p$. 

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.\(^7\) 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 $p$ is too large then even if $\mu$ is relatively high the reduction in consumer willingness to pay for entry to the marketplace outweighs any increase in commission and $\alpha^* = 0$.\(^8\)

One of the major implications of Proposition 3 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 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

\(^7\)If we were to relax this assumption, then $t$ increases consumers would be less willing to engage in direct transactions and $\tilde{\alpha}$ would decrease in $t$.

\(^8\)We might expect $p$ 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 $p$ and $\mu$. 


to steer, the more it can charge in commissions as this limitation reduces the value to sellers of transacting outside the platform. If this limitation is taken away, then the platform 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 result is robust even if the platform is partially 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 eliminate platform leakage.

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A Benchmark Model with Endogenous Seller Pricing.

In this section I extend the benchmark model to allow for sellers to set prices endogenously. 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 $p_j$ in response to the platform’s fee and a marginal cost of production $c$, and they also have the ability to set a price for off-platform transactions denoted $p_{j}^{θ}$. Consumers on the platform can choose to transact directly with sellers rather than on the platform, but they incur a switching cost $t$ if they do so, 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. The timing of the model is as follows:

1. The platform sets commission $ξ$

2. Sellers set prices

3. Consumers search and make purchasing decisions

A.1 Consumer utility and demand

If consumer $i$ searches and observes seller $j$ receives an idiosyncratic match value draw $\epsilon_{ij} \sim F[\xi, \infty)$ 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

$$\epsilon_{ij} - p_j$$

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

$$\int_{ξ}^{∞} \max\{U, \epsilon - p\}d\epsilon - s$$

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

$$s = \int_{U+p}^{∞} (\epsilon - p - U)d\epsilon$$

which then implies that $j$ faces demand

$$1 - F(U + p_j)$$  \hspace{1cm} (13)$$

Once aware of a seller, the consumer can choose to transact with them directly and pay the direct transaction price $p_{j}^{θ}$ instead of the on-platform price $p_j$, 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

$$p_j - p_{j}^{θ} > t$$

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.
A.2 Seller profit and prices

A seller setting price $p_j$ against expected price $p$ (and choosing to set $p_j - p_j^θ ≤ t$) faces demand given by (13) which yields profit

$$\pi_j = ((1 - ξ)p_j - c) [1 - F(U + p_j)]$$

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

$$p_j = \frac{c}{1 - ξ} + \frac{1 - F(U + p_j)}{f(U + p_j)}$$

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

$$\pi_j = (1 - ξ)(1 - F(U + p_j))^2$$

The reservation match value $U + p_j$ does not depend on the equilibrium price as long as prices on the platform are symmetric, so this price is increasing in $ξ$ while on-platform profit is decreasing.

A seller could instead induce all consumers who purchase from it to transact directly (e.g. by setting $p_j$ arbitrarily high) and transacting with all its consumers via a single pooled price $p_j^{steer}$.

In this case its profit is

$$(p_j^{steer} - c) [1 - F(U + t + p_j^{steer})]$$

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

$$p_j^{steer} = c + \frac{1 - F(U + t + p_j^{steer})}{f(U + t + p_j^{steer})}$$

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

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

The RHS of (17) is decreasing in $t$ for any value of $p_j^{steer}$, which implies that the value of $p_j^{steer}$ which solves (17) is decreasing in $t$ and so it must be the case that $t + p_j^{steer}$ is increasing in $t$ and $1 - F(U + t + p_j^{steer})$ is decreasing in $t$ so $\pi_j^{steer}$ is also decreasing in $t$. We can apply this same logic to show ?? and ?? are decreasing in $t$, and essentially identical logic to show that $p_j^{steer}$ and $\pi_j^{steer}$ are increasing in $p$, which in turn is increasing in $ξ$. Further, given the similarity between (17) and (15), $p_j$ is equivalent to $p_j^{steer}$ with $t = 0$, which implies $p_j^{steer} + t > p_j$ for any $U$. This observation on $t$ completes the proof of Lemma A.1.

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

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 \cite{Bar-Isaac2012} the value of an additional search is

$$
\begin{align*}
    s &= \beta \int_{U+p+\tau}^{\infty} (e-p_{\text{steer}} - t - U)f(\epsilon)d\epsilon + (1-\beta) \int_{U}^{\infty} (e-p - U)f(\epsilon)d\epsilon
\end{align*}
$$

The demand and pricing equations are unchanged from an individual deviation, except that from Lemma A.1, for any value of $U$, $U+p+\tau > U+p$, meaning that the RHS of 19 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 A.2 compares the rate of change for the two seller types.

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

*Proof.* Taking the derivative of 15 with regard to $U$

$$
\frac{dp}{dU} = \frac{-(1-F(U+p))f'(U+p)-f(U+p)^2}{f(U+p)^2}(1+\frac{dp}{dU})
$$

solving

$$
\frac{dp}{dU} = \frac{-(1-F(U+p))f'(U+p)-f(U+p)^2}{2f(U+p)^2+(1-F(U+p))f(U+p)}
$$

Now taking the derivative of 16

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

Using 21 and solving

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

Following identical logic

$$
\frac{d\pi_{\text{steer}}}{dU} = -(1-F(U+p_{\text{steer}}+t))
$$

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

$$
\begin{align*}
    \pi_j &= (1-\xi)(1-F(U+p_j))^2 \frac{f(U+p_j)}{f(U+p_j)} \\
    &\geq (1-F(U+p_{\text{steer}}+t))(1-F(U+p_j)) \frac{f(U+p_j)}{f(U+p_j)} \\
    &> (1-F(U+p_{\text{steer}}+t))^2 \frac{f(U+p_{\text{steer}}+t)}{f(U+p_{\text{steer}}+t)} = \pi_{\text{steer}}
\end{align*}
$$

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

$$
\frac{d\pi_j}{d\beta} = \frac{d\pi_j}{dU} \frac{dU}{d\beta} < 0
$$

and we know $\frac{dU}{d\beta} < 0$, so we can simply reverse the signs on $\frac{d\pi_j}{dU}$ and $\frac{d\pi_{\text{steer}}}{dU}$ above when considering the impact of $\beta$ on seller profits. This then implies that $\pi_j - \pi_{\text{steer}}$ is decreasing.
in $\beta$ whenever $\pi_j < \pi_j^{\text{steer}}$, 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. We formalize this in Proposition A.1

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

**A.3 Platform Profit and Commission**

Every consumer will make a purchase eventually, so from Proposition A.1 the platform’s profit in the hetero benchmark is given by

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

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.

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

Which means $\xi$ is given implicitly by

$$\xi^* = 1 - \frac{(1-F(U+t+p^{\text{steer}}))^2}{f(U+t+p^{\text{steer}})^2} \frac{(1-F(U+p))^2}{f(U+p)^2} (24)$$

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

**Proposition A.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 24 remain valid if some proportion $\beta$ of sellers choose to steer consumers to direct transactions for exogenous reasons. An increase in $\beta$ will lower the equilibrium commission, but will not qualitatively change any of the results in this section.

Intuitively, proposition A.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.

B Preventing Leakage via Low Quality-Sellers

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 eliminating direct options 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 lower price and 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 0 utility. The distribution of match values is now

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

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.\(^9\) Given the refund policy, the low-quality sellers only make a positive profit if they make a sale through the direct channel.

\(^9\)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.
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.

For tractability and ease of exposition, I assume \( c = 0 \) for the entirety of Section B.

**B.1 Consumer Search Behavior and Utility**

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

\[ \epsilon_{ij} - p_j \]

If purchasing through the platform and

\[ \frac{\beta(1-\alpha)}{\beta(1-\alpha) + \alpha} \epsilon_{ij} - p_j - t \]

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 inducing direct transactions is

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

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

\[ s = (1-\beta)(1-\alpha) \int_{U+p}^{\infty} [(\epsilon - p) - U] f(\epsilon) d\epsilon + (\beta(1-\alpha) + \alpha) \int_{U+p_{steer}}^{\psi(1-\alpha)} [\psi \epsilon - p_{steer} - t - U] f(\epsilon) d\epsilon \]

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

\[ \epsilon_{ij} - p_j > U \]

which leads to demand

\[ 1 - F(U + p_j) \]

Equivalently, demand for a steering seller is

\[ 1 - F\left( \frac{U + p_{steer} + t}{\psi} \right) \]

**B.2 Seller pricing and profit**

26 and the definition of \( \psi \) immediately imply

**Proposition B.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 achieve 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 A, except that $U$ is determined by 25. Therefore their profit is

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

Proposition B.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 for the rest of this section we assume that a minimum proportion $\beta$ of the high quality sellers will steer consumers to the direct channel regardless of the platform’s commission.\(^{10}\)

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

$$(p^j_{steer} - c) \left( 1 - F\left(\frac{U + p^j_{steer} + t}{\psi}\right) \right)$$

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

$$p^{steer} = c + \psi \frac{1 - F\left(\frac{U + p^{steer} + t}{\psi}\right)}{f\left(\frac{U + p^{steer} + t}{\psi}\right)}$$

and profit

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

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

\(^{10}\)This could be justified for various reasons, strategic trembles, desire to keep sensitive commercial data away from the large platform, or small businesses with taste based aversion to transacting through the platform or a concern that high prices on the platform would harm brand image.
but $U, c$, and $t$ are all positive, $\psi < 1$, $F(\cdot)$ is log concave, so $U + p > \frac{U + p_{\text{steer}} + t}{\psi}$ implies
\[
\frac{1 - F(U + p)}{f(U + p)} < \frac{1 - F(U + p_{\text{steer}} + t)}{f(U + p_{\text{steer}} + t)},
\]
which means that the right hand side of the above inequality must be greater than the left, which contradicts the assumption that $U + p > \frac{U + p_{\text{steer}} + t}{\psi}$. Next, from the definition of $\psi$
\[
(\beta(1 - \alpha) + \alpha) \int_{U + p_{\text{steer}} + t}^{\infty} [\psi c - p_{\text{steer}} - t - U] f(c) dc = \beta(1 - \alpha) \int_{U + p_{\text{steer}} + t}^{\infty} [\epsilon - \frac{p_{\text{steer}} + t + U}{\psi}] f(\epsilon) d\epsilon
\]
which combined with the fact that $U + p < \frac{U + p_{\text{steer}} + t}{\psi}$ implies that, if we hold $U$ constant, the right hand side of 25 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 25 decreasing in $p$ as $p$ increases.

Now suppose $\frac{U + p_{\text{steer}} + t}{\psi}$ were decreasing or constant in $t$, this would imply that $U$ is decreasing in $t$, which means the first integral on the RHS of 25 would be increasing, while the second integral is non-decreasing, but this creates a contradiction as 25 could then no longer be satisfied. Therefore $\frac{U + p_{\text{steer}} + t}{\psi}$ 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 A.2, we have that
\[
\frac{d\pi_j}{d\beta} = -\frac{dU}{d\beta} (1 - \xi) (1 - F(U + p_j))
\]
While from 27
\[
\frac{d\pi_{\text{steer}}}{d\beta} = \frac{\partial \pi_{\text{steer}}}{\partial U} \frac{dU}{d\beta} + \frac{\partial \pi_{\text{steer}}}{\partial \beta} + \frac{\partial \pi_{\text{steer}}}{\partial p_{\text{steer}}} \frac{dp_{\text{steer}}}{d\beta}
\]
From the envelope theorem $\frac{\partial \pi_{\text{steer}}}{\partial p_{\text{steer}}} = 0$ so we can treat price as a constant when evaluating this derivative. Taking the derivative of 27 with regard to beta shows $\frac{\partial \pi_{\text{steer}}}{\partial \beta} > 0$, while $\frac{\partial \pi_{\text{steer}}}{\partial U} \frac{dU}{d\beta}$ which from 27 is equal to $-f\left(\frac{U + p_{\text{steer}} + t}{\psi}\right) \frac{dU}{d\beta} (p_{steer} - c) = -\frac{dU}{d\beta} \psi \left(1 - F\left(\frac{U + p_{\text{steer}} + t}{\psi}\right)\right)$. Noting that this implies $\frac{d\pi_{\text{steer}}}{d\beta} > -\frac{dU}{d\beta} \psi \left(1 - F\left(\frac{U + p_{\text{steer}} + t}{\psi}\right)\right)$. Noting that $\frac{dU}{d\beta} < 0$ we can then repeat the rest of the logic from Lemma A.2 to show that $\pi_j < \pi_{\text{steer}}$ implies $\frac{d\pi}{d\beta} < \frac{d\pi_{\text{steer}}}{d\beta}$, which by the same logic as in Lemma A.2 completes the proof.

The logic behind the lack of interior $\beta$ is similar to that in the hetero 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 B.2

**Proposition B.2.** There exists a cutoff $\xi^*$ such that $\beta = \beta_0$ 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 $\xi$.

\[
\frac{d\pi_j}{d\xi} = \frac{\partial \pi_j}{\partial U} \frac{dU}{d\xi} + \frac{\partial \pi_j}{\partial \xi} \frac{d\xi}{dU} = -(1 - \xi)(1 - F(U + p)) \frac{dU}{d\xi} - \frac{(1 - F(U + p))^2}{f(U + p)}
\]

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

\[
\frac{d\pi_{steer}}{d\xi} = \frac{\partial \pi_{steer}}{\partial U} \frac{dU}{d\xi} + \frac{\partial \pi_{steer}}{\partial \xi} \frac{d\xi}{dU} = -\psi(1 - F\left(\frac{U + p_{steer} + t}{\psi}\right)) \frac{dU}{d\xi}
\]

By the same logic as in Lemma B.1, $\pi_{steer} > \pi_j$ implies $-\psi(1 - F\left(\frac{U + p_{steer} + t}{\psi}\right)) \frac{dU}{d\xi} > -(1 - \xi)(1 - F(U + p)) \frac{dU}{d\xi}$, and $-(1 - F(U + p))^2 < 0$, 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 B.1 $U + p < U + p_{steer} + t$, 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

\[
\frac{d\pi_{steer}}{d\alpha} = \frac{\partial \pi_{steer}}{\partial U} \frac{dU}{d\alpha} + \frac{\partial \pi_{steer}}{\partial \alpha} \frac{d\alpha}{dU} = -\psi(1 - F\left(\frac{U + p_{steer} + t}{\psi}\right)) \frac{dU}{d\alpha} + \frac{\partial \pi_{steer}}{\partial \alpha}
\]

and

\[
\frac{d\pi_j}{d\alpha} = \frac{\partial \pi_j}{\partial U} \frac{dU}{d\alpha} = -\psi(1 - F\left(\frac{U + p_{steer} + t}{\psi}\right)) \frac{dU}{d\alpha}
\]

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 $t$.

\section*{B.3 Platform Commission and Profit}

The probability that a consumer purchases through the platform is

\[
\frac{(1 - \beta)(1 - \alpha)(1 - F(U + p))}{(1 - \beta)(1 - \alpha)(1 - F(U + p)) + (\beta(1 - \alpha) + \alpha)\left(1 - F\left(\frac{U + p_{steer} + t}{\psi}\right)\right)}
\]
Π = \begin{cases} 
\frac{(1-\beta)(1-\alpha)(1-F(U+p))}{(1-\beta)(1-\alpha)(1-F(U+p)) + (\beta(1-\alpha) + \alpha \frac{1-F(U+p)}{U+p_{steer}+t})} \xi p & \xi \leq \xi^* \\
0 & \xi > \xi^* 
\end{cases}

\text{(1 - \beta)(1-\alpha)(1-F(U+p)) + (\beta(1-\alpha) + \alpha \frac{1-F(U+p)}{U+p_{steer}+t})}

Let

\gamma \equiv \frac{(1-\beta)(1-\alpha)(1-F(U+p))}{(1-\beta)(1-\alpha)(1-F(U+p)) + (\beta(1-\alpha) + \alpha \frac{1-F(U+p)}{U+p_{steer}+t})}

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

\xi^* = 1 - \psi \frac{(1-F(U+p))^2}{f(U+p_j)} \text{ (31)}

and in equilibrium

\Pi = \gamma \xi^* p \text{ (32)}

**Proposition B.3.** There is a profit maximizing level of \( \alpha \) denoted \( \alpha^* \) which is decreasing in \( t \)

Proposition B.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 B.1 implies \( \psi \left( 1 - \frac{U+p_{steer}+t}{t} \right) = (1-\xi^*)(1-F(U+p)) \) so we can find,

\gamma = \frac{(1-\beta)(1-\alpha)}{(1-\beta)(1-\alpha) + (\beta(1-\alpha) + \alpha \frac{1-\xi^*}{\psi})}

\gamma = \frac{(1-\beta)(1-\alpha)}{(1-\beta)(1-\alpha) + (\beta(1-\alpha) + \alpha)^2 \frac{1-\xi^*}{\beta(1-\alpha)}}

\gamma = \frac{(1-\beta)(1-\alpha)^2}{(1-\beta)(1-\alpha)^2 + (\beta(1-\alpha) + \alpha)^2 \frac{1-\xi^*}{\beta}}

Which gives

\gamma = \frac{(1-\beta)(1-\alpha)^2}{(1-\beta)(1-\alpha)^2 + (\beta(1-\alpha) + \alpha)^2 \frac{1-\xi^*}{\beta}} \text{ (33)}

Which goes to 0 as \( \alpha \to 1 \) so long as \( \xi \) does not approach 1 too quickly (which from 31 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).

\( \beta \) 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

\[ 0 = \frac{d\gamma}{d\alpha} \xi^* p + \gamma \left( \frac{d\xi^*}{d\alpha} p + \xi^* \frac{dp}{d\alpha} \right) \text{ (34)} \]
The following identities will thus be useful:

From 15 (recall that the pricing problem for sellers allowing on-platform transactions is qualitatively unchanged from the hetero benchmark)

\[ \frac{dp}{d\alpha} = \frac{(1 - F(U + p))f'(U + p) + f(U + p)^2}{(1 - F(U + p))f'(U + p) + 2f(U + p)^2} \frac{dU}{d\alpha} \]  

(35)

Which we can then use to find

\[ \frac{dU}{d\alpha} + \frac{dp}{d\alpha} = \frac{f(U + p)^2}{(1 - F(U + p))f'(U + p) + 2f(U + p)^2} \frac{dU}{d\alpha} \]  

(36)

Next, from 29 we can restate \( \xi^* \)

\[ \xi^* = 1 - \frac{\pi^{steer}}{f(U + p^j)} \]  

(37)

\( \xi^* \) is the only place \( p^{steer} \) appears in \( \Pi \), so 33, 37, and the envelope theorem together imply that the platform will treat \( p^{steer} \) as a constant when setting \( \alpha \).

We can state the platform’s maximization problem using a Lagrangian multiplier \( \lambda \)

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

Taking the FOC with regard to \( \xi \):

\[ \frac{(1 - \beta)^2(1 - \alpha)^2(\beta(1 - \alpha) + \alpha)}{(1 - \beta)(1 - \alpha)^2 + (\beta(1 - \alpha) + \alpha)^2} \xi p + \gamma p + \lambda = 0 \]

\[ p \left( \frac{(1 - \beta)^2(1 - \alpha)^2(\beta(1 - \alpha) + \alpha)}{(1 - \beta)(1 - \alpha)^2 + (\beta(1 - \alpha) + \alpha)^2} \xi + \gamma \right) = -\lambda \]  

(38)

Where the first term in the derivative on the first line comes from 33. Now taking the FOC with regard to \( \alpha \)

\footnote{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.}
\[ 0 = \frac{-2(1 - \beta)(1 - \alpha) - \left[ -2(1 - \beta)(1 - \alpha) + 2(\beta(1 - \alpha) + \alpha)(1 - \beta)\frac{1 - \xi}{2} \right]}{\left[ (1 - \beta)(1 - \alpha)^2 + (\beta(1 - \alpha) + \alpha)^2 \frac{1 - \xi}{2} \right]^2} \xi p \]

\[
-\gamma \xi \frac{f(U + p)^2 + (1 - F(U + p))f'(U + p)}{2f(U + p)^2 + (1 - F(U + p))f'(U + p)} dU + \alpha \left( \frac{\partial \psi}{\partial \alpha} \right) \left[ \frac{1 - F(U + p)}{f(U + p)} \right] \\
+ \frac{U + p + \alpha + t}{\psi} \left( \frac{2(1 - F(U + p))f(U + p) + (1 - F(U + p))f'(U + p)}{f(U + p) + (1 - F(U + p))f'(U + p)} \right) d\alpha \]

Pulling out common terms and substituting in 38

\[
\left[ \gamma + \frac{(1 - \beta)(1 - \alpha)^2 \frac{\beta(1 - \alpha) + \alpha^2}{(1 - \beta)(1 - \alpha)^2} \frac{1 - \xi}{2}}{\frac{1 - F(U + p)}{f(U + p)}} \right] \\
\times \left[ \left( \frac{\beta}{\beta(1 - \alpha) + \alpha} \right) \left[ (1 - F(U + p) + t) \frac{U + p + \alpha + t}{\psi} \right] \right]
\]

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. \( \square \)