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Consumer Multi-Homing and Price Parity Clauses

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Abstract

Price parity clauses (PPCs) allow intermediaries to restrict their sellers' pricing strategies off-platform. In addition, if sellers are available across platforms and consumers multi-home to find the best prices, then PPCs necessarily eliminate multi-homing. To investigate the interplay between consumer multi-homing and PPCs, we develop a double Hoteling model where sellers within an intermediary compete for that intermediary's consumers via Hoteling and intermediaries compete for consumers via Hoteling. By considering asymmetric intermediary competition, which is commonly observed looking at market shares, we find that PPCs effectively result in surplus transfers from the smaller platform to the larger platform. Naturally, this benefits the large platform. However, we also show that this can benefit the larger platform's consumers so that some consumers are better off. To enrich the seller side of the model, we consider an extension where intermediaries use recommendations and find that, combined with price parity clauses, they enlarge the parameter space in which a seller becomes exclusive to one platform.

Keywords: Intermediary, PPC, Platform

JEL Classification: D40, L10, L20, L40

1 Introduction

This paper analyzes how price parity clauses (PPCs), which require sellers to maintain the same price across platforms, affect competition in markets with differentiated platforms and multi-homing consumers and sellers. Unlike much of the literature on multi-homing, we assume that consumers have unit demand and therefore only purchase from one platform even if they multi-home. Consumers make homing decisions based on expected prices and then the prices they observe, relative to their expectations, from the first platform they visit. In the laissez-faire case without PPCs, the dominant platform charges higher fees but still retains a larger consumer base due to its intrinsic advantage. Prices differ across platforms, encouraging some consumers to multi-home and then purchase from the lower-priced option. This equilibrium results in more competition and consumer surplus from the less dominant platform (relative to the PPC equilibrium).

When PPCs are introduced, sellers must set uniform prices across platforms, which prevents consumers from benefitting by shopping across intermediaries (eliminating multi-homing). We show that this results in higher prices and higher total platform fee revenues. While PPCs can improve outcomes for consumers on the dominant platform (by shifting fee burden to users of the smaller platform), overall consumer surplus declines compared to the laissez-faire case, especially for users of the less dominant platform. Thus, PPCs shift surplus away from consumers and toward platforms, weakening inter-platform competition.

Extensions show that PPCs can hinder platform entry by eliminating the incentive to multi-home, which reduces consumer responsiveness to potential entrants. Additionally, if platforms use recommendation systems that favor specific sellers, PPCs can induce those sellers to exit the platform that favors them less, resulting in de facto exclusivity. This raises concerns about long-run platform competition, as PPCs, especially when combined with recommender systems, may reinforce market power and lead to greater market segmentation.

There exists diverse coverage of PPCs in the literature with both empirical, due policies restricting PPCs, and theoretical contributions. Edelman and Wright (2015) show that intermediaries want to restrict prices off the intermediary in order to increase demand for the intermediary. This leads to inflated prices and harms welfare. To limit intermediary price restrictions, some jurisdictions have placed restrictions on PPCs. For example, Mantovani et al. (2021) reveal that the removal of booking.com's wide PPC, a PPC that targets both other intermediaries and direct sales channels, in France reduced hotel prices. However, there has been some debate about whether wide and narrow PPCs should be allowed, where narrow PPCs only apply to other platforms (not direct sales channels).[1]

Legal scholars largely argue that wide PPC is more harmful to consumers than narrow PPC (Ezrachi (2015)). Navarra (2023) considers wide PPCs when sellers have the option between platforms and direct sales. They find that wide PPCs will always be implemented by both platforms; however, platforms are symmetric and recommendation systems are not considered in their model. In this paper, we focus on narrow PPCs when sellers offer their product across multiple platforms, instead of focusing on the case where the direct to consumer channel exists.[2]

Calzada et al. (2022) show how PPCs can results in market segmentation as some sellers leave some platforms to avoid the PPC restrictions. At the same time, it is well established that recommendation systems impact consumer purchasing decisions (Häubl and Trifts (2000)), but little is known about how recommendation systems may distort the effects from PPCs.[3] Thus, we extend our base model to allow platforms to make product recommendations and find that recommendation systems can exacerbate this effect resulting in greater exclusivity; this pushes the concerns about PPCs resulting in market segmentation by Calzada et al. (2022) even further.

[1]Tangentially related to our work, Gomes and Mantovani (2025) consider platform fee caps as an alternative policy to limiting PPCs. They find that certain caps prevent efficiency losses that stem from restricting PPCs. This is a novel result; however, while some governments have discussed excessive fee regulation, we have yet to see platform fee caps in practice (unlike restrictions of PPCs which are not uncommon).

[2]Hunold et al. (2020) show that online travel agencies can still harm hotels that set lower prices on their own websites by lowering their rank in search results, which aligns with a model of platform search design by Heresi (2023).

[3]One exception is Peitz and Sobolev (2024); however, their recommendation system improves match quality between buyers and sellers where recommendations in our setting simply bias sales toward the recommended seller.

2 Model

Suppose there are two intermediaries (A and B) that facilitate transactions between buyers and sellers. For simplicity, we assume a single product is offered by each of the two sellers (denoted by Firms 1 and 2). Both sellers are on both platforms and consumers only purchase a single good: either good 1 from intermediary A or B, or good 2 from intermediary A or B. Thus, unlike the majority of models on consumer multi-homing, a multi-homing consumer in our setting observes both products across intermediaries but only makes a purchase on a single platform (opposed to both as is common in the multi-homing literature).

To allow for differentiation at both the intermediary and product levels, we use a double Hotelling model with Hotelling differentiation between products and Hotelling differentiation between intermediaries. Suppose there exists a unit mass of consumers whose tastes for products and intermediaries is given by x and y which are drawn from $U[0,1]$ and are i.i.d., where x denotes the consumer's taste for products with product 1 located at 0 and product 2 located at 1 and y denotes the consumer's taste for intermediaries with intermediary A located at 0 and intermediary B located at 1. Thus, differentiation between sellers occupies the x-axis while differentiation between intermediaries occupies the y-axis.

Consumers first consider which intermediary to use when investigating a product. This decision is based on their inherent preferences across intermediaries and their expected consumer surplus based on some knowledge about product prices. More specifically, suppose that consumer utilities from intermediaries A and B are given by

$$\begin{aligned} U_A(y) &= E(CS|P) - t_A y, \\ U_B(y) &= E(CS|P) - t_B(1-y), \end{aligned}$$

where CS is the consumer surplus generated from the product, P is the expected price of the product (given by the average across the four prices) — we assume that sellers do not account for how their prices impact the expected price when price setting and that this acts as a reference point for consumers who may then think an intermediaries prices are too high, and t_i for $i = A, B$ denotes the transportation cost that captures intermediary differentiation.

Consumers first go to the intermediary that they prefer, then, upon observing prices on that intermediary, they may decided to multi-home and shop on the other intermediary. This implies that multi-homing only occurs when intermediaries are asymmetric (something that is almost always true in practice). Thus, we assume that $t_A \neq t_B$, or $t_A \leq t_B$ without loss of generality, so that A has an advantage over B. Furthermore, we assume that $t_A = \theta T \leq T = t_B$ with $\theta \in (0, 1]$ capturing the degree in which intermediary A has an advantage over B.

A result of this distinction in intermediaries is that more consumers will start with intermediary A over intermediary B; however, multi-homing will occur unless intermediary A also has product prices weakly less than intermediary B. More formally, we have that once a consumer selects an intermediary based on the expected price, they observe the product prices on that intermediary. Based on P and the prices they observe, they infer whether or not their current intermediary selection has prices that are too high and decide whether to multi-home. Thus, consumers' first intermediary selection, denoted by $\tilde{y}$, is given by

$$E(CS|P) - \theta T\tilde{y} = E(CS|P) - T(1 - \tilde{y}) \text{ or } \tilde{y} = \frac{1}{1+\theta}, \tag{1}$$

and consumers' second intermediary selection, denoted by y^c, is given by

$$E(CS_A|p_{A1}, p_{A2}) - \theta T y^c = E(CS_B|p_{B1}, p_{B2}) - T(1 - y^c), \tag{2}$$

where p_{ij} denotes the price for product j on intermediary i.

Turning to the market within the intermediaries, we assume symmetric Hotelling competition between the two sellers on each platform. Thus, consumer utility for products 1 and

2 on intermediary i is given by

$$\begin{aligned} u_{i1}(x) &= v - tx - p_{i1}, \\ u_{i2}(x) &= v - t(1-x) - p_{i2}. \end{aligned}$$

This produces the standard Hotelling demands:

$$\begin{aligned} D_{i1} := D_i \cdot x_i^c &= D_i \cdot \left[\frac{1}{2} + \frac{p_{i2} - p_{i1}}{2t}\right] \\ D_{i2} := D_i \cdot (1 - x_i^c) &= D_i \cdot \left[\frac{1}{2} + \frac{p_{i1} - p_{i2}}{2t}\right] \end{aligned}$$

where D_i denotes the demand for intermediary i, given by the mass of consumers that make purchases on intermediary i ($D_A = y^c$ and $D_B = 1 - y^c$ under full support in y) and taken as given by the sellers, and x_i^c captures the critical consumer that is indifferent between products 1 and 2 on intermediary i.

We assume that a transaction fee, f_i, is paid to the seller for each sale through intermediary i.[4] This implies that seller j has the following profit function

$$\pi_j = \sum_{i=A,B} [p_{ij} - f_i] \cdot D_{ij}(p_{ij}),$$

Similarly, intermediary profit is given by

$$\Pi_i = f_i D_i(f_i).$$

The timing of the game is as follows. Information is perfect for intermediaries and sellers so intermediaries first set their transaction fees, then sellers set their prices. Second, consumers are unaware about the difference between t_A and t_B, they only observe their individual preferences in the form of $t_i y$ and $t_i(1-y)$, and so they first consider which inter-

[4]We assume a fixed fee, opposed to an ad valorem fee, to ensure that we can solve our model. See Wang and Wright (2017) and Wang and Wright (2018) for more on this issue.

mediary to use, based on the price they expect across intermediaries and without knowledge of their x draw. Second, upon observing prices on the intermediary they selected, and comparing them to their expected prices, consumers consider multi-homing with knowledge of their y draw. Lastly, consumers observe their x draw and make purchasing decisions.

3 Equilibrium

Solve the game backwards for each of the two regimes (Laissez Faire and Price Parity Clauses).

3.1 The Laissez Faire Equilibrium

Without restrictions on seller prices, we start with the sellers' pricing decisions for each platform taking the platforms' fees and consumer bases as given. In this case, we have that symmetric competition between sellers on intermediary i follows the standard Hotelling solution:

$$\begin{aligned} p_i &= t + f_i, \\ x_i^* &= \frac{1}{2}, \\ E(CS_i) &= v - \frac{5}{4}t - f_i. \end{aligned}$$

We focus on the parameters that ensure full support in x under the laissez faire equilibrium. Note that under such parameters, full support need not occur under price parity clauses which we show in the next subsection.

Turning to the intermediaries problem, we have asymmetric Hotelling competition (recall that $t_A = \theta T \leq T = t_B$ giving intermediary A an advantage over B) so that demands are given by the expected consumers surplus above and Equation 2:

$$y^c = \frac{1}{(1+\theta)} + \frac{f_B - f_A}{(1+\theta)T}.$$

Maximizing intermediary profits and solving the system of equation for transaction fees yields the following equilibrium:

$$\begin{aligned} f_A^* = \frac{(2+\theta)}{3}T &> \frac{(1+2\theta)}{3}T = f_B^*, \\ D_A^* = y^* = \frac{(2+\theta)}{3(1+\theta)} &> \frac{(1+2\theta)}{3(1+\theta)} = 1 - y^* = D_B^*, \\ p_A^* = t + f_A^* &> t + f_B^* = p_B^*, \\ E(CS_A) = v - \frac{5}{4}t - \frac{(2+\theta)}{3}T &\leq v - \frac{5}{4}t - \frac{(1+2\theta)}{3}T = E(CS_B). \end{aligned}$$

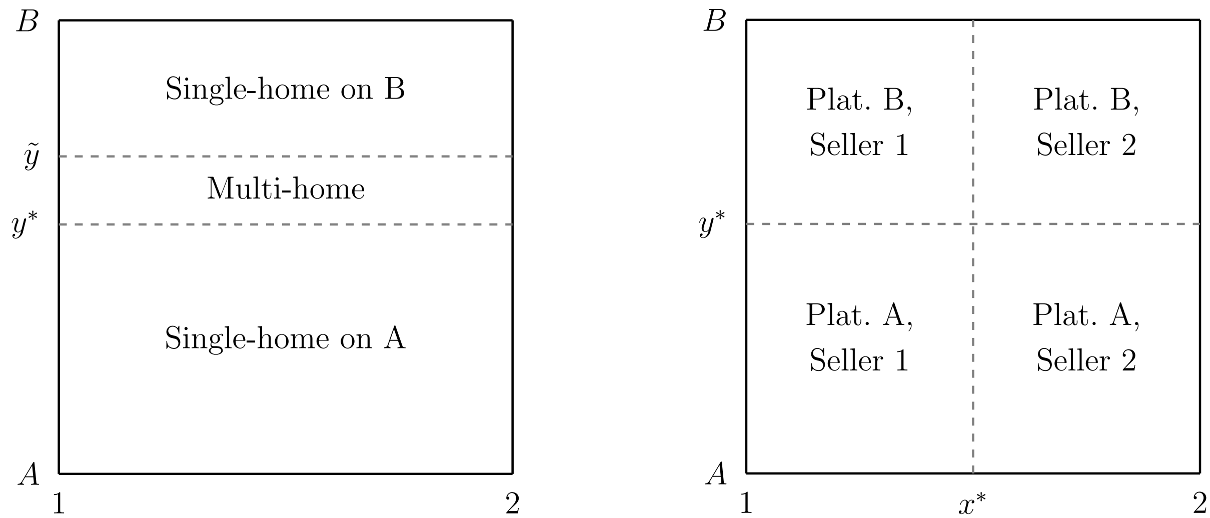
We see that intermediary A uses its intrinsic advantage over B to charge a higher transaction fee while maintaining a larger market share. This is commonly seen in these markets (e.g., Amazon v.s. eBay and Airbnb v.s. VRBO). However, higher prices on intermediary A implies that some consumers will multi-home and purchase on intermediary B upon first observing product prices on A. Indeed, we find that the equilibrium amount of multi-homing consumers is given by $\tilde{y} - y^* = \frac{(1-\theta)}{3(1+\theta)} > 0$. To see this explicitly, we present agent homing and purchasing decisions in Figure 1 where we see that all multi-homing consumers purchase from the cheaper platform (Platform B).

Lastly, note that we have full support in x and y whenever $u_{A1}(x_A^*) \geq 0$ and $U_A^*(y^*) \geq 0$. These simplify to:

$$v - \frac{5}{4}t \geq \frac{(1+2\theta)(2+\theta)}{3(1+\theta)}T = \frac{2+5\theta+2\theta^2}{3(1+\theta)}T, \tag{3}$$

$$v - \frac{3}{2}t \geq \frac{2+\theta}{3}T. \tag{4}$$

Figure 1: Homing and Purchasing Decisions in the Laissez Faire Equilibrium



3.2 The Price Parity Clause Equilibrium

Under a price parity clause (PPC), the sellers' pricing problem must be solved jointly across intermediaries as each seller now uses a single price. As a starting point, and it can be shown to be the case under parameters that satisfy Equations (3) and (4), we consider the case that mirrors the Laissez Faire Equilibrium where we have full support in x and y.

In this case, PPC eliminates price differences between platforms, which reduces platform competition since sellers pass platform fees onto consumers in the form of higher prices. This incentivizes platforms to increase their fees as consumers on both platforms now bear some of the platform fee for each platform. To see this explicitly, note that Firm j has the following profit function under PPC:

$$\pi_j = \sum_{i=A,B} [p_j - f_i] \cdot D_{ij}(p_j),$$

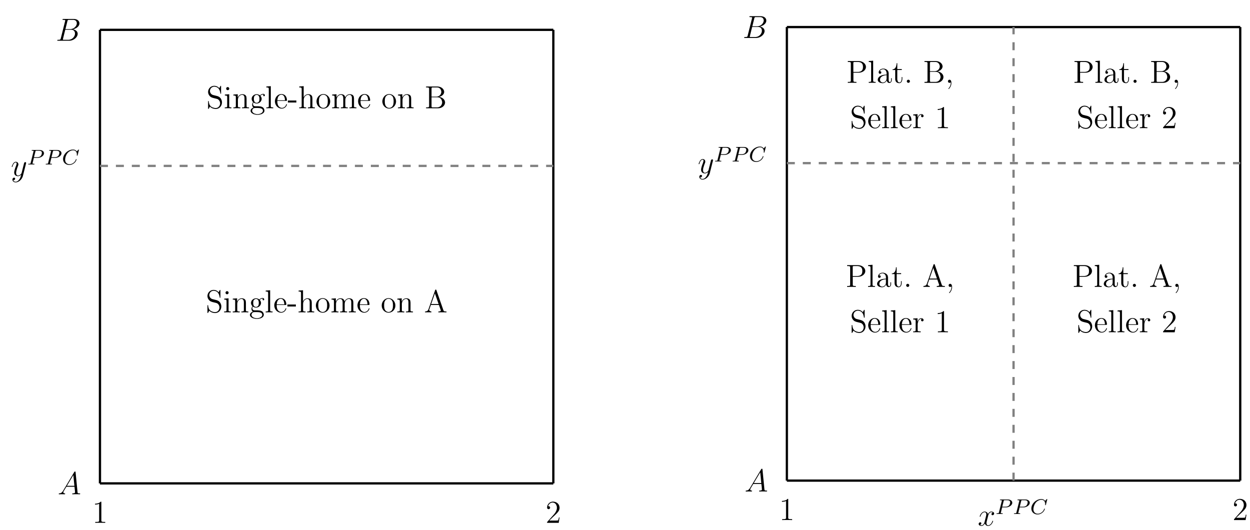
where $D_{ij} = D_i \cdot \left(\frac{1}{2} + \frac{p_{-j} - p_j}{2t}\right)$ under full support in x. With symmetric competition between sellers on intermediary i, we have the following subgame under full support in x:

$$
\begin{aligned}
p &= t + \frac{D_A f_A + D_B f_B}{D_A + D_B}, \\
x^{PPC} &= \frac{1}{2}, \\
E(CS) &= v - \frac{5}{4}t - \frac{D_A f_A + D_B f_B}{D_A + D_B}.
\end{aligned}
$$

Note that the price of the product is the same across sellers and intermediaries. In addition, instead of passing the platform specific fee onto consumers, as in the Laissez Faire Equilibrium, the sellers charge a weighted average of the platform fees to buyers on both platforms.

Turning to the intermediary subgame, the solution to the seller subgame produces $E(CS_A) = E(CS_B)$ so that no multi-homing occurs under PPC. That is, consumers have no incentive shop across platforms as product prices are the same. As a result, equilibrium single-homing is given by $D_A^{PPC} = y_{FS}^{PPC} = \tilde{y} = \frac{1}{1+\theta} > y^*$ and $D_B^{PPC} = 1 - y_{FS}^{PPC} = 1 - \tilde{y} = \frac{\theta}{1+\theta} < 1 - y^*$. Thus, more consumers shop at Platform A, the dominant platform and homing and purchasing decisions are given by Figure 2.

Figure 2: Homing and Purchasing Decisions in the PPC Full Support Equilibrium



The solution to the seller subgame complicates the intermediary subgame since $E(CS_A) =$

$E(CS_B)$, which implies that intermediary fee choices do not impact consumer demands so long as $U_A, U_B > 0$. Thus, under full support, we have that intermediary fees that are restricted by:

$$U_A(y^{PPC}) = U_B(1 - y^{PPC}) = v - \frac{5}{4}t - \frac{1}{1+\theta}f_A - \frac{\theta}{1+\theta}f_B - \frac{\theta T}{1+\theta} \geq 0,$$

This produces a continuum of potential equilibrium fee values:

$$\frac{f_A^{PPC} + \theta f_B^{PPC}}{1+\theta} = v - \frac{5}{4}t - \frac{\theta}{1+\theta}T.$$

While we are unable to pin down exact fees, we are still able to largely consider welfare since the fee equilibrium implies that

$$\begin{aligned} p^{PPC} &= t + v - \frac{5}{4}t - \frac{\theta}{1+\theta}T, \\ E(CS^{PPC}) &= \frac{\theta}{1+\theta}T. \end{aligned}$$

If we compare these two the Laissez Faire Equilibrium, we find the following result:

Proposition 1. *There exist parameters,* $\frac{2+6\theta+\theta^2}{3(1+\theta)}T \geq v - \frac{5}{4}t \geq \frac{2+5\theta+2\theta^2}{3(1+\theta)}T$, *so that* $E(CS^{PPC}) \geq E(CS_A)$ *and* $p^{PPC} \leq p_A^*$. *Otherwise,* $E(CS^{PPC}) < E(CS_A)$ *and* $p^{PPC} > p_A^*$

However, for all parameters (Equation (3) *holds), we have that* $E(CS^{PPC}) < E(CS_B)$ *and* $p^{PPC} > p_B^*$.

In the first part of Proposition 1, the second inequality holds by assumption, from Equation (3), and $\theta \leq 1$ ensures that $2 + 6\theta + \theta^2 > 2 + 5\theta + 2\theta^2$ so that parameters exist where the PPC equilibrium benefits consumers that shop on Platform A as they now face lower prices under PPC than under the Laissez Faire Equilibrium.

How is this possible? Well, in some cases the sharing of the platform fee burden across platforms results in the Platform A consumers effectively paying lower prices as enough of the Platform A fee is passed on to Platform B consumers. Thus, under these parameters, PPC effectively shifts surplus from Platform B consumers to Platform A consumers enough so that Platform A consumers are better-off under PPC. This highlights how PPC can benefit a dominant platform and it's loyal consumers at the expensive of a smaller platform and it's loyal consumers.

Lastly, consider how PPC impacts platform profits. While we cannot distinguish between platform across platforms as there exist many fee equilibrium. We can compare fee revenues with the Laissez Faire Equilibrium. More specifically, note that total fee revenues in each equilibrium are given by

$$\begin{aligned} TR^* = f_A^* y^* + f_B^*(1-y^*) &= \frac{5+8\theta+5\theta^2}{9(1+\theta)}T, \\ TR_{FS}^{PPC} = \frac{f_{A,FS}^{PPC} + \theta f_{B,FS}^{PPC}}{1+\theta} &= v - \frac{5}{4}t - \frac{\theta}{1+\theta}T. \end{aligned}$$

Comparing the two generates the following result:

Proposition 2. *For all parameters (Equation* (3) *holds), we have that total intermediary fee revenues increase under PPC:* $TR_{FS}^{PPC} > TR^*$.

This highlights how platforms clearly have an incentive to use PPCs.

4 Extensions

In this section we consider several extensions that are important to consider when investigating the welfare effects of price parity clauses.

4.1 Price Parity Clauses and Multi-homing

Comparing Figures 1 and 2 we see that PPCs eliminate multi-homing and direct transactions away from the smaller platform and onto the larger platform. Thinking beyond our simple model, these results suggest that there is a concern that PPC could effectively foreclose platform entry against establish incumbents. More specifically, if PPCs eliminate multi-homing so that consumers to not shop around when making purchases, then an attempted platform entry will likely be thwarted so that the failure-to-launch equilibrium occurs for the entrant.

4.2 Price Parity Clauses and Recommender Systems

Many platforms use recommender systems which create asymmetric competition between their sellers. Thus, it is worthwhile to consider how including recommender systems in our model may impact our results on PPCs. Thus, we extend our base model to consider a simple setting of recommendation within the Hotelling competition that exists between sellers. To do so, suppose that consumer utility for products 1 and 2 on intermediary i is given by

$$\begin{aligned} u_{i1}(x) &= v + r_i - tx - p_{i1}, \\ u_{i2}(x) &= v - r_i - t(1-x) - p_{i2}, \end{aligned}$$

where the additional r_is capture the benefits (costs) of the platform's recommendation towards a seller (a seller's rival).

If we assume the same timing, with recommendations being chosen with platform fees, then the seller subgame equilibrium is given by

$$\begin{aligned} p_{i1} &= t + f_i + \frac{2}{3}r, \\ p_{i2} &= t + f_i - \frac{2}{3}r, \\ x_i &= \frac{1}{2} + \frac{r_i}{3t}, \\ E(CS_i) &= v - \frac{5}{4}t - f_i + \frac{1}{9t}r_i^2. \end{aligned}$$

Comparing with the base model, we see that recommendation systems increase expected consumer surplus by $\frac{1}{9t}r_i^2$. Thus, recommendation systems give platforms another dimension in which they can compete. We see this explicitly for intermediaries problem where differences in expected surplus and consumer intermediary preferences imply that

$$y^c = \frac{1}{(1+\theta)} + \frac{f_B - f_A}{(1+\theta)T} + \frac{r_A^2 - r_B^2}{9t(1+\theta)T}.$$

If recommendation systems are costless, then platforms will fully prioritize one seller over the other so that markets are effectively served by a single seller (a corner solution). Instead, with costly recommendations, in interior solution exists so that both sellers are present but one is favored. Thus, compared to the base model, recommendation systems add greater differences in seller asymmetry on each platform. Naturally, this impacts the effect of PPCs on market outcomes. In particular, if platforms favor different sellers (e.g., Platform A favors Seller 1 and Platform B favors Seller 2), then the introduction of a PPC by the larger platform, Platform A, makes it difficult for Seller 1 since their prices are very different across platforms without the PPC. In this case, Seller 1 may simply leave Platform B to avoid the price effects from the PPC. Thus, PPCs can make it more likely that sellers are exclusive to one platform when recommendation systems exist, effectively turning them into exclusive deals, which is concerning for long-run platform competition. In other words, PPCs combined with recommendations systems can effectively generate exclusive deals between platforms and sellers which is something that the literature has found harmful to consumers (Shekhar (2021) and Carroni et al. (2024)).

5 Conclusion

Over the last decade, we have seen a variety of changes in terms of PPCs. From regulation that restricts or eliminates their use on OTAs in Europe, to Amazon succumbing to external pressure to eliminate their use of PPCs entirely. Given the wide range in outcomes, it is important to understand how PPCs interplay with other features commonly seen in intermediary competition. In this paper, we contribute to the literature by revealing how PPCs eliminate consumer benefits from multi-homing and can result in greater seller exclusivity when recommender systems exists. However, we also show that PPCs can increase consumer surplus for those loyal to the larger intermediary by transferring surplus to them from the other platform.

References

Calzada, J., Manna, E., and Mantovani, A. (2022). Platform price parity clauses and market segmentation. *Journal of Economics & Management Strategy*, 31(3):609–637.

Carroni, E., Madio, L., and Shekhar, S. (2024). Superstar exclusivity in two-sided markets. *Management Science*, 70(2):991–1011.

Edelman, B. and Wright, J. (2015). Price coherence and excessive intermediation. *The Quarterly Journal of Economics*, 130(3):1283–1328.

Ezrachi, A. (2015). The competitive effects of parity clauses on online commerce. *European Competition Journal*, 11(2-3):488–519.

Gomes, R. and Mantovani, A. (2025). Regulating platform fees under price parity. *Journal of the European Economic Association*, 23(1):190–235.

Häubl, G. and Trifts, V. (2000). Consumer decision making in online shopping environments: The effects of interactive decision aids. *Marketing Science*, 19(1):4–21.

Heresi, J. I. (2023). Platform price parity clauses and consumer obfuscation. *The Journal of Industrial Economics*, 71(1):291–322.

Hunold, M., Kesler, R., and Laitenberger, U. (2020). Rankings of online travel agents, channel pricing, and consumer protection. *Marketing Science*, 39(1):92–116.

Mantovani, A., Piga, C. A., and Reggiani, C. (2021). Online platform price parity clauses: Evidence from the eu booking. com case. *European Economic Review*, 131:103625.

Navarra, F. (2023). Platform pricing strategies when consumers web/showroom. *Working Paper*.

Peitz, M. and Sobolev, A. (2024). Product recommendations and price parity clauses. *Working Paper*.

Shekhar, S. (2021). Platform pricing choice: Exclusive deals or uniform prices. *Review of Network Economics*, 20(3):159–186.

Wang, Z. and Wright, J. (2017). Ad valorem platform fees, indirect taxes, and efficient price discrimination. *RAND Journal of Economics*, 48(2):467–484.

Wang, Z. and Wright, J. (2018). Should platforms be allowed to charge ad valorem fees? *Journal of Industrial Economics*, 66(3):739–760.

A Appendix of Proofs

Proof of Proposition 1: From Equation (3), we require that $v - \frac{5}{4}t \geq \frac{2+5\theta+2\theta^2}{3(1+\theta)}T$. In addition, $E(CS^{PPC}) \geq E(CS_A)$ if and only if $\frac{\theta}{1+\theta}T > v - \frac{5}{4}t - \frac{2+\theta}{3}T$ and $p^{PPC} \leq p_A^*$ if and only if $t + v - \frac{5}{4}t - \frac{\theta}{1+\theta}T \leq t + \frac{2+\theta}{3}T$. Both of these reduce to if and only if $\frac{2+6\theta+\theta^2}{3(1+\theta)}T \geq v - \frac{5}{4}t$. Finally, note that $\frac{2+6\theta+\theta^2}{3(1+\theta)}T \geq \frac{2+5\theta+2\theta^2}{3(1+\theta)}T$ since $\theta \in [0,1]$ so that the set is non-empty.

Making the same comparisons for intermediary B reveals that for all parameters (Equation (3) holds), $E(CS^{PPC}) < E(CS_B)$ and $p^{PPC} > p_B^*$ hold. □

Proof of Proposition 2: Comparing total fee revenues across regimes we have that $TR_{FS}^{PPC} > TR^*$ if and only if $v - \frac{5}{4}t - \frac{\theta}{1+\theta}T > \frac{5+8\theta+5\theta^2}{9(1+\theta)}$. This holds if and only if $v - \frac{5}{4}t > \frac{5+8\theta+14\theta^2}{9(1+\theta)}$. From Equation (3), we require that $v - \frac{5}{4}t \geq \frac{2+5\theta+2\theta^2}{3(1+\theta)}T > \frac{5+8\theta+14\theta^2}{9(1+\theta)}$ so that this always holds. □