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Chengsi Wang
University of Mannheim

Julian Wright
National University of Singapore

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Platform investment and price parity clauses*

Chengsi Wang[†] and Julian Wright[‡]

Abstract

Platforms use price parity clauses to prevent sellers charging lower prices when selling through other channels. Platforms justify these restraints by noting they are needed to prevent free-riding, which would undermine their incentives to invest in their platform. In this paper, we study the effect of price parity clauses on three different types of platform investment, and evaluate these restraints taking into account these investment effects. We find, that wide price parity clauses lead to excessive platform investment while without such price parity clauses there is insufficient platform investment. Even taking these investment effects into account, wide price parity clauses always lower consumer surplus and often lowers total welfare.

JEL classification: D40, L11, L14, L42

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1 Introduction

Price parity clauses (or third-party MFNs as they are sometimes also known) have attracted considerable recent attention from policymakers and scholars. These clauses, imposed by platforms like Amazon or Expedia, put restrictions on the prices that a firm can offer on the platform relative to the prices the same firm offers when selling the same item through other channels. Essentially, they require that a firm offers its best price through the given platform.

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[†]Department of Economics, University of Mannheim, Germany, E-mail: chewang@mail.uni-mannheim.de

[‡]Department of Economics, National University of Singapore, Singapore, E-mail: jwright@nus.edu.sg

These restrictions can be thought of as vertical restraints imposed by platforms on participating sellers. Existing literature, which we have contributed to, has explored how such price parity clauses can result in higher prices and can be anticompetitive. See, in particular, Boik and Corts (2014), Johnson (2014), Edelman and Wright (2015), and Wang and Wright (2016). There have been several recent competition investigations and law changes in Europe on the use of price parity clauses by platforms (see Hviid, 2015 and Wang and Wright, 2016 for further details).

Platforms defend their price parity clauses by noting that they are necessary to prevent a free-riding problem, which is that consumers search on the platform for suppliers since it provides the lowest search costs, but then having found a good match, switch to buy through some other channel at a lower price if this is allowed. Using a search framework, we looked at this possibility (which we called “showrooming”) in an earlier paper (Wang and Wright, 2016). In that paper, a platform only makes a binary decision, whether to operate or not. However, arguably, the viability of certain platforms like Amazon and Expedia is not really in question, even in the absence of any price parity clauses. Nevertheless, these platforms’ level of investment may indeed be impacted by the possibility of showrooming, and the use of price parity clauses to overcome showrooming. We therefore explore how platforms’ investment incentives are affected by price parity clauses, and whether taking into account these effects changes the economic analysis of these restrictions.

To address these questions, in this paper we adapt our previous model of search platforms (Wang and Wright, 2016) to look at the implications of free-riding and price parity clauses on three types of possible platform investment: (i) investment in the search technology, (ii) investment in advertising the platform’s services; and (iii) investment in the consumers’ benefit of using the platform for transactions, which we call convenience benefits.

In settings with competing platforms (or potential competition), we will explore the effect of two types of price parity clauses. A wide price parity clause requires that the price a firm sets on the platform be no higher than the price the same firm charges for the same good through any other channel, including when it sells directly and when it sells through a rival platform. A narrow price parity clause requires only that the price a firm sets on the platform be no higher than the price the firm sets when it sells directly. In 2015, after investigations by several European authorities into their use of price parity clauses, Booking.com and Expedia, the two largest booking platforms for hotels, made commitments to remove their wide price parity clauses in Europe but have retained their narrow price parity clauses

which prevent hotels offering lower prices when selling directly online. Thus, it is interesting to separately distinguish the effects of both types of price parity clauses on investment.

Consider first platform investment in reducing search costs. We find a monopoly platform will not invest in search cost reduction if it cannot use a price parity clause but will invest excessively in such search cost reduction when it can use a price parity clause. This is because without a price parity clause, its fees are constrained to be the convenience benefits it offers because of the showrooming problem, so it cannot recover any reduced search costs in higher fees. On the other hand, with a price parity clause in place, a platform can extract not only the additional social surplus generated by the lowered search cost but also the extra profit margin that firms lose in intensified competition on the platform. Taking into account these investment effects, a price parity clause can lead to higher or lower welfare. However, it always lowers consumer surplus. A price parity clause removes the restriction on the platform's fees implied by the direct market alternative since consumers always prefer to buy on the platform given prices are never higher. As a result, the monopoly platform fully extracts consumers' expected surplus from trade.

We find similar results for wide price parity clauses in case there is an incumbent platform that faces potential competition from an entrant, and can first decide how much to invest in search cost reduction before the entrant does likewise. Narrow price parity clauses do not solve the under-investment problem—each platform does not want to invest in search cost reduction given the other platform can free-ride on their lower search costs. Wide price parity clauses rule out consumers wanting to switch to the lower priced channel. Instead, wide price parity clauses give the lower-search-cost platform an advantage. In case of homogeneous platforms, consumers will all complete transactions on the lower-search-cost platform. For differentiated platforms, it allows the lower-search-cost platform to sustain higher fees in equilibrium. As a result, each platform will want to be the lower-search-cost platform. In the equilibrium with wide price parity clauses, the incumbent platform overinvests in search cost reduction to prevent the entrant from wanting to invest at all. In the homogeneous case we find welfare is unambiguously lower with this over-investment compared to the case without wide price parity clauses. With differentiated platforms, the welfare effects are ambiguous. However, regardless of how platform competition is modelled, we find consumers are always worse off with wide price parity clauses.

Next consider platform investment in advertising, which increases the number

of consumers that are aware of the platform’s services. We find, compared to the efficient advertising level, a platform will under-invest without a price parity clause, as showrooming restricts its ability to extract the consumer surplus created from platform search and so it ignores this component of social gain. In contrast, with a price parity clause, the platform fully extracts the surplus of consumers who use the platform. Since this includes the extra profit margin that firms lose in intensified competition on the platform, there is excessive investment in advertising with a price parity clause. It also means consumers who are not informed of the platform will no longer want to purchase, since the expected surplus on the direct channel is negative. This is an additional welfare loss arising from a wide price parity clause. We show the total welfare effects of a price parity clause are ambiguous, but that a price parity clause continues to unambiguously lower consumer surplus.

Finally, we consider platforms’ investment in the per-transaction convenience benefits consumers get from using the platform to complete transactions. We find without price parity clauses or with just a narrow price parity clause in case of competing platforms, an incumbent platform will always want to invest the efficient amount in per-transaction convenience benefits given it fully extracts the consumer surplus from higher convenience benefits in these cases. However, with wide price parity clauses, since consumers no longer compare prices on the competing platforms, a platform that can offer higher convenience benefits will attract all consumers to complete their transactions regardless of the fees it charges, provided consumers get non-negative surplus from doing so. Thus, the incumbent platform will invest in per-transaction convenience benefits to the point that the entrant cannot cover its costs if it invests even more in such benefits. This necessarily involves an excessive amount of investment. Thus, while narrow price parity clauses will not affect consumer surplus or welfare, taking into account investments in convenience benefits, we find wide price parity clauses lower consumer surplus and total welfare.

In the rest of the document, we lay out the basic model we propose to use (Section 2), which builds on the model in Wang and Wright (2016). After providing some preliminary analysis (Section 3), we use the model to analysis what happens for each of the three different types of investment (Sections 4-6). Finally, in Section 7, we briefly conclude.

2 The model

There is a continuum of consumers (or buyers) denoted B and risk-neutral firms (or sellers) denoted S , of measure 1 in each case. Each firm produces a horizontally differentiated product. We normalize the firms' production cost to zero. In the baseline setting, there is a single platform (M) which facilitates trades between the firms and consumers. In this section we present the model based on a single platform. When we extend the model to allow for platform competition we will explain how our assumptions need to be modified.

□ **Preference.** Each consumer l has a taste for firm i (i.e. to buy one unit of its product) described by the gross utility (ignoring any search cost) of the form

$$v_l^i - p^i$$

if she buys from i at price p^i . The term v_l^i is a match value between consumer l and firm i . This match value is distributed according to a common distribution function G over $[\underline{v}, \bar{v}]$ for any l and i . It is assumed that all match values v_l^i are realized independently across firms and consumers. We assume G is twice continuously differentiable with a weakly increasing hazard rate and a strictly positive density function g over $[\underline{v}, \bar{v}]$. Increasing hazard implies $1 - G(\cdot)$ is log-concave, which together with other assumptions will imply a firm's optimal pricing problem is characterized by the usual first-order condition.

□ **Consumer search.** All firms are available for consumers to search even if the platform is absent. For consumers who search directly (not via M), they incur a search cost $s_d > 0$ every time they sample a firm. By sampling firm i , a consumer l learns its price p_d^i and the match value v_l^i . We interpret the search cost as the cost of investigating each firm's offerings, so as to learn p_d^i and v_l^i (e.g. a hotel's location, facilities, feedback, room type and prices for particular dates; or an airline's flight times, connections, aircraft type, cancellation policy and baggage policy). Note this is not the cost of going from one link to another on a website, which is likely to be trivial. Consumers search sequentially with perfect recall.

The utility of a consumer l is given by

$$v_l^i - p_d^i - k s_d$$

if she buys from firm i at price p_d^i at the k th firm she visits. We assume the search cost s_d is sufficiently low that consumers would want to search directly if this were

their only choice. (This assumption will be formalized in the next section.) Up to this point the model is standard, following in particular Bar-Isaac *et al.* (2012), but assuming firms are ex-ante identical.

□ **Platform.** A platform M provides search and transaction services to consumers. If a firm i also sells over the platform, its price on the platform is denoted p_m^i . When consumers search via M instead of directly, we assume search works in the same way¹ but their search cost reduces to $0 < s_m < s_d$. Thus, we assume the platform provides a less costly search environment for consumers. Platforms speed up the sequential comparison of different firms' offerings. When consumers complete a transaction on the platform we assume they also obtain a convenience benefit of $b \geq 0$. This captures that the platform may make completing a transaction more convenient (e.g. with respect to payment and entering customer information) and may provide superior after-sale service (e.g. tracking delivery, manage bookings, etc). For instance, large platforms like Amazon, Booking.com and Expedia have created their own consumer Apps to provide such benefits. We assume M does not incur any marginal cost of handling transactions.

□ **Showrooming.** In the case of a single platform, we are interested in the case that consumers want to search through the platform for a good match and then buy directly if the direct price is low enough. With competing platforms, we are also interested in the possibility that consumers search through one platform to find a good match and then buy through another platform. In either case, we call this phenomenon showrooming. It is possible only if consumers can observe a firm's identity when they search on the platform.² To be as general as possible, we allow consumers to also switch in the other direction, in that they can search directly but having identified a good match, switch to buy on the platform. When consumers switch (in either direction), they can choose to stop and purchase from the firm (or any previous firm they have already searched) or continue to search on the channel they have switched to, or switch back again. We assume that having identified a firm and its match value, there is no cost to the consumer of such switching. In practice, any such cost is likely to be trivial in the case where the purchases are all online. Costless switching ensures consumers can switch back to buy on the platform in case they find that the price on the other channel is higher than expected.

□ **Instruments.** We allow the platform to set a non-negative per-transaction fee.

¹By sampling firm i on M , a consumer l learns its price p_m^i and the match value v_l^i .

²Otherwise, switching would involve starting the search over again.

In Wang and Wright (2016) we showed that the per-transaction fee for consumers is redundant (either because only the total per transaction fee to consumers and firms matters, so the fee to buyers can be normalized to zero, or it equals zero in the equilibria characterized). The same is true for the analysis in this paper. Thus, for notational convenience we fix the per-transaction fee to buyers to zero and drop it from the analysis. This is also consistent with the observation that the types of platforms we are interested in do not charge consumers for transactions. Instead, we just focus on a fee charged to firms when they make a transaction through M , which we denote f . All the platforms discussed in the Introduction charge firms fees when they sell through the platform. The fees are either fixed per transaction or are a percentage of the value of the transaction. In our framework, for simplicity, we assume platforms use fixed per transaction fees. In practice, platforms also do not generally charge users registration fees for joining (i.e. registration fees). This is consistent with our equilibrium analysis if registration fees result in the trivial equilibrium being selected where firms and consumers do not join the platform, since they do not expect others to join. In our model, firms pass through platform fees in equilibrium, so have no reason to coordinate on joining only for low values of per-transaction fees. However, their profit will be strictly lowered by registration fees, so do have a reason to coordinate on not joining when registration fees are charged. Competition between platforms could also be another reason registration fees are not usually used. Thus, we abstract from any registration fees.

□ **Investment.** We separately consider three types of investments that can be made by platforms. First, platforms can invest in reducing their search cost s_m . Second, platforms can invest in advertising to attract more consumers to use the platforms. Finally, platforms can invest to increase their convenience benefits b . The precise details of the investing technologies are given in the corresponding sections.

□ **Timing and equilibrium concept.** The timing of the game is as follows:

1. M chooses an investment level.
2. M sets the fee f to maximize its profits. Firms and consumers observe the fee.
3. Firms decide whether to join M and set prices.
4. Without observing firms' decisions, consumers decide whether to search on M or search directly (possibly switching search channels along the way), and carry out sequential search until they stop search or complete a purchase.

For the case of a single platform M , we focus on symmetric perfect Bayesian equilibrium where all firms make the same joining decisions and set the same prices. We adopt the usual assumption that consumers hold passive beliefs about the distribution of future prices upon observing any sequence of prices. This is natural since all firms set their prices at the same time. Note there will always be a trivial equilibrium in which consumers do not search through the platform because they expect no firms to join, and firms do not join because they do not expect any consumers to search through the platform. To avoid this trivial equilibrium, in any user subgame (i.e. the subgame starting from stage 2), we select an equilibrium in which all firms join the platform and set the same prices if such a symmetric equilibrium exists. We also rule out equilibria that only arise because firms do not sell to any consumers directly or do not sell to any consumers through a platform in the equilibrium. That is, in case direct prices (intermediated prices) are not pinned down in the user subgame because there are no consumers expected to buy in the direct market (on the platform), we determine equilibrium prices $p(n)$ when there is an exogenous positive mass n of consumers that only search and buy directly (on the platform) and let equilibrium prices p_d in the direct market (p_m on the platform) be the limit of $p(n)$ as n goes to zero.

3 Preliminary analysis

With these assumptions, in Wang and Wright (2016) we derived the consumers optimal search behavior and the firms equilibrium pricing. These provide the basic ingredients which are necessary to analysis the platform's optimal investment and fee-setting choices. For completeness, we have summarized these results here.

The consumers' gross (including search costs, but not taking into account the price paid) expected surplus of searching directly is x_d , which is implicitly given by

$$\int_{x_d}^{\bar{v}} (v - x_d) dG(v) = s_d. \quad (1)$$

We assume s_d is sufficiently small so that $\int_{\underline{v}}^{\bar{v}} (v - \underline{v}) dG(v) > s_d$. This, together with the fact the left-hand side of (1) is strictly decreasing in x_d and equals zero when $x_d = \bar{v}$ ensures a unique value of (1) exists satisfying $\underline{v} < x_d < \bar{v}$. When searching directly, each consumer employs the following optimal cutoff strategy: (i) she starts searching if and only if $x_d \geq p_d$; (ii) she stops and buys from firm i if she finds a price p_d^i such that $v_i^i - p_d^i \geq x_d - p_d$; and (iii) she continues to search the next firm

otherwise. The rule for stopping and buying from firm i says that a consumers' actual gross utility from firm i (i.e. $v_l^i - p_d^i$) must be at least equal to $x_d - p_d$, which is also the consumer's expected value of initiating a search.

With all firms available on M , the optimal stopping rule for a consumer searching on M is the same but with the consumers' (gross) expected surplus of searching via M being x_m , which is implicitly given by

$$\int_{x_m}^{\bar{v}} (v - x_m) dG(v) = s_m$$

and with the prices p_d^i and p_d replaced by p_m^i and p_m respectively, where p_m is the symmetric equilibrium price on M . However, consumers will start search if and only if $x_m \geq p_m - b$ since b an additional benefit they obtain when they make a purchase through M .

Since $s_m < s_d$ and the left-hand side of (1) is decreasing in x_d , we have $x_m > x_d$. Consumers tend to search more when using M due to the low search cost; i.e. they hold out for a higher match value. We denote this difference in the gross surplus from searching through the platform and directly as

$$\Delta_s = x_m - x_d$$

and call it the *surplus differential* of the platform. It reflects the additional surplus consumers enjoy from being able to search at a lower cost on the platform, ignoring any difference in prices.

When firms compete for consumers who search and purchase directly, the equilibrium prices in the direct market are given by

$$p_d = \lambda(x_d), \tag{2}$$

where the mark-up is just the inverse of the hazard rate, defined as $\lambda(x) = \frac{1-G(x)}{g(x)}$. We assume the search cost s_d is sufficiently low so that

$$x_d > \lambda(x_d). \tag{3}$$

This ensures that $x_d > p_d$, so consumers expect a positive surplus from searching in the first place.

When firms compete on M for consumers who search and purchase through M ,

the equilibrium prices are given by

$$p_m(f) = f + \lambda(x_m), \quad (4)$$

which takes into account firms face the per-transaction fee f . We assume

$$x_m + b > \lambda(x_m) \quad (5)$$

so that consumers expect a positive surplus from searching and buying through the platform when it doesn't charge anything.

We denote the difference in the equilibrium markups across the two channels as

$$\Delta_m = \lambda(x_m) - \lambda(x_d)$$

and call it the *markup differential* of the direct market. We know that since $s_m < s_d$, we have $x_m > x_d$, which implies $\lambda(x_m) \leq \lambda(x_d)$ or $\Delta_m \geq 0$ given our assumption that the hazard rate is weakly increasing. That is, the equilibrium price markups of firms are lower on M , reflecting that consumers search more on M . We are now ready to analyze the effects of platform investment.

4 Investing in better search

We explore what happens in our setting if M can invest in reducing search costs.³ Suppose that M can reduce search cost by Δs_m and thereby increase the consumers' expected (gross) match value by Δx_m . Since Δx_m is monotonically increasing in Δs_m according to

$$\int_{x_m + \Delta x_m}^{\bar{v}} [v - (x_m + \Delta x_m)] dG(v) = s_m - \Delta s_m,$$

we can equally focus on the increase in Δx_m instead of the increase in Δs_m .

M 's investment cost is $C(\Delta x_m)$ with $C(\cdot)$ strictly increasing and convex. Assume the cost function and the mark-up function satisfy the following properties: $y - \lambda(x_m + y)$ and $C(y)$ has a unique intersection at $\bar{y}$, $y - \lambda(x_m + y) > C(y)$ when $y < \bar{y}$ and $y - \lambda(x_m + y) < C(y)$ when $y > \bar{y}$.

³Note we have assumed initially M has lower search costs ($s_m < s_d$) since otherwise consumers would have no reason to use it.

A social planner maximizes the incremental total welfare by solving

$$\max_{\Delta x_m} \Delta x_m - C(\Delta x_m),$$

which yields the efficient investment level Δx_m^e implied by

$$C'(\Delta x_m^e) = 1. \quad (6)$$

4.1 No free-riding benchmark

We first consider the case where consumers are not allowed to switch between selling channels (e.g. from the search platform to the firm directly) and price parity clauses are not imposed. From Wang and Wright (2016), for given s_m , the equilibrium involves M setting the fee

$$f^* = \Delta_s + \Delta_m + b. \quad (7)$$

The firms' direct prices are given by (2) and firms' on-platform prices are given by (4). On-platform prices involve the full pass-through of M 's fee. Given this, the platform increases its fee f until the higher prices on the platform just offset the sum of the extra surplus consumers get from lower search costs on the platform (the surplus differential) and the transaction convenience they get from completing transactions on the platform, thereby leaving consumers indifferent between searching on the platform and searching directly. In doing so, M takes into account that without any fee, prices would be higher when buying directly because of the markup differential, so this also allows it to set a higher fee.

When switching is impossible, M always overinvests. If M invests, by the same argument as above, it can increase its fee to

$$f(\Delta x_m) = x_m + \Delta x_m - x_d + \lambda(x_d) - \lambda(x_m + \Delta x_m) + b,$$

where f is determined by the sum of the new surplus and markup differentials (reflecting the additional investment in lowering search costs on M), plus the convenience benefit of completing transactions on the platform. M 's optimal investment level x_m^* is given by maximizing $f(\Delta x_m) - C(\Delta x_m)$ with respect to Δx_m , and is characterized by the first order condition:

$$C'(\Delta x_m^*) = 1 - \lambda'(x_m + \Delta x_m^*). \quad (8)$$

Comparing (6) and (8), it is clear that M invests more than the efficient level given $\lambda'(\cdot) \leq 0$ (i.e. the increasing hazard rate assumption). When the search cost decreases, consumers tend to search more, the competition among firms is intensified, and firms' mark-ups decrease. The mark-up that firms lose from search cost reduction goes to M by way of a higher fee. This implies that, when search cost is lowered, the incremental profits to M are greater than the incremental social benefits. M therefore tends to over-invest.

4.2 Showrooming

Consider the case in which consumers can freely switch between channels. This case is analyzed in Wang and Wright (2016). They show that M 's fee has to be constrained below b as otherwise firms will profitably induce consumers to switch. Obviously, investing in reducing search costs and thus increasing expected surplus has no impact on the constraint $f \leq b$. Therefore, given the optimal fee without showrooming is given by (7), which exceeds b , the constraint from showrooming will always bind and M has no incentive to invest at all even if the efficiency calls for investment. All the additional benefits from search cost reduction are obtained by consumers. M therefore under-invests since it cannot recover its investment.

4.3 Price parity

A platform's incentive to invest in reducing search costs will be restored when it imposes a price parity clause. From Wang and Wright (2016), for given s_m , we know a price parity clause enables M to set a fee of $f = x_m - \frac{1-G(x_m)}{g(x_m)} + b$ and thus fully extract consumer surplus. Since a firm cannot charge lower prices when selling directly, consumers no longer have any incentive to switch to the direct channel and forgo the convenience benefit b (or to search directly in the first place). Given consumers all search on M , firms will strictly prefer to participate at this fee. Under price parity, M therefore invests in search so as to maximize f , which means maximizing:

$$\max_{\Delta x_m} x_m + \Delta x_m - \lambda(x_m + \Delta x_m) + b - C(\Delta x_m).$$

This leads to the same solution as in (8). It implies that, just as in the case without showrooming, M over-invests in search cost reduction. When price parity clauses are used, M can extract not only the additional value generated by the lowered search cost but also the extra profit margin that firms lose in intensified competition on

M .

With showrooming but in the absence of price parity clauses, the total welfare is $x_m + b$, reflecting that there will be no investment in search cost reduction. If a price parity clause is imposed, the total welfare is $x_m + \Delta x_m^* + b - C(\Delta x_m^*)$ where Δx_m^* is determined by (8). Clearly, price parity clauses increase total welfare if and only if $\Delta x_m^* > C(\Delta x_m^*)$. Since there is insufficient investment without the price parity clause and excessive investment with the price parity clause, the effect of the price parity clause on welfare is in general ambiguous. For instance, suppose v is drawn from the uniform distribution on the interval $[\underline{v}, \bar{v}]$, so $G(v) = \frac{v-\underline{v}}{\bar{v}-\underline{v}}$ and $\lambda(x) = \bar{v} - x$. Assume that $C(\Delta x_m) = \frac{c}{\eta}(\Delta x_m)^\eta$. Then (8) implies $\Delta x_m^* = \left(\frac{2}{c}\right)^{\frac{1}{\eta-1}}$ and so $\Delta x_m^* > C(\Delta x_m^*)$ if and only if $\eta > 2$. That is, taking into account investment effects, welfare is only higher under the price parity clause if the cost function is more convex than a quadratic function. Indeed, in case costs are quadratic in Δx_m in this example, the welfare without the price parity clause exactly equals welfare with the price parity clause. For more concave cost functions, welfare is higher without a price parity clause.

Having shown the welfare effects of a price parity clause are ambiguous for welfare, we next consider how price parity clauses impact consumer surplus. Without price parity, showrooming will arise and consumers will only pay b . Since there will be no investment, consumer surplus is $x_m - \lambda(x_m)$, reflecting that the fee firms pay will just equal the convenience benefit consumers obtain. Recall from (3) that $x_d > \lambda(x_d)$. Since $x_m \geq x_d$ and $\lambda(x_d) \geq \lambda(x_m)$, we have that consumer surplus is strictly positive without price parity clauses. Under price parity, however, consumer surplus is zero as M sets its fee at the level at which consumer surplus is fully extracted.

We summarize our findings in the following proposition.

Proposition 1. (The effect of a price parity clause)

Without a price parity clause, M underinvests in search cost reduction. With a price parity clause, M overinvests in search cost reduction. The total welfare effects of a price parity clause are ambiguous. However, a price parity clauses unambiguously lowers consumer surplus.

Taking into account the effects of investing in search cost reduction therefore does not change the conclusion in Wang and Wright (2016) that when a monopolist platform imposes a price parity clause it reduces consumer surplus and has an ambiguous effect on total welfare.

4.4 Platform competition

In this section we modify the previous monopoly model to allow for platform competition. We start by supposing there is an incumbent platform, M^I , that is in the identical situation to that modeled above for the monopoly platform. It already provides a basic search service with search costs s_m . By investing the amount $C(\Delta x_m)$ it can raise consumers' gross surplus on the platform from x_m to $x_m + \Delta x_m$. Following the incumbent's decision, it faces an entrant platform, M^E , which can also invest in reducing its search cost. M^E also offers a basic search service with search costs s_m , and it can reduce this search cost with the same technology available to M^I . Define $x_m^j = x_m + \Delta x_m^j$ to be the gross surplus available for consumers searching and purchasing on platform M^j ($j = I, E$) after the respective platforms have made their investment decisions. We also assume initially that both platforms provide the same level of convenience benefit b to consumers. The timing is that first M^I decides its investment level, followed by M^E , after which the two platforms choose their fees simultaneously.

We consider an equilibrium where firms join both platforms. Given consumers can freely switch channels, consumers will always search on the platform that has lower search costs. Given consumers get the same benefit b from completing transactions on each platform, we assume they complete the transaction on the channel that has lower expected on-platform prices, but if indifferent, they complete the transaction on the platform they search on. When the incumbent and entrant have the same search costs, we assume they search on the platform they expect to complete the transaction on (i.e. the platform with lower expected prices). In case search costs and expected prices are the same on both platforms, we break the tie in favor of the incumbent, so consumers all search on M^I .

Consider first what happens without any form of price parity clause. Competition between the platforms drives their fees down to marginal cost, which we have normalized to zero. Anticipating this, no platform will want to invest in search cost reduction in the first place. To see this, notice that the platform with the lower search cost can only benefit from a lower search cost if it can maintain a fee above its marginal cost. But this is not possible with homogenous competition between the platforms given that consumers can freely switch between platforms. In equilibrium, without any investments in reducing search costs by either platform, prices on both platforms would end up being the same in equilibrium and consumers would search on M^I , which would complete all transactions. M^E disciplines M^I 's fee to a competitive level. Consumer surplus is $x_m - \lambda(x_m) + b > 0$ and total welfare is

$x_m + b$. The same outcome arises under narrow price parity clauses. Narrow price parity clauses just rule out the direct purchase option, which is not relevant in this competitive setting given the equilibrium fee is less than b .

Now consider the situation in which platforms are allowed to impose wide price parity clauses. We consider an equilibrium in which both platforms impose wide price parity clauses. (It is straightforward to show each platform has a unilateral incentive to impose such clauses if the other does not, and can never do better by not imposing the clause if the other does impose it). In this case, given firms join both platforms, the on-platform prices are the same across platforms. Clearly, M^E cannot attract any business unless it has lowered its search cost below the level M^I has chosen. If M^E has a lower search cost, the equilibrium involves $f^I = f^E = x_m^E - \lambda(x_m^E) + b$ with M^E attracting all consumers to search and complete their transactions on its platform. These fees fully extract the consumers' expected surplus. Notice that M^I cannot reduce its fee to attract consumers. First, if firms continue to join both platforms, the price on M^I is no lower following the reduction of f^I due to the wide price parity clause imposed by M^E . Second, if a firm withdraws from M^E and exclusively joins M^I , it cannot attract any consumers since all consumers are searching on M^E given its lower search cost and that consumers continue to expect all firms join both platforms. They will therefore never find such a deviating firm. In this case, M^I obtains no transactions and no profit.

Given that the platform with lower search costs obtains all the profit and M^I makes its investment decision first, M^I will want to invest in lowering its search cost to the point that M^E cannot profitably invest to offer lower search costs in the next stage. That is, M^I will choose Δx_m^I to solve

$$x_m^I - \lambda(x_m^I) + b = C(\Delta x_m^I). \quad (9)$$

This involves investing to the point where the platform's monopoly profit from full consumer-surplus extraction is fully offset by investment costs. Compared to the case without wide price parity clauses, the existence of M^E no longer disciplines fees, but instead puts pressure on the incumbent to over-invest in its search technology.

We now show this excessive level of investment unambiguously lowers welfare compared to the welfare that arises without any investment. Recall that an investment Δx_m lowers welfare compared to no investment if and only if $\Delta x_m < C(\Delta x_m)$. From (9), the equilibrium level of investment solves $\Delta x_m^I = C(\Delta x_m^I) + \lambda(x_m^I) - (x_m + b)$. So welfare will be lower as a result of the wide price parity clauses if and only if

$x_m + b > \lambda(x_m^I)$. From (5), we have $x_m + b > \lambda(x_m)$, and since $\lambda(x_m) \geq \lambda(x_m + \Delta x_m)$, we indeed get that $x_m + b > \lambda(x_m^I)$. In terms of consumer surplus, the conclusion is unchanged from the monopoly setting. Wide price parity clauses result in consumer surplus being zero, whereas consumer surplus is unambiguously positive in the absence of wide price parity clauses.

We summarize our findings in the following proposition.

Proposition 2. (The effect of narrow and wide price parity clauses)

Suppose there are competing homogenous platforms. Without price parity clauses or with just narrow price parity clauses, platforms will not invest in search cost reduction. With wide price parity clauses, platforms overinvest in search cost reduction. While narrow price parity clauses will not affect consumer surplus or welfare, wide price parity clauses lower consumer surplus and total welfare.

Taking into account the effects of investing in search cost reduction therefore does not change the conclusion in Wang and Wright (2016) that when homogeneous competing platforms impose price parity clauses, consumer surplus is reduced (to zero). However, unlike the case with constant investment, wide price parity clauses now also unambiguously reduce total welfare.

4.5 Differentiated platforms

With homogenous platforms, we found that welfare and consumer surplus is unambiguously lower under wide price parity clauses. In this section we explore what happens when we allow platforms to be differentiated. Specifically, we consider a market with two horizontally differentiated platforms. The basic setting follows the one with homogeneous platform except that consumers now have heterogenous preference regarding which platform provides higher convenience benefits. More specifically, half of the consumers obtain convenience benefit b from buying on M^1 and $b - a$ from buying on M^2 , while the other half of the consumers obtain convenience benefit b from buying on M^2 and $b - a$ from buying on M^1 . We will refer to the platform on which a consumer obtains b rather than $b - a$ as the consumer's "preferred platform". Before choosing which platform to use in stage 4 of the game, each consumer observes a random shock a , which is drawn from a continuously differentiable distribution $F(a)$ on $[0, b]$, which has a strictly positive density on $[0, b]$. Suppose y is a non-negative constant. We assume the maximization problems $\max_x x(1 + F(y - x))$ and $\max_x x(1 - F(x - y))$ each have a unique solution which

can be characterized by the respective first order conditions. Note this requirement is satisfied when F is the uniform distribution.

This model of competition between symmetric differentiated platforms is considered in Wang and Wright (2016) as an extension of their base model. When neither platform adopts a price parity clause or they adopt narrow price parity clause, the analysis remains the same as in Wang and Wright. This is because, as explained in Wang and Wright, the equilibrium fees will be pinned down either by the showrooming constraint so that $f^I = f^E = b$ or by the competitive price

$$f^* = \frac{1}{F'(0)} \quad (10)$$

in case either (i) $f^* \leq b$ or (ii) $f^* > b$ but narrow price parity clauses are in place. Since the equilibrium fees do not depend on the platform's search costs, platforms have no incentive to invest in reducing search costs. A platform that invests in reducing search costs will attract all consumers to search on that platform, but consumers will continue to complete their transactions on their preferred platform.

Things are different with wide price parity clauses. Platform fees will no longer be constrained by showrooming or direct competition. Instead, in the presence of wide price parity clauses, platform fees are constrained only by the possibility of a platform lowering its fees to attract firms to list exclusively. Firms' incentives to do so depend on which platform consumers are searching on, which explains why differences in investment in search cost reduction matter for the equilibrium analysis.

Suppose M^j , $j = I, E$, is the one with lower search cost after the investments have taken place (we will consider the case they have the same search costs below). In the fee setting stage, we consider an equilibrium where the platform with lower search cost sets a higher fee and consumer surplus is fully extracted. In equilibrium, both platforms impose wide price parity clauses. The fees are given by

$$f^j = \alpha(x_m^j - \lambda(x_m^j) + b) \quad \text{and} \quad f^k = (2 - \alpha)(x_m^j - \lambda(x_m^j) + b),$$

where different values of $\alpha \geq 1$ map out a continuum of equilibria in the fee setting subgame. For example, $\alpha = 1$ would select the symmetric equilibrium in fees regardless of the differences in search costs while $\alpha = 2$ would select the equilibrium which is best for the platform with lower search costs regardless of the level of those costs. We impose $\alpha \geq 1$ to reflect that the platform with lower search costs should be able to charge higher fees.

Given the seller fees set by the platforms, all firms join both platforms and set

$$p_m(f^j, f^k) = \frac{1}{2}f^j + \frac{1}{2}f^k + \lambda(x_m^j). \quad (11)$$

Consumers search on M^j and complete their transactions on the platform which provides higher convenience benefits net of price.

We next show the above fees, prices and user choices characterize an equilibrium in the subgames following the investment choices. Given that all consumers use M^j to search and other firms join both platforms and price according to (11), it is optimal for an individual firm i to price according to (11) if it also joins both platforms. Firm i does not have any incentive to exclusively join M^k , $k \neq j$, even if M^k reduces its fee as all consumers search on M^j and they will not find firm i if firm i is only listed on M^k .

Next suppose M^j reduces its fee to f^j . Suppose firm i exclusively joins M^j and sets price p'_m on M^j . Consumers whose preferred search platform is M^j will buy from firm i if $v^i - p'_m + b \geq x_m^j - p_m(f^j, f^k) + b$, or equivalently, $v^i \geq x_m^j - p_m(f^j, f^k) + p'_m$. A consumer whose preferred platform is M^k will buy from firm i if $v^i - p'_m + b - a \geq x_m^j - p_m(f^j, f^k) + b$, or equivalently, $v^i \geq x_m^j - p_m(f^j, f^k) + a + p'_m$. Firm i 's deviating profit, denoted $\pi^d(f^j, f^k; x_m^j)$, is

$$\begin{aligned} \pi^d(f^j, f^k; x_m^j) &= \max_{p'_m} \frac{(p'_m - f^j)}{1 - G(x_m^j)} \left[\frac{1}{2} \left(1 - G(x_m^j - p_m(f^j, f^k) + p'_m) \right) \right. \\ &\quad \left. + \frac{1}{2} \int_0^b \left(1 - G(x_m^j - p_m(f^j, f^k) + a + p'_m) \right) dF(a) \right] \\ &= \max_z \frac{(z + \frac{1}{2}(f^k - f^j))}{1 - G(x_m^j)} \left[\frac{1}{2} \left(1 - G(x_m^j - \lambda(x_m^j) + z) \right) \right. \\ &\quad \left. + \frac{1}{2} \int_0^b \left(1 - G(x_m^j - \lambda(x_m^j) + a + z) \right) dF(a) \right] \end{aligned}$$

The equality comes from the change of variables $z = p'_m - (\frac{1}{2}f^j + \frac{1}{2}f^k)$. Since firm i 's equilibrium profit is $\lambda(x_m^j)$, it will not deviate in this way if

$$\pi^d(f^j, f^k; x_m^j) \leq \lambda(x_m^j).$$

Now consider whether platforms would like to charge a fee different from the equilibrium fee given their rival sets the equilibrium fee. Both platforms will not raise their fee above the equilibrium level as, given (11), this leads to a negative expected payoff to consumers and consumers will stop using platforms to search

and buy. M^k will not reduce its fee below the equilibrium level as it can neither reduce price on M^k to attract consumers due to M^j 's wide price parity clause nor induce firms to join M^k exclusively due to the fact that all consumers search using M^j . Given the result above, M^j has to reduce its fee to at least $\hat{f}$ to attract exclusive selling, where $\hat{f}$ is given by

$$\pi^d(\hat{f}, f^k; x_m^j) = \lambda(x_m^j).$$

Then, M^j will not reduce its fee if the profit from attracting firms exclusively, i.e. $\hat{f}$, is no higher than its equilibrium profit, $\frac{1}{2}f^j$; i.e. provided

$$\frac{1}{2}f^j \geq \hat{f}.$$

Since $\pi^d(f^j, f^k; x_m^j)$ is decreasing in f^j , the condition for M^j not to want to reduce its fee becomes

$$\pi^d\left(\frac{1}{2}f^j, f^k; x_m^j\right) \leq \lambda(x_m^j).$$

Plugging in $f^j = \alpha(x_m^j - \lambda(x_m^j) + b)$ and $f^k = (2 - \alpha)(x_m^j - \lambda(x_m^j) + b)$, we can rewrite this condition as

$$\begin{aligned} \max_z \frac{(z + (1 - \frac{3}{4}\alpha)(x_m^j - \lambda(x_m^j) + b))}{1 - G(x_m^j)} \left[\frac{1}{2} \left(1 - G(x_m^j - \lambda(x_m^j) + z) \right) \right. \\ \left. + \frac{1}{2} \int_0^b \left(1 - G(x_m^j - \lambda(x_m^j) + a + z) \right) dF(a) \right] \leq \lambda(x_m^j). \end{aligned} \quad (12)$$

Since

$$\lambda(x_m^j) = \max_z \frac{z}{1 - G(x_m^j)} \left(1 - G(x_m^j - \lambda(x_m^j) + z) \right),$$

condition (12) will hold when α is relatively large, e.g., $\alpha \geq \frac{4}{3}$. Also, notice that there is an equilibrium where the platform with lowest search cost gets all profits and the other platform gets zero profit although they still equally split the market, i.e., $\alpha = 2$.

Next consider what happens when both platforms choose the same level of investment. In this case, provided firms join both platforms so prices are the same on both platforms, consumers should search and buy on their preferred platform. In contrast to the case in which one platform attracts all consumers to search, it is natural to consider symmetric equilibrium fees in this case. Suppose one platform (M^j) reduces its fee to attract exclusive selling. If an individual firm i exclusively

joins M^j and sets on-platform price p'_m , it can only sell to the consumers whose preferred platform is M^j as the other consumers only search on M^k .

Firm i 's deviating profit is

$$\begin{aligned} & \max_{p'_m} \frac{p'_m - f^j}{1 - G(x_m^j)} \left[\frac{1}{2} (1 - G(x_m^j - p_m(f^j, f^k) + p'_m)) \right] \\ &= \max_z \frac{z + \frac{1}{2}(f^k - f^j)}{1 - G(x_m^j)} \left[\frac{1}{2} (1 - G(x_m^j - \lambda(x_m^j) + z)) \right]. \end{aligned}$$

It will deviate only if this profit is higher than its equilibrium profit $\lambda(x_m^j)$. As before, M^j will not reduce its fee to induce exclusive selling if

$$\max_z \frac{z + \frac{1}{2}(f^k - \frac{1}{2}f^j)}{1 - G(x_m^j)} \left[\frac{1}{2} (1 - G(x_m^j - \lambda(x_m^j) + z)) \right] \leq \lambda(x_m^j).$$

Since we consider symmetric equilibrium when search costs are equal, $f^j = f^k = f^*$. Also, let us first see whether full surplus extraction equilibrium can exist, i.e., $f^* = x_m^j - \lambda(x_m^j) + b$. Then the condition above becomes

$$\max_z \frac{z + \frac{1}{4}(x_m^j - \lambda(x_m^j) + b)}{1 - G(x_m^j)} \left[\frac{1}{2} (1 - G(x_m^j - \lambda(x_m^j) + z)) \right] \leq \lambda(x_m^j).$$

If this condition holds, then each platform gets profit $\frac{1}{2}(x_m^j - \lambda(x_m^j) + b)$. Otherwise, the symmetric equilibrium profit needs to be lower than the level with full consumer surplus extraction.

We finally consider the investment decisions made by each platform. We continue to assume M^j is the platform with lower search cost in the market. It is natural to select the equilibrium in the subgame in which M^j sets the highest possible fee, i.e., $\alpha = 2$. We show in the appendix that the results we obtain here are robust to assuming any α close to 2. Define $\pi(x_m) = x_m - \lambda(x_m) + b$. Then, $f^j = 2\pi(x_m^j)$ and $f^k = 0$. Suppose $\pi(\Delta x_m) - C(\Delta x_m)$ is single-peaked. Define y by

$$y = \arg \max_{\Delta x_m} \pi(\Delta x_m) - C(\Delta x_m).$$

The equilibrium of the full game involves that M^I invests a positive amount $\Delta x_m^* > y$ where Δx_m^* satisfies

$$\pi(\Delta x_m^*) - C(\Delta x_m^*) = 0, \tag{13}$$

and M^E does not invest. Obviously, M^E has no incentive to invest any positive

amount. If M^E chooses a strictly positive Δx_m^E which is lower than Δx_m^* , its revenue is still zero but its cost is positive. If it chooses $\Delta x_m^E > \Delta x_m^*$, it gets negative profit under (20). If M^I chooses any $\Delta x_m^I < \Delta x_m^*$, it always gets zero profit as M^E will always invests more than Δx_m^I and M^I gets profit $\frac{1}{2}(2 - \alpha)\pi(\Delta x_m^E) = 0$.

The equilibrium investment level Δx_m^* is unambiguously higher than the efficient level. There are two effects impacting on M^I 's investment at the same time. First, if M^I invest less than Δx_m^* , it cannot prevent M^E from investing more and becoming the platform with lower search cost. Thus, a higher Δx_m^I is needed to preempt M^E 's investment. Second, an increase in Δx_m^I decreases $\lambda(\Delta x_m^I)$ given firms compete more aggressively when search costs are lower. This loss of firms' mark-up goes to M^I under wide price parity. However, this pure transfer is not taken into account when determining the efficient level of investment. These two effects imply over-investment.

Consumers are unambiguously worse off under wide price parity as they get zero surplus compared to the positive surplus they obtain without it. Without wide price parity, total welfare is $x_m + b$ as platforms have no incentive to invest. Under wide price parity, total welfare is $x_m + \Delta x_m^* + b - C(\Delta x_m^*)$. Wide price parity clauses reduce efficiency if $\Delta x_m^* < C(\Delta x_m^*)$. Recall Δx_m^* is determined by (20) and therefore $C(\Delta x_m^*) - \Delta x_m^* = x_m - \lambda(x_m^*) + b > 0$ since $x_m > \lambda(x_m) \geq \lambda(x_m^*)$. It is clear that wide price parity clauses decrease total welfare.

We summarize our findings in the following proposition.

Proposition 3. (The effect of narrow and wide price parity clauses)

Suppose there are competing differentiated platforms. Without price parity clauses or with just narrow price parity clauses, platforms will not invest in search cost reduction. With wide price parity clauses, platforms overinvest in search cost reduction. Narrow price parity clauses can reduce consumer surplus if the competitive fee exceeds b , but they have no effect on welfare. Wide price parity clauses lower both consumer surplus and total welfare.

Taking into account the effects of investing in search cost reduction therefore does not change the conclusion in Wang and Wright (2016) that when differentiated competing platforms impose price parity clauses, consumer surplus is reduced (to zero) and that total welfare may be higher or lower as a result.

5 Platform advertising

Suppose instead of investing in reducing search costs, the platform M can invest in advertising to attract consumers. Only consumers who receive M 's advertisements (ads) can consider whether to use the platform. If they do not receive an ad from the platform, consumers will search directly since they will not be aware of the existence of M .

Suppose M can choose the number of consumers who receive its ads, n_m , by incurring an advertising cost $A(n_m)$. The usual assumptions are imposed on $A(n_m)$: $A'(n_m) > 0$, $A''(n_m) \geq 0$ and $A(0) = A'(0) = 0$. By way of a benchmark, a social planner would choose the advertising level which maximizes the total surplus $n_m(x_m + b) + (1 - n_m)x_d - A(n_m)$. We assume the socially optimal advertising level n_m^e exists and is given by

$$\Delta_s + b = A'(n_m^e). \quad (14)$$

In this section we assume firms can charge lower direct prices for consumers who have come through the platform (i.e. they find the firm on the platform and then switch to buy directly) than for consumers who go directly to the firm to purchase, provided this does not violate any price parity restriction. This possibility was not relevant before, since all consumers were aware of the platform and therefore would always prefer to search on the platform before switching. The possibility of price discrimination simplifies the analysis of showrooming, since a firm can induce consumers to switch without lowering the price it obtains from consumers who do not receive the platform's ad and so search directly.⁴ In other cases, such price discrimination will not be relevant.

5.1 No free-riding benchmark

Suppose consumers are not allowed to switch channels. For a given n_m , M chooses the optimal fee $f = \Delta_s + \Delta_m + b$ as in Section 3. When choosing the advertising level, M 's maximization problem is

$$\max_{n_m} n_m(\Delta_s + \Delta_m + b) - A(n_m).$$

⁴The results we find in the case of showrooming are also consistent with the results that would be obtained without allowing for price discrimination in the special case that the distribution of v is the exponential distribution (i.e. so the hazard rate is constant and the markup differential is zero).

The optimal advertising level n_m^* is given by the first order condition

$$\Delta_s + \Delta_m + b = A'(n_m^*). \quad (15)$$

Compare (15) with (14). M will advertise more than the efficient level as $\Delta_m \geq 0$. For each additional consumer that M attracts, M obtains not only the surplus differential Δ_s which the social planner cares about but also the markup differential Δ_m which is a pure transfer from firms to M . As a result, M over-invests compared to the efficiency benchmark.

5.2 Showrooming

Consider the case with showrooming. The pricing strategies of firm are still given by $p_d = \lambda(x_d)$ and $p_m = f + \lambda(x_m)$. Since firms can price discriminate across consumers coming from different selling channels, they do not sacrifice their profits from the $1 - n_m$ consumer who only search directly when they try to attract the n_m consumers to switch by lowering the direct price for these consumers. As before, the possibility of showrooming then restricts M 's fee to be no higher than b . If M sets its fee strictly higher than b , it will be profitable for the firms to reduce their direct price targeted to those switching to induce the consumers who search using M to switch to buy directly while maintaining their price $\lambda(x_d)$ to the $1 - n_m$ consumers who only search directly. As a result, the equilibrium fee is $f^* = b$ for given n_m . M 's maximization problem is

$$\max_{n_m} n_m b - A(n_m).$$

The optimal advertising intensity n_m^* is characterized by

$$b = A'(n_m^*). \quad (16)$$

Compared to the efficient advertising level (14), M under-invests as showrooming restricts its ability to extract the consumer surplus from platform search (the surplus differential) and so M ignores the potential social gain Δ_s . The resulting consumer surplus is $n_m^*(x_m - \lambda(x_m)) + (1 - n_m^*)(x_d - \lambda(x_d))$, which is strictly positive. The resulting total welfare is $n_m^*(x_m + b) + (1 - n_m^*)x_d - A(n_m^*)$, where n_m^* is given by (16).

5.3 Price parity

Suppose a price parity clause is imposed. Suppose all firms join M for given n_m . Each firm chooses a price to maximize the total profits on both channels. Suppose a unique symmetric optimal price p_c exists

$$p_c = \arg \max_{p'} (p' - f)n_m \frac{1 - G(x_m - p_c + p')}{1 - G(x_m)} + p'(1 - n_m) \frac{1 - G(x_d - p_c + p')}{1 - G(x_d)}.$$

The resulting profit is just $n_m(p_c - f) + (1 - n_m)p_c = p_c - n_m f$. Also, firms should have no incentive to withdraw from M and only sell in the direct market

$$p_c - n_m f \geq \arg \max_{p'} p'(1 - n_m) \frac{1 - G(x_d - p_c + p')}{1 - G(x_d)}.$$

However, the previous analysis is based on the assumption that consumers who do not receive M 's ads still participate in the direct market. This was true when prices in the direct market are not linked to the platform prices. But this may no longer be the case under a price parity clause.

Consider the following situation where the $1 - n_m$ consumers hold high expectation about the direct price and choose not to participate. M sets $f = x_m - \lambda(x_m) + b$. Firms price at $p_c = f + \lambda(x_m) = x_m + b$ on both selling channels. Consumers who do not receive M 's ads expect that the direct price exceeds the expected match value x_d (since $x_m + b > x_d$) and therefore do not participate. An individual firm therefore cannot withdraw from M to exclusively sell in the direct market since it cannot find any consumer in the direct market. M thus maximizes $n_m(x_m - \lambda(x_m) + b) - A(n_m)$. The optimal advertising level under price parity is therefore given by

$$x_m - \lambda(x_m) + b = A'(n_m^*). \quad (17)$$

Compare (17) with (14). We have $n_m^* > n_m^e$ as $x_m - \lambda(x_m) + b > \triangle_s + \triangle_m$ given (3). M thus over-invests when price parity clause is imposed.

We next compare the impact of price parity on consumer surplus and total welfare with respect to when only showrooming is present. Under price parity, consumers surplus is zero since the consumers who use M gets their surplus fully extracted and the rest of the consumers do not participate. On the contrary, consumer surplus is strictly positive under showrooming. The total welfare under price parity is $n_m^*(x_m + b) - A(n_m^*)$ where n_m^* is given by (17). Whether wide price parity increases or decreases total welfare is in general ambiguous. Using the same func-

tional forms as the previous example, so that $A(n_m) = \frac{c}{\eta}(n_m)^\eta$ and $G(v) = \frac{v-\bar{v}}{\bar{v}-\underline{v}}$, the total surplus under showrooming is

$$\left(\frac{b}{c}\right)^{\frac{1}{\eta-1}}(x_m + b) + \left(1 - \left(\frac{b}{c}\right)^{\frac{1}{\eta-1}}\right)x_d - \frac{c}{\eta}\left(\frac{b}{c}\right)^{\frac{\eta}{\eta-1}}$$

In this case $n_m^* = \left(\frac{b}{c}\right)^{\frac{1}{\eta-1}}$ so we assume $b < c$. The total welfare under price parity is

$$\left(\frac{2x_m + b - \bar{v}}{c}\right)^{\frac{1}{\eta-1}}(x_m + b) - \frac{c}{\eta}\left(\frac{2x_m + b - \bar{v}}{c}\right)^{\frac{\eta}{\eta-1}},$$

where $n_m^* = \left(\frac{2x_m + b - \bar{v}}{c}\right)^{\frac{1}{\eta-1}}$ so we also assume $2x_m + b - \bar{v} \leq c$. To show the welfare effect is ambiguous, let $c = 1$, $\bar{v} = 1$ and $\eta = 2$. Then our various restrictions and assumptions require $b < 1$, $x_d > \frac{1}{2}$ and $1 < 2x_m + b < 2$. Price parity decreases total welfare if

$$x_d > \frac{x_m - \frac{1}{2}}{1 - b} \quad (18)$$

which is implied by the restrictions and assumptions noted above. Thus, with $c = 1$, $\bar{v} = 1$ and $\eta = 2$, welfare is always lower. Now suppose instead that $1 < \bar{v} + c < 2x_m + b$, so $n_m^* = 1$ under price parity. Assuming $\eta = 2$, price parity increases total welfare if

$$x_m - x_d > \frac{c}{2}\left(1 - \frac{b}{c}\right)$$

which can hold for some parameter values such that $b < c$.

We summarize the above findings in the following proposition.

Proposition 4. (The effect of a price parity clause)

Without a price parity clause, M underinvests in advertising. With a price parity clause, M overinvests in advertising. The total welfare effects of a price parity clause are ambiguous. However, a price parity clauses unambiguously lowers consumer surplus.

A platform underinvests without a price parity clause because showrooming restricts the platform's ability to extract the consumer surplus that it creates by offering better search. A price parity clause allows it to extract this surplus, but also the extra profit margin that firms lose in intensified competition on the platform, resulting in excessive investment in advertising. Consumer surplus is also lower under a price parity clause because consumers who are not informed of the platform will no longer search.

6 Investing in convenience benefits

As well as facilitating search, we have assumed platforms can provide convenience benefits, which we denoted b per transaction. In this section, we suppose the convenience benefit offered by a platform also depends on the platform's investment in providing these benefits. The case with a monopoly platform is trivial since the additional benefit can always be recovered by increasing fees and therefore the platform also chooses the efficient level of investment. For instance, this is true even under showrooming, because under showrooming we know that M 's fees will be constrained by the b it offers. Thus, M will always want to maximize the per transaction benefit it offers to consumers net of the cost of providing this benefit, which is also the efficient outcome. For this reason, here we focus on what would happen when there are competing platforms that determine their investment in this technology sequentially, and which compete head-to-head.

Suppose prior to its other decisions, platform M^j can spend k (a fixed cost) to increase convenience benefits to $b_j + b(k)$ per transaction. Assume $b(k)$ is continuous and strictly increasing in k for $k \geq 0$, and that there exists a unique $\bar{k} > 0$ such that $b(\bar{k}) = \bar{k}$. Assume $b(k) > k$ for $k < \bar{k}$ and $b(k) < k$ for $k > \bar{k}$. This captures the possibility that a platform can offer rewards and benefits where the cost of these exceeds their benefit. Define the efficient investment k^e which maximizes $b(k) - k$.

Assume to start with (before any investment by either platform) the incumbent platform M^I offers a per-transaction convenience benefit of b_I and the entrant platform M^E offers a per-transaction convenience benefit of b_E . We assume that $0 \leq b_I - b_E \leq b(\bar{k}) - b(k^e)$, which implies the ex-ante asymmetry between the two platforms is not too large. We assume M^I chooses k first, followed by M^E , before the rest of the game unfolds as usual.

Before considering wide price parity clauses, we first consider what happens without such clauses. Efficient investment also emerges with showrooming or with a narrow price parity clause. To see why, consider first the case with showrooming (i.e. without narrow price parity clauses). Note that if M^I invests at the efficient level k^e , M^E will not be able to profitably invest more and attract any business. This is because M^E will need to choose $k \geq k^e$ to do so, and in this case will obtain the profit $b_E + b(k) - b_I - b(k^e) - k$. But this must be negative since $b(k) - k$ is maximized at k^e , which means the most profit M^E can possibly obtain is $b_E - b_I - k^e < 0$. Thus, M^I does best setting $k = k^e$ which maximizes its profit $b_I + b(k) - b_E - k$, which also must be positive given $b(k^e) > k^e$. Now consider the case in which the

narrow price parity rule is in force. Since in equilibrium M^I ends up charging a fee below its convenience benefit (i.e. it equals $b_I + b(k^e) - b_E$), narrow price parity will lead to the same equilibrium outcome as with showrooming (i.e. narrow price parity will not have any effect here).

Focusing now on the case with wide price parity clauses, the analysis of Section 3 applies with b_j replaced by $b_j + b(k^e)$. Note k^e exists since $b(k) - k$ is continuous and the k maximizing this must be bounded between 0 and $\bar{k}$.⁵

Consider then the case in which wide price parity clauses are in place. Suppose M^I has set k implying convenience benefits $b_I + b(k)$. The entrant M^E could undercut M^I if it could offer sufficient rewards or other such benefits to consumers to offset its initially lower convenience benefits, thereby making all consumers prefer to search and purchase on its platform given firms join both, and allowing it to charge firms higher fees given wide price parity holds. This implies M^I will need to invest in providing convenience benefits to the point that M^E can no longer afford to attract consumers in this way. If M^E sets k so as to attract all consumers to search and buy on its platform exclusively, then with a wide price parity clause, it can obtain a profit of $x_m - \lambda(x_m) + b_E + b(k) - k$. It is thus willing to spend

$$k^* = x_m - \lambda(x_m) + b_E + b(k^*) \quad (19)$$

to attract consumers in the first place. Given $x_m + b_E > \lambda(x_m)$ from (5), the solution of (19) must satisfy $k^* > \bar{k}$. In equilibrium, M^I sets k such that $b(k) + b_I \geq b(k^*) + b_E$, so it can still attract all consumers. Then M^I 's profit is $\max_k \{x_m - \lambda(x_m) + b_I + b(k) - k\}$ subject to $b(k) + b_I = b(k^*) + b_E$. Let the resulting k be denoted $\hat{k}$. M 's profit at $\hat{k}$ is at least as much as $x_m - \lambda(x_m) + b_I + b(k^*) - k^* = b_I - b_E$ since M^I can always set $k = k^*$ and attract all consumers given $b(k^*) + b_I > b(k^*) + b_E$.

Since $\hat{k}$ satisfies $b_I - b_E \geq b(k^*) - b(\hat{k})$ and $b(\bar{k}) - b(k^e) \geq b_I - b_E$ (by assumption), we have $b(\bar{k}) - b(k^e) \geq b(k^*) - b(\hat{k})$. Then $k^* > \bar{k}$ implies $b(k^*) > b(\bar{k})$, which requires $b(\hat{k}) > b(k^e)$ and so $\hat{k} > k^e$. That is, there is excessive investment in convenience benefits under a wide price parity clause.⁶

Since investment was efficient without wide price parity clauses, wide price parity clauses unambiguously lower welfare in this setting. Note if there is no ex-ante

⁵In case there are multiple values of k maximizing $b(k) - k$, without any loss of generality, define k^e as the lowest such value.

⁶Note that $b_I - b_E \leq b(\bar{k}) - b(k^e)$ is a sufficient but not necessary condition for having excessive investment by M^I . A necessary and sufficient condition under which $k^e \leq \hat{k}$ is $b(k^e) \leq k^* - (x_m - \lambda(x_m) + b_I)$ where k^* is defined by (19).

asymmetry between platforms (i.e. $b_I = b_E$) other than that b_I has the first-mover advantage, then $\hat{k} \geq k^* > \bar{k}$. This implies M^I ends up investing in offering inefficient rewards and benefits to attract consumers exclusively, indeed to the point that it makes no profit in equilibrium. Finally, consumer surplus in the new equilibrium is $x_m - \left(x_m + b_I + b(\hat{k})\right) + b_I + b(\hat{k}) = 0$, which is the same outcome as in the case with wide price parity with exogenous convenience benefits. We summarize the results in the following proposition.

Proposition 5. (The effect of narrow and wide price parity clauses)

Without price parity clauses or with just narrow price parity clauses, an incumbent platform invests the efficient amount in per-transaction convenience benefits. With wide price parity clauses, the incumbent platform will overinvest in per-transaction convenience benefits. While narrow price parity clauses will not affect consumer surplus or welfare, wide price parity clauses lower consumer surplus and total welfare.

Taking into account the effects of investing in increasing the convenience benefits of transacting on platforms therefore increases the harm from wide price parity clauses—consumers continue to do just as badly as in the case that investment is not taken into account but now total welfare is also unambiguously harmed.

7 Conclusions

Previous research has shown that price parity clauses can be harmful to consumers since they remove competitive pressures on platform fees. However, this previous work has ignored the implications of price parity clauses for platform investment, and how platform investment may change the effects of price parity clauses. This paper extends the analysis of search platforms in Wang and Wright (2016) to take into account such investment effects.

We find that for investments that improve search and which increase the number of consumers informed about the platform (i.e. platform advertising), there is insufficient investment without price parity clauses and excessive investment with price parity clauses. Thus, our paper would seem to provide some support for platforms' arguments that price parity clauses are actually beneficial since they promote investment. However, the welfare effects of price parity clauses are at best ambiguous. When we consider instead investment in convenience benefits, there is efficient investment without wide price parity clauses and excessive investment with price

parity clauses, so welfare is unambiguously lower with wide price parity clauses. Moreover, for all three types of investment, price parity clauses lower consumer surplus. Thus, while investment incentives could potentially provide a welfare justification for allowing for price parity clauses, there should be no presumption that this is indeed the case. Any justification for price parity clauses based on investment would also need to trade off the loss in consumer surplus with any possible efficiency benefits arising from higher platform investment.

While we allowed for platform competition in considering investment in search cost reduction and convenience benefits, we have not yet done so in the context of advertising investments. In exploring the implications on advertising investments, a future direction is also to consider a variation of our model where a platform (or platforms) and firms compete in advertising to attract consumers (possibly through a general search engine such as Google). By heavily spending in advertising, platforms can lower firms' direct exposure to consumers and therefore weaken their outside option of withdrawing from the platforms and selling independently. In future work it would be interesting to see how this channel may work, with and without the use of price parity clauses.

References

- [1] Bar-Isaac, Heski, Guillermo Caruana and Vincente Cunat (2012) "Search, Design, and Market Structure," *American Economic Review*, 102(2), 1140-1160.
- [2] Boik, Andre and Kenneth S. Corts (2014) "The Effects of Platform MFNs on Competition and Entry," Working paper, University of Toronto.
- [3] Edelman, Benjamin and Julian Wright (2015) "Price Coherence and Excessive Intermediation," *Quarterly Journal of Economics*, 130(3), 1283-1328.
- [4] Hviid, Morten (2015) "Vertical Agreements between Suppliers and Retailers that Specify a Relative Price Relationship between Competing Products or Competing Retailers" Paper prepared for OECD, DAF/COMP(2015)6.
- [5] Johnson, Justin (2014) "The Agency Model and MFN Clauses," Working Paper, Samuel Curtis Johnson Graduate School of Management, Cornell University.
- [6] Wang, Chengsi and Julian Wright (2016) "Search Platforms: Showrooming and Price Parity Clauses," working paper.

Appendix.

In this appendix we consider an extension of Section 4.5 to arbitrary $\alpha > 1$ and show that the result we derived from the special case where $\alpha = 2$ is robust. As we discussed in Section 4.5, the platform with a strictly lower search cost will make a higher profit. Suppose α is exogenous and large enough so that the equilibrium in the subgame in which $f^j = \alpha\pi(x_m^j)$ and $f^k = (2 - \alpha)\pi(x_m^j)$ proposed in Section 4.5 can be sustained. Suppose $\frac{1}{2}\alpha\pi(\Delta x_m) - C(\Delta x_m)$ is single-peaked. Define y by

$$y = \arg \max_{\Delta x_m} \frac{1}{2}\alpha\pi(\Delta x_m) - C(\Delta x_m).$$

The equilibrium of the full game involves that M^E does not invest and that M^I invests a positive amount $\Delta x_m^* > y$ where Δx_m^* satisfies

$$\frac{1}{2}\alpha\pi(\Delta x_m^*) - C(\Delta x_m^*) = \frac{1}{2}(2 - \alpha)\pi(\Delta x_m^*) \Leftrightarrow (\alpha - 1)\pi(\Delta x_m^*) = C(\Delta x_m^*). \quad (20)$$

Obviously, M^E has no incentive to invest any positive amount below Δx_m^* as its revenue would not change but its costs would increase. M^I has to make sure that M^E does not want to invest more than Δx_m^* . When $\Delta x_m^* > y$, M^E will only want to invest an infinitesimal amount more than Δx_m^* if it tries to be the platform with the lowest search cost. This is because M^E is maximizing $\frac{1}{2}\alpha\pi(\Delta x_m^E) - C(\Delta x_m^E)$ subject to $\Delta x_m^E > \Delta x_m^*$. Since the objective function without the constraint is maximized at y and $\Delta x_m^* > y$, a further increase above Δx_m^* will decrease M^E 's profit. M^E will not choose such a $\Delta x_m^E > \Delta x_m^*$ if this profit is lower than its equilibrium profit $\frac{1}{2}(2 - \alpha)\pi(\Delta x_m^*)$. Given (20), M^E does not want to do so. M^E will not choose $\Delta x_m^E = \Delta x_m^*$ either as it can get at most profit $\frac{1}{2}\alpha\pi(\Delta x_m^*) - C(\Delta x_m^*)$ when the equilibrium with full surplus extraction can be sustained in the resulting subgame, which is strictly lower than the R.H.S. of (20), or an even lower profit if the equilibrium with full surplus extraction cannot be sustained in the resulting subgame. Alternatively, M^I may invest nothing in search cost reduction in the first stage so as to free ride on M^E 's investment.⁷ Then M^E will invest $\Delta x_m^E = y$. M^I 's

⁷We can also rule out M^I investing some amount between 0 and Δx_m^* . Since $\frac{1}{2}\alpha\pi(\Delta x_m) - C(\Delta x_m)$ is assumed to be single-peaked, if M^I chooses some Δx_m^I between 0 and Δx_m^* , M^E can always invest an amount which is slightly higher than Δx_m^I and make a profit higher than $\frac{1}{2}(2 - \alpha)\pi(\Delta x_m^I)$.

profit is $\frac{1}{2}(2 - \alpha)\pi(y)$. M^I will prefer choosing Δx_m^* to choosing 0 if

$$\frac{1}{2}\alpha\pi(\Delta x_m^*) - C(\Delta x_m^*) = \frac{1}{2}(2 - \alpha)\pi(\Delta x_m^*) > \frac{1}{2}(2 - \alpha)\pi(y).$$

But since $\pi(\Delta x_m)$ increases in Δx_m and $\Delta x_m^* > y$, this condition always holds.

Whether the investment is higher or lower than the efficient level is ambiguous. There are three effects impacting on M^I 's investment at the same time. First, if M^I invest less than Δx_m^* , it cannot prevent M^E from investing more and becoming the platform with lower search cost. Thus, a higher Δx_m^I is needed to preempt M^E 's investment. Second, an increase in Δx_m^I decreases $\lambda(\Delta x_m^I)$ given firms compete more aggressively when search costs are lower. This loss of firms' mark-up goes to M^I under wide price parity. However, this pure transfer is not taken into account when determining the efficient level of investment. These two effects suggest over-investment. Finally, unless $\alpha = 2$, M^E free-rides on M^I 's investment. That is, M^I 's return on investment is multiplied by $\frac{1}{2}\alpha$, which is less than one if $\alpha < 2$. This effect suggests under-investment.

To illustrate the above equilibrium analysis, suppose $C(\Delta x_m) = \frac{1}{2}(\Delta x_m)^2$, $G(v) = v$ and $F(a) = \frac{a}{b}$. We can show that the equilibrium we proposed above can be sustained whenever $\alpha \geq \frac{4}{3} - \frac{b}{3+3b}$. This ensures $\alpha \geq \frac{8(x_m + \Delta x_m^j) + 3b - 4}{6(x_m + \Delta x_m^j) + 3b - 3} = \frac{4}{3} - \frac{b}{6(x_m + \Delta x_m^j) + 3b - 3}$ given $x_m + \Delta x_m^j < 1$. The equilibrium investment made by M^I given in (20) is

$$\Delta x_m^* = \frac{2(\alpha - 1) + \sqrt{2(\alpha - 1)}\sqrt{c(b - 1 + 2x_m) + 2(\alpha - 1)}}{c}$$

The efficient investment level is

$$\Delta x_m^e = \frac{1}{c}.$$

If $\alpha \geq \frac{4}{3}$, M^I always over-invests, i.e., $\Delta x_m^{I*} > \Delta x_m^e$. However, if α is smaller, M^I may under-invest. For example, if $\alpha = \frac{4}{3} - \frac{b}{3+3b}$, $b > \frac{1}{3}$ and $c < \frac{3b-1}{4x_m+2b-2}$, we have $\Delta x_m^{I*} < \Delta x_m^e$.

Consumers are unambiguously worse off under wide price parity as they get zero surplus compared to the positive surplus they obtain without it. Without wide price parity, total welfare is $x_m + b$ as platforms have no incentive to invest. Under wide price parity, total welfare is $x_m + \Delta x_m^* + b - C(\Delta x_m^*)$. Wide price parity clauses improve efficiency if $\Delta x_m^* > C(\Delta x_m^*)$. The effect is ambiguous in general. However, since over-investment takes place when α is close to 2, wide price parity clauses are more likely to reduce welfare when α is close to 2.