The Effects of Platform MFNs on Competition and Entry

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Abstract

In the context of sellers who sell their products through intermediary platforms, a platform MFN (most-favored-nation clause) is a contractual restriction requiring that a particular seller will not sell at a lower price through another platform than through the platform with which it has the platform MFN agreement. Contractual restrictions observed in ebook markets and in credit card transaction processing, among other settings, can be viewed as examples of this phenomenon. We show that platform MFNs typically raise platform fees and retail prices, and also curtail entry by potential entrants pursuing low-cost business models. This has important implications for competition policy, including cases currently being pursued in both of these markets.

1 Introduction

Recent interest from competition authorities in contracts that reference rivals has dovetailed with interest in platforms and two-sided markets to draw significant attention to the effects of a type of contract known variously as a platform parity agreement or platform most-favored nation agreement. In settings in which a seller sets a price and transacts with a buyer through an intermediary platform (which may charge a fee or a commission to the seller), such contracts restrict the seller not to sell through any alternative platform at a lower price. Most-favored-nation contracts and other contracts that reference rivals have recently been the subject of a US Department of Justice Antitrust Division workshop (Baker and Chevalier, 2013), a UK Office of Fair Trading report (Lear, 2012), and a speech by the Deputy Assistant Attorney General of the US DOJ Antitrust Division (Scott Morton, 2012). Platform MFN agreements in particular have played a key role in recent antitrust cases involving credit cards, ebooks, and health care networks (see Salop and Scott Morton (2013) for an overview). The policy-oriented literature conjectures that these agreements can raise prices for consumers and profits for platforms, and also that they may limit entry of low-cost business models. However, there exists little theoretical work to support or qualify these assertions. Analyzing these agreements in an explicit model, we find support for some of these claims, but with important caveats.

To fix ideas, consider two examples of such a platform MFN policy. First, Apple facilitates the sale of ebooks through its online platform, where publishers set retail prices and pay a fraction of

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their revenue to Apple. Apple has in place agreements that require publishers not to sell the same ebooks through other channels at lower prices. Second, a bank that issues VISA cards processes transactions between retailers and consumers at prices determined by the retailer, with the retailer paying a fee to the card-issuing bank. VISA has in place contractual provisions that limit the ability of the retailer to offer lower retail prices for purchases made through other payment mechanisms. The conventional wisdom about these agreements, which appears with varying degrees of clarity or explicitness in Schuh, Shy, Stavins, and Triest (2012), Salop and Scott Morton (2013) and in chapter 6 of the Lear (2012) report for the OFT, among other places, is simple.[1] These policies create an incentive for the platform to raise fees in attempt to squeeze the retailer, since the platform MFN limits the ability of the platform to pass through higher fees in the form of higher retail prices. These higher fees in turn lead in equilibrium to higher retail prices and potentially higher fees and profits for platforms. In addition, such policies disadvantage potential platform entrants with low-end business models by eliminating the entrant's ability to win customers away from the incumbent through lower prices.

However, we find that the effects of these policies are not quite that simple. With respect to price and profit effects, we find that platform MFN agreements do tend to raise prices, but also that they may raise prices so much that they hurt industry profits. Whether this is the case depends on the substitutability of the platforms. With respect to effects on entry, we find that a platform MFN agreement may encourage or discourage entry when the entrant's competitive position is exogenous, depending on how different from the incumbent the entrant is. When the entrant's competitive position is endogenous, a platform MFN agreement may distort the entrant's choice toward a lower-end business model even when it fails to deter entry. Our results therefore support some aspects of the conventional wisdom, but add important nuance and qualification that aid in understanding the effects of these platform MFN policies.

The most relevant theoretical paper is Johnson (2013), which studies an environment in which multiple sellers sell through multiple platforms under either the "wholesale" model (in which sellers set wholesale prices and platforms set retail prices, as in traditional bricks-and-mortar retailing) or the "agency" model (in which sellers set retail prices and platforms set commissions paid by the retailer, as in many online marketplaces such as Amazon Marketplace, eBay's fixed price auctions, and the market for ebooks). That paper is primarily concerned with the comparison between these two models; however, one section addresses the effect of platform MFN agreements on the equilibrium under the agency model. That paper finds, as do we, that platform MFNs raise platform fees and retail prices; however, it also shows, in contrast to our results, that platform MFNs always raise industry profits and are always adopted by platforms in equilibrium. These differences arise because of a difference in the way demand is modeled, which is discussed in more detail in the text. Johnson does not consider asymmetric firms and only tangentially considers effects on entry incentives, noting that in some circumstances the price-increasing power of platform MFNs might induce socially desirable entry.

In a paper on the dissemination of mobile applications, Gans (2012) studies a model in which the firm controlling the mobile platform can offer direct access to app purchases within the platform, while app developers can also sell directly to consumers. He is primarily focused on the difficulties platforms have in charging for the platform in the presence of hold-up by apps developers, and he shows that a

[1] One of the authors of the present paper (Corts) was retained by Lear to coauthor the cited report.

platform MFN policy can help solve this problem. The literature on payment processing arrangements in credit card markets largely either ignores the no-surcharge rule (which is arguably tantamount to a platform MFN in this setting) or takes it for granted. A notable exception is Rochet and Tirole (2002), which briefly discusses the ambiguous welfare effects of abolishing the no-surcharge rule in their model. Thus, the literature is quite limited; in this context, we make a significant contribution by explicitly considering the effects of platform MFN policies in a fairly general setting, including effects on the potential entry of a differentiated firm.

Section 2 lays out the model. Section 3 considers the effects of platform MFN agreements on competition between two symmetric incumbent platforms. Section 4 considers the equilibrium adoption of such agreements. Section 5 analyzes the effect of such policies on incentives for entry and endogenous choice of competitive position for an entrant platform. Section 6 concludes by relating this paper to recent antitrust activity in the credit card, ebook, and health insurance markets.

2 Model

A single seller S sells its products to buyers through one or both of two platforms (or "marketplaces") M_i, $i = \{1, 2\}$. The seller incurs three kinds of costs: fixed cost K_S, constant marginal and average production cost c_S, and a per-unit transaction fee f_i charged by each platform i.[2] The seller sets a price p_i on each platform i. Buyer demand through a particular platform i is given by $\widehat{q}_i(p)$. Each platform i incurs a fixed cost K_i and a constant marginal and average production cost c_i.

The timing is as follows. The platforms simultaneously choose whether to require platform MFN policies. They then simultaneously choose transaction fees f_i. The seller then sets prices p_i, abiding by the terms of any platform MFN policies in place. The seller earns profits $\pi_S = \sum_{i=1,2}[p_i - f_i - c_S]\widehat{q}_i(p)$; each platform i earns profit of $\pi_i = [f_i - c_i]\widehat{q}_i(p)$. For the analysis of competition between incumbent platforms (sections 3 and 4), we ignore any fixed costs, which will not affect pricing or fee-setting incentives. Fixed costs are introduced in section 5, in which we focus on the effect of platform MFN policies on entry decisions.

Because the final stage involves only the single seller's pricing decision, it is convenient to suppress this stage of the game in the analysis by writing platform-level demand functions as a function of the transaction fees f_i rather than prices p_i, where these demand functions indicate demand at the seller's optimal prices given the transaction fees. Note that the seller is effectively a simple multi-product monopolist (where the underlying product sold through each of the platforms is thought of as a distinct product) facing demand $\widehat{q}_i(p)$ and with potentially different marginal costs $(c_S + f_1)$ and $(c_S + f_2)$ for its two "products". However, the seller may also face a constraint imposed by the presence of one or more platform MFN agreements. Therefore, this implied demand function varies with the platform MFN regime. We denote this implied demand function $q_i^k(f)$, where $k = 0, 2$ denotes how many platform MFN agreements are present. The case of a single platform MFN agreement is analyzed separately and does not require its own implied demand functions for reasons that will become apparent later.

[2] In many applications, platforms charge a commission proportional to retail price rather than a fixed per-unit fee. We expect that our qualitative results would apply to both types of fees. In general, in these kinds of models, a proportional commission has the effect of raising the seller's "perceived marginal cost" (as in Johnson (2013)) because of the divergence between the taxed revenue and the maximized profit, whereas in our model the fixed unit fee directly raises that marginal cost.

We analyze this model under two different scenarios for demand: "general" and "linear". We first assume that an unspecified underlying general demand function induces a unique optimal pricing rule for the single multi-product seller, yielding a differentiable and well-behaved implied demand function on transaction fees, $q_i^k(f)$. We later assume that the underlying demand function is a familiar linear differentiated-products demand function, which we show satisfies all of the assumptions we maintain in the general demand case.

2.1 General Demand

In the general demand case, we assume that the multi-product seller's optimal pricing, given underlying demand and a given set of transaction fees, is well-behaved, yielding an implied demand function $q_i^k(f)$ with the following properties.

(A1) Implied demand is a differentiable function $q_i^k(f)$.

(A2) Implied demand is not too nonlinear; in particular, second-order effects do not overwhelm first-order effects in signing second-order conditions or the slopes of best-response functions.

(A3) Implied demand for each platform is downsloping in that platform's own fee, $\frac{\partial q_i^k}{\partial f_i} < 0$, and aggregate demand is downsloping in a common fee (for $f_1 = f_2 = \overline{f}$, $\frac{\partial q_i^k}{\partial \overline{f}} < 0$).

(A4) Quantity demanded is more responsive to one's own fee when there are no platform MFN agreements than when there are two platform MFN agreements: $\frac{\partial q_i^0}{\partial f_i} < \frac{\partial q_i^2}{\partial f_i} < 0$.

(A5) Quantity demanded is increasing in the rival's fee if and only if there are no platform MFN agreements: $\frac{\partial q_i^0}{\partial f_j} > 0 > \frac{\partial q_i^2}{\partial f_j}$.

Again, each of these properties will subsequently be shown to hold for a linear differentiated products demand model. In addition, the appendix will (eventually) show that they hold for general (non-linear) demand functions satisfying typical regularity conditions (these properties can be derived by applying the implicit function theorem to the seller's multi-product pricing first-order conditions). Conditions (A4) and (A5) should be intuitive, but they merit further discussion because they lie at the heart of the strategic effects of platform MFN agreements (hereafter, PMFNs).

First consider (A4). When there are no PMFNs in effect, the multi-product seller reacts to a fee increase by one platform by raising that platform's price, which diverts demand to the other, now relatively higher-margin, platform. When there are two PMFNs in effects, the seller is constrained to set a uniform prices across platforms. As a result, it has reduced flexibility in diverting sales to the other platform. Raising price on one platform means raising price on both platforms. While the higher fee on one platform does induce the seller to raise price on that platform (and on the other platform), this is now more costly in lost demand on both platforms, and the seller optimally chooses to raise price on the fee-raising platform less than it would have absent the PMFN agreements. Now consider (A5). Absent PMFNs, the seller's price increase for a platform in response to a fee increase on that platform increases demand for the non-fee-raising platform. But, with two PMFNs, the seller's uniform price increase reduces demand for both platforms.

2.2 Linear Demand

We show that all of the above assumptions for general demand do in fact hold when the underlying demand takes the familiar linear differentiated products form: $\widehat{q}_i(p) = a - bp_i + dp_j$,where $a, b, d > 0$ and $b > d$. In this case we also assume $c_i + c_s < \frac{a}{b-d}$, where this quantity is the symmetric choke price. It is in fact straightforward to determine the optimal pricing rule for the two-product monopoly seller under both the 0-PMFN and 2-PMFN regimes. Maximizing the seller's profit yields optimal prices that are linear in the platform fees. These optimal pricing rules give non-negative quantities as long as the seller's total effective marginal cost is less than the symmetric choke price–that is, $c_S + f_i < \frac{a}{b-d}$, which can be shown to hold for all profit-maximizing f_i under the assumption on $c_S + c_i$ above.

Substituting the optimal pricing rules into the demand function yields implied demand as a function of transaction fees:

$$\begin{aligned} q_i^0(f) &= [a - b(c_s + f_i) + d(c_s + f_j)]/2 \\ q_i^2(f) &= [2a - (b-d)(2c_s + f_i + f_j)]/4. \end{aligned}$$

It is easy to check that these implied demand functions immediately satisfy conditions (A1)-(A5).

3 Competitive effects of platform MFNs

This section analyzes a model with two symmetric incumbent platforms: the platforms have the same cost structure and demand is symmetric ($\widehat{q}_i(p_i = y, p_j = z) = \widehat{q}_j(p_j = y, p_i = z)$). In this section, we analyze the best-response functions and equilibrium transaction fees that arise in the stage 2 subgame in which platforms simultaneously set fees. This allows us to characterize the impact of PMFN policies on competition, comparing the cases with and without PMFN policies present.

3.1 General Demand

Platform i's profit is given by $\pi_i = (f_i - c_i)q_i^k(f)$, which yields a first-order condition of

$$\frac{\partial \pi_i}{\partial f_i} = (f_i - c_i)\frac{\partial q_i^k(f)}{\partial f_i} + q_i^k(f) = 0.$$

This yields a second-order condition of

$$\frac{\partial^2 \pi_i}{\partial f_i^2} = (f_i - c_i)\frac{\partial^2 q_i^k(f)}{\partial f_i^2} + 2\frac{\partial q_i^k(f)}{\partial f_i}.$$

The last term is negative by (A3); the second-order condition therefore holds by (A2).

Totally differentiating the FOC gives the slope of the best-response function in the fee-setting game:

$$\frac{df_i^k}{df_j} = -\frac{\frac{\partial q_i^k(f)}{\partial f_j} + (f_i - c_i)\frac{\partial^2 q_i^k(f)}{\partial f_i \partial f_j}}{(f_i - c_i)\frac{\partial^2 q_i^k(f)}{\partial f_i^2} + 2\frac{\partial q_i^k(f)}{\partial f_i}}.$$

The denominator is exactly the second-order condition; therefore, the slope of the best-response function has the same sign as the numerator. By (A2), the best-response function therefore has the same sign as the first-order cross-partial $\frac{\partial q_i^k(f)}{\partial f_j}$. By (A5), this implies a game of strategic substitutes with 0 PMFNs and a game of strategic complements with two PMFNs. Assume the existence of a symmetric equilibrium under both 0 PMFNs and 2 PMFNs. Each of these equilibria must be unique by the monotonicity of the best-response functions. Denote these equilibrium fees f_i^{k*}.

The first result of interest arises from comparing these equilibria. In fact, as the conventional wisdom suggests, fees and prices are higher when both firms adopt PMFN policies. To see this, note that by (A4) the FOC for 2 PMFNs evaluated at the 0 PMFN equilibrium fees is positive. Thus, the symmetric equilibrium fees must be higher under 2 PMFNs than under 0 PMFNs. Moreover, (A3) implies that these higher fees also lead to higher prices. Specifically, the fact that quantity falls as both fees rise implies that the seller's prices are rising along with fees. These results can be summarized in the following proposition.

Proposition 1 *Assume that (A1)-(A5) hold. Then there exists a unique symmetric equilibrium in transaction fees if no platforms have PMFN agreements or if both platforms have PMFN agreements. Equilibrium fees and prices are higher when both platforms have PMFN agreements.*

The intuition for this result should be quite clear. Consider the case in which both platforms have PMFN agreements and consider hypothetical fees equal to the 0 PMFN equilibrium fees. These are best-response fees absent PMFN agreements. They weigh off the increased margin of a higher fee against the reduction in quantity that results from the multi-product seller raising one's price and diverting demand to the other platform. When PMFNs are present and the seller is constrained in its price-setting, this trade-off is altered. The increase in margin of a higher fee is no longer offset by the same reduction in demand. Rather, the reduction in demand is smaller because the constrained seller must raise the fee-raising platform's price *and also* the other platform's price, which has a positive impact on quantity at the fee-raising firm. This effects leads to higher equilibrium fees and prices and is at the heart of the competitive effects of PMFN agreements.

We can also compare the 2PMFN equilibrium fees and prices to those that would arise under collusive platform fee-setting absent PMFNs. Perhaps surprisingly, PMFNs necessarily lead to fees and prices even higher than those chosen by perfectly colluding platforms. To see this, note first that under either symmetric collusive fees or symmetric 2PMFN equilibrium, the seller optimally chooses a symmetric price. In the 0PMFN equilibrium the seller's variable profit following collusive symmetric fee-setting reduces to $\sum_{i=1,2}[p-c_S-f]\widehat{q}_i(p) = 2[p-c_S-f]\widehat{q}_1(p)$. In the 2PMFN equilibrium, the seller variable profit reduces to $\sum_{i=1,2}[p-c_S-f_i]\widehat{q}(p) = 2[p-c_S-(f_1+f_2)/2]\widehat{q}_1(p)$. Importantly, in both of these cases (and unlike the non-collusive 0PMFN case) the seller's optimal pricing rule can be reduced to a function of the average fee $\overline{f} = (f_1+f_2)/2$. Therefore, both situations generate the same implied demand function, which can be denoted $q^{SYM}(\overline{f})$. Now compare the collusive fee-setting FOC with the 2PMFN equilibrium fee-setting FOC. The former yields $\frac{\partial q^{SYM}}{\partial \overline{f}}(f-c_i)+q^{SYM}(f)=0$, while the latter yields $\frac{1}{2}\frac{\partial q^{SYM}}{\partial \overline{f}}(f_i-c_i)+q^{SYM}(\overline{f})=0$. The latter is clearly positive at the solution to the former, implying that the 2PMFN fees (and therefore prices) must be higher than the collusive fees and prices absent PMFNs.

Proposition 2 *Assume that (A1)-(A5) hold. Then the unique symmetric equilibrium fees and prices when both platforms have PMFN agreements are higher than the symmetric equilibrium fees and prices that would arise under collusive fee-setting by platforms absent PMFNs.*

This is the point at which the stark contrast with the results on platform MFN agreements in Johnson (2013) is most evident. That paper shows that platform MFNs lead to equilibrium pricing that maximizes industry profits (defined as the sum of seller and platform profits). This is clearly not the case in the present paper, where retail prices under platform MFNs are higher than those under collusive fee-setting, which are themselves already higher than those that would maximize industry profits, given the inefficiencies involved in the double markup problem associated with higher-than-cost platform fees. This result in turn drives the difference between Johnson's adoption results (in which platform MFN adoption is always part of an equilibrium with appropriate beliefs) and ours (in which adoption is far from certain because the resulting equilibrium may not be very attractive). These differences arise because of differences in the way demand is modeled. In particular, Johnson employs a unit demand model and maintains an assumption of market coverage. This implies that there is no aggregate demand effect–i.e., that increases in symmetric prices never reduce quantity sold or industry profit. This is not the case in either the general or linear version of our model. In our model, even at the fees that maximize joint platform profits, an individual platform has an incentive under PMFNs to raise its fee (this is exactly Proposition 2): it raises its unit revenue without losing its share of sales, with the aggregate demand effect being shared across all firms (that is, imposing an externality through reduction of demand for the platforms that did not raise their fee but nonetheless faced retail price increases). In Johnson's model, aggregate demand is fixed (by the unit demand and market coverage assumptions); therefore, only shares of sales matter. Since these shares are themselves fixed under PMFNs, an individual platform does not have an incentive to raise fees beyond the point at which joint platform profits are maximized, and PMFNs necessarily increase profits.[3]

3.2 Linear demand

The linear model allows us to explore some aspects of the model for which we do not have general results. Proposition 2 suggests the possibility that 2-PMFN profits might actually fall below the 0-PMFN profits, since fees and prices are higher than in the case of collusive fee-setting. The linear model allows us to examine under what conditions this may arise; the following pair of results demonstrate that which case prevails depends on the own- and cross-price elasticities of demand.

Proposition 3 *In the linear model, 2-PMFN profits are higher than 0-PMFN profits if platforms are sufficiently close substitutes–that is, if $b-d$ is sufficiently small. Specifically, for any $b>0$, there exists a $\overline{d}<b$ such that 2-PMFN equilibrium profits are higher than the 0-PMFN profits for all $d>\overline{d}$.*

Proposition 4 *In the linear model, 0-PMFN profits are higher than 2-PMFN profits if platforms are sufficiently independent and demand is sufficiently inelastic in own price. Specifically, if $d=\alpha b$, then for b sufficiently small there exists an $\overline{\alpha}>0$ such that 0-PMFN profits are higher than 2-PMFN profits for all if $\alpha<\overline{\alpha}$.*

Both propositions are proved algebraically by analyzing $\pi^{2*}-\pi^{0*}$. While the individual profit expressions are complex, the sign of this difference can be shown to be of the same sign as $(2b-d)^2-9(b-d)$. Since this is continuous, increasing in d, and strictly positive at $d=b$, the expression must be positive for all $d<b$ sufficiently close to b, as in the first of these propositions. Similarly, substituting $d=\alpha b$ in this expression, the expression is negative if $b<\frac{9(1-\alpha)}{(2-\alpha)^2}$, which holds in the limit as $\alpha\to 0$ if $b<\frac{9}{2}$. The result then follows by continuity of the expression.

[3] Put differently, in Johnson's model the discrete drop in demand encountered when the buyer's utility hits that of the outside option limits the incentive of the platform to raise fees. Once fees are high enough to create a retail price such that the buyer's outside option binds (which is also the price that maxmizes industry profits) and the platforms capture all the available surplus, there is no incentive to raise fees further because sales will fall to zero. This discrete drop in demand never arises in our model.

It is important to develop some intuition for why the higher prices that result under 2PMFN pricing are more likely to be profitable for platforms the more substitutable they are. One can think of the effects on the platform in the 2PMFN regime as having two effects: a "squeezing the seller" effect and a "softening competition" effect. The "squeezing the seller" effect exists regardless of the interdependence of demand. This captures the idea that each platform knows that the seller is constrained in its pricing, making the seller (optimally) less responsive to a unilateral increase in fee. This leads each platform to raise fees even beyond the collusive fee solution (this is the effect used in proving Proposition 2). Moreover, note that this effect exists without any regard to the substitutability of the products. Even if the two platforms served entirely distinct markets, it would remain true that the constraint to equal pricing would reduce the seller's pass-through of a unilateral fee increase (thus, "squeezing the seller"), leading to higher-than-collusive pricing. The fact that profits fall once fees pass the collusive fees indicates that the firms reach a point where each suffers more from the rival's excessive incentive to raise fees than each gains from its own ability to squeeze the seller directly.

In contrast, the "softening competition" effect exists only when platform demand is interdependent, and its strength increases with the interdependence of demand. Since each platform's implied demand is increasing in the other platform's price, each platform effectively faces less elastic demand when the seller is constrained to symmetric pricing. Any unilateral increase in fee is passed through (equally) in both platform prices, and that increase in the rival platform's price increases the fee-raising platform's demand, mitigating the direct effect of its own higher price. Since this effect serves to raise profits (i.e., the same increase in joint fees has a less negative impact on profits when demand is more interrelated because of the positive effect of a higher rival's price on one's own demand), conditions are more favorable for PMFNs to raise equilibrium profits when it is at work.

4 Endogenous adoption of PMFN policies

This section considers stage 1 of the full game, in which firms simultaneously decide whether to endogenously adopt PMFN policies. The above results on whether PMFNs raise profits for the platforms do not suffice to demonstrate whether PMFNs will be adopted in equilibrium when chosen by the platforms simultaneously; rather, we must characterize the outcome when only one firm adopts a PMFN and compare the profits under that equilibrium to 0PMFN and 2PMFN profits. This section continues to employ the symmetric duopoly model.

4.1 General Demand

The results on equilibrium fees and best-response functions can be graphed to develop further intuition about competition under PMFNs and, in particular, about incentives to adopt PMFNs in the first stage of the full game. Figure 1 lays out two sets of best-response functions–those that prevail under 0PMFN and 2PMFN–in a single graph in $f_1 \times f_2$ space. We denote platform i's best-response curve under a scenario with k PMFNs by b_i^k. Best-response functions are for simplicity portrayed as linear, as they are under the linear differentiated product demand model. The two points along the 45-degree line at which b_1^k and b_2^k cross define the 0PMFN and 2PMFN equilibria. The primary value in this figure is in the analysis of competition in the scenario in which only one platform (which we assume to be platform 1) has a PMFN in place. We therefore proceed to construct the best-response functions in this scenario, using bold solid and dashed lines to denote these best-response functions, as indicated in Figure 1.

INSERT FIGURE 1 HERE

First, note that for a particular platform, pricing incentives are determined under either the 0PMFN best-response calculation (there is no PMFN binding and $q^0(f)$ is relevant) or the 2PMFN best-response calculation (there is a PMFN binding and $q^2(f)$ is relevant). Which of these calculations is relevant depends on the relative prices of the two platforms. In particular, the PMFN is irrelevant if $f_1 < f_2$, and the 0PMFN incentives apply. Alternatively, when $f_1 > f_2$, the PMFN binds; the fact that platform 2 does not have a PMFN is irrelevant; and the 2PMFN incentives apply.

Consider platform 2, the platform without the PMFN agreement. At low f_1, platform 2 prices off its b_2^0 curve; since this calls for overpricing the platform with the PMFN, the presence of the PMFN is irrelevant. Once that b_2^0 curve falls below the 45-degree line (at the 0-PMFN equilibrium fee), however, this best-response curve is no longer relevant as the price it dictates will trigger 2PMFN pricing by the seller. Considering this, platform 2 prefers to price off its b_2^2 curve. However, any price above the 45-degree line renders the PMFN not binding, triggering 0PMFN pricing by the seller. As a result, the best response by the non-adopting platform 2 is to match platform 1's fee for all fees between the 0PMFN equilibrium and 2PMFN equilibrium fees. (Put another way, over this range of f_1, profits under the PMFN-binding regime are increasing in f_2 below f_2^2 and profits under the PMFN-not-binding regime are decreasing in f_2 above f_2^0.) Once f_1 exceeds the 2-MFN equilibrium fee, platform 2's b_2^2 is relevant since it prescribes undercutting platform 1, triggering the PMFN policy and making the 2PMFN best-response the relevant curve.

Now consider platform 1. At any f_2 equal to or below the 0-PMFN equilibrium fee, platform 1's best-response is given by b_1^2, which prescribes overpricing platform 2, making the PMFN bind. Since even its 0-PMFN best-response involves overpricing platform 2, the PMFN will certainly be binding; given this, b_2^2 reflects the correct incentives. For any fee equal to or above the 2-PMFN equilibrium fee, platform 1's best-response is given by b_1^0. Since even the PMFN-binding incentives (reflected in the 2-PMFN best-response) imply a best-response fee at which the PMFN is not binding (i.e., lie above the 45-degree line), the PMFN will not be binding and b_1^0 gives the correct best-response. Somewhere between the 0- and 2-PMFN equilibrium fees there lies a fee $\widehat{f}_2$ at which firm 1 is indifferent between undercutting and overpricing platform 2's fee. Since firm 1 is indifferent between these two strategies, it is part of a mixed strategy equilibrium for firm 1 to randomize between $b_1^0(\widehat{f}_2)$ and $b_1^2(\widehat{f}_2)$ with any probabilities σ and $1-\sigma$, respectively. In addition, there is a unique $\hat{\sigma}$ for which $\hat{f}_2$ is the best response of platform 2 to platform 1's mixing strategy; more formally, there exists a $\hat{\sigma}$ such that $\hat{f}_2 = \arg\max_{f_2} \;\; \hat{\sigma}\pi_2(b_1^0(f_2), f_2) + (1-\hat{\sigma})\pi_2(b_1^2(f_2), f_2)$. This follows from the continuity of the profit function. If $\hat{\sigma} = 0$ then the argmax is f_2^2, and if $\hat{\sigma} = 1$ then the argmax is f_2^0. There is some $\hat{f}_2$ in between that is the best response of platform 2 to platform 1's mixing strategy $\hat{\sigma}$. This $\hat{f}_2$ and $\hat{\sigma}$ constitute a mixed strategy equilibrium to the simultaneous pricing subgame when only platform 1 has adopted a PMFN policy. This yields the figure as drawn (for an arbitrary and illustrative $\widehat{f}_2$ between the two equilibrium fees). The following proposition follows from this analysis.

Proposition 5 *Assume (A1)-(A5) hold. Then (1) there can be no pure-strategy equilibrium in fees when exactly one firm has a PMFN agreement, and (2) there is a mixed-strategy equilibrium in which firm 2 sets $\widehat{f}_2$ (such that $f_i^{0*} < \widehat{f}_2 < f_i^{2*}$) and firm 1 randomizes with appropriate probabilities between $b_1^0(\widehat{f}_2)$ and $b_1^2(\widehat{f}_2)$.*

Without further structure on demand, it is impossible to evaluate $\widehat{f}_2$ or the profits in this mixed strategy equilibrium. It is therefore not possible to assess in general the profitability of the unilateral adoption of a PMFN policy as required to characterize the equilibrium of the full game with adoption of PMFN policies preceding price-setting. However, this analysis is sufficient to characterize the pure strategy equilibria of the related game in which PMFNs are adopted or not simultaneously with the setting of transaction fees.

Proposition 6 *Consider a game with the alternative timing in which platforms simultaneously set fees and adopt PMFNs in the same stage. Then there are exactly two pure strategy equilibria; one in which both firms adopt PMFNs and set fees f_i^{2*} and one in which both firms do not not adopt PMFNs and set fees f_i^{0*}.*

PMFNs may or may not be adopted in this game depending on the equilibrium selection mechanism. It remains true as in the earlier propositions that either of these equilibria may be the more profitable one for the platforms, depending on the substitutability of the products and other characteristics of demand. Note that this implies that in this game with alternative timing it is possible to experience a coordination trap in two forms: firms might fail to adopt PMFNs when it is profitable and firms might also adopt PMFNs when they raise prices so high as to lower profits.

4.2 Linear Demand

Focusing on the linear demand model does allow us to more fully characterize incentives for PMFN adoption. First, it allows a straightforward corollary to the last proposition, combining it with the earlier result on the relative profitability of 0PMFN and 2PMFN equilibria.

Corollary 7 *Consider a game with the alternative timing in which platforms simultaneously set fees and adopt PMFNs in the same stage, and assume an equilibrium selection rule that eliminates equilibria that are Pareto-dominated from the point of view of the platforms. Then in the unique Pareto-undominated pure strategy equilibrium both platforms adopt PMFNs if the two platforms are sufficiently close substitutes.*

Moreover, focusing on the linear demand model allows us to characterize equilibrium adoption in the full game, with simultaneous adoption of PMFN policies preceding simultaneous fee-setting by the platforms. What is required to characterize the conditions for equilibrium mutual adoption of PMFN policies is an understanding of the 1PMFN equilibrium profits. In what follows, asterisks indicate profits in under the fees that arise in equilibrium of the ensuing fee-setting subgame, the superscript indicates the number of platform with PMFN policies, and the subscript indicates the platform, where platform 1 is the adopter in the 1PMFN subgame. If $\pi_i^{0*} < \pi_1^{1*}$ (a single PMFN adopter finds the policy profitable) and $\pi_2^{1*} < \pi_i^{2*}$ (a single PMFN non-adopter finds it profitable also to adopt the policy), then mutual adoption is the unique equilibrium in the full game. We proceed by showing that both of these are true in the linear model when platforms are close enough substitutes.

That the first inequality holds is easy to see. The sole adopter's profit is $\pi_1^{1*} = \pi_1^0(b_1^0(\widehat{f}_2), \widehat{f}_2) > \pi_i^0(f^{1*})$. That is, the sole adopter's 1PMFN equilibrium profit is the profit at that firm's best response to a rival's higher price, compared to the 0PMFN equilibrium. This is clearly higher since higher rival's prices directly raise profits under 0PMFN pricing by the seller.

The second inequality is much more complicated to assess, as it requires the non-adopter's profit under 1PMFN, which is a weighted average of being undercut and overpriced by the adopting firm while maintaining the price $\widehat{f}_2$. First, note that being overpriced in the mixed strategy equilibrium is always worse than being in the 2PMFN equilibrium. To see this, note that $\pi_2^2(b_1^2(\widehat{f}_2), \widehat{f}_2) < \pi_2^2(b_1^2(\widehat{f}_2), b_2^2(b_1^2(\widehat{f}_2)) < \pi_2^2(f_2^{2*})$. The first of these inequalities follows from the fact that platform 2 would certainly rather be best-responding to the adopter's price (in the figure, platform 2 would rather be on b_2^{2*}, directly above the point at which platform 1 overprices against $\widehat{f}_2$). The second inequality follows from the fact that profits under the 2PMFN equilibrium are decreasing in the rival's fee (in the figure, platform 2 would rather be at the 2PMFN equilibrium than down the b_2^2 curve at a higher f_1).

Now, in addition we show, as a sufficient condition, that platform 2 also prefers the 2PMFN equilibrium to being undercut.[4] This seems natural, in the sense that the situation in which platform 1 is able to best-respond to $\widehat{f}_2$ with an undercutting fee, and in which the seller, in turn, is unconstrained by any PMFNs in altering prices to reflect these relative prices, seems very grim indeed for the non-adopting platform 2. However, it does not immediately follow that the non-adopter prefers the 2PMFN equilibrium to this since it is at least conceptually possible that the 2PMFN pricing is so high that it is preferable to be undercut at some price intermediate to the 0PMFN and 2PMFN equilibrium pricing. The earlier results suggest that this will not be the case when platforms are close substitutes, so that the 2PMFN fee equilibrium is not so high as to be terribly destructive of platform profits. This is true, although the algebra to prove the result is extremely tedious; it is therefore reserved for the Appendix.

Proposition 8 *Consider the full game, in which platforms simultaneously adopt PMFNs prior to simultaneously setting fees. Then if platforms are sufficiently close substitutes, both firms adopt PMFN policies.*

5 The effects of PMFNs on entry incentives

This section explores the effects of PMFNs on entry incentives. Obviously, for symmetric firms, whether PMFNs induce additional entry or curtail entry depends on how they affect equilibrium profits. This follows directly from the results proved earlier on when adoption of PMFNs raises equilibrium platform profits. What is of interest in this section, therefore, is the effect that PMFNs might have on the entry of firms with different characteristics in demand or cost, or on the endogenous selection of those characteristics. We will consider the sequential entry of a firm facing different demand or cost parameters against an incumbent firm with a PMFN in place. Given that PMFNs explicitly rule out a low-price entry strategy for an entrant, and given that such a strategy is likely to be especially important for an entrant who has a lower cost or a lower-value platform, it is natural to assume (as in the conventional wisdom described in the introduction) that a PMFN policy by an incumbent inhibits entry by lower-cost, lower-value platforms. For example, one might expect that adoption of a PMFN by a full-service platform would make entry by platform with a bare-bones,

[4] Note that this condition is sufficient but not necessary. What is necessary is that the *weighted average* of the nonadopter's 1PMFN profits under the mixed strategy equilibrium is lower than its 2PMFN profit. For tractability, we focus instead on conditions for which *each component* of that weighted average is smaller.

low-cost (and potentially) low-price business model much more difficult, given the constraint it places on the seller's ability to pass through those lower costs or to offer a discount price for transactions through the lower-quality platform. Similarly, one could argue that these same forces would lead an entrant endogenously determining its cost and value characteristics to choose a higher-cost, higher-value position or business model than it might have done otherwise.

To analyze these questions we focus on the linear demand model but allow two kinds of asymmetry. Specifically, we allow $c_2 < c_1$, where firm 1 refers to the incumbent throughout this section. We also permit the possibility that the entrant has a lower value offering, resulting in a reduction in demand of $x > 0$ for any given prices: $\widehat{q}_1(p) = a - bp_1 + dp_2$ and $\widehat{q}_2(p) = a - x - bp_2 + dp_1$. Note that lower x need not reflect an "inferior" platform in a general sense; it is a platform that faces lower demand at given prices, but this may be accompanied by lower variable or fixed costs that make the entrant quite a viable competitor and a potential contributor to total welfare. Similarly, a lower cost need not make a firm a superior creator of value if it is accompanied by a demand disadvantage.

Given the results on equilibrium PMFN adoption above, we assume that the 2PMFN regime will prevail post-entry. This is basically an assumption that either the entrant adopts a PMFN along with the incumbent, or the entrant is asymmetric enough that the fee-setting equilibrium behaves as if there are 2 PMFNs. It is evident in Figure 1 that if the non-adopting platform has a much lower best-response function, there will come to be an intersection of the bolded 1PMFN best-responses where both firms are on their 2PMFN portions of the best-responses; in this case, the (incumbent's) single PMFN is binding because platform 2 is undercutting platform 1 and whether platform 1 (the entrant) in fact has adopted a PMFN policy is irrelevant.

5.1 The effects on implied demand

The basic logic of this argument that PMFNs skew entry away from lower-cost, lower-value business models and toward higher-cost, higher-value business models can be seen directly from the implied demand functions. Again, the basic intuition is that a firm seeking to compete on the basis of low-price (typically, a demand-disadvantaged or marginal cost-advantaged firm) has a hard time competing when the possibility of undercutting the higher-value, or higher-cost incumbent is precluded.

For the case of x this is evident in the implied demand functions if $\frac{\partial q_2^{2*}}{\partial x} < \frac{\partial q_2^{0*}}{\partial x} < 0$–that is, if increases in x lowers demand more quickly in the presence of 2PMFNs. This reflects the seller's inability to discount the lower-value platform in order to attract customers to it. It is easy to check from the (linear) implied demand functions that this is true: $\frac{\partial q_2^{2*}}{\partial x} = -\frac{3}{4} < -\frac{1}{2} = \frac{\partial q_2^{0*}}{\partial x} < 0$.

For the case of $c_2 < c_1$ this is evident in the implied demand functions if $\frac{\partial q_2^{0*}}{\partial f_2} < \frac{\partial q_2^{2*}}{\partial f_2} < 0$–that is, if lowering one's fees in response to one's lower marginal cost has a smaller effect on one's sales in the presence of 2PMFN. It is easy to check from the (linear) implied demand functions that this is true: $\frac{\partial q_2^{0*}}{\partial f_2} = -\frac{b}{2} < -\frac{b-d}{4} = \frac{\partial q_2^{2*}}{\partial f_2} < 0$.

Thus, with respect to choices in both willingness-to-pay and marginal cost, the entrant's residual demand more quickly diminishes as its position deviates from the incumbent's (toward lower costs or lower value) when the incumbent has adopted a PMFN policy. In this sense, the incumbent's PMFN can be said to skew incentives for choice of business model or inhibit entry of low-cost, low-value business models.

5.2 The effects on profits

Of course, a full analysis of the incentives for entry are more complex. The analysis in previous sections suggests that PMFNs may raise *levels* of profits, even as they increase the absolute value of the *slope* of profits in quality or costs (that is, making profits fall more quickly as a platform becomes more downward differentiated). It seems entirely possible that the former effect might outweigh the latter, causing PMFNs to encourage the entry of competing platforms even as they skew incentives for competitive positioning. To make progress in understanding these competing effects, we need to characterize the relationship of profits to competitive position across regimes both with and without PMFNs. For tractability, we pursue this for the case of differentiated products ($x > 0$) with zero costs throughout the model ($c_1 = c_2 = c_S = 0$). We are interested in the entrant's profits as a function of x and as a function of whether the incumbent has adopted a PMFN policy. Because we are interested in entry, we are interested in net profits, accounting for fixed entry costs, which we allow to vary with x. The entrant will enter if $\pi_2^{k*}(x) - f_2(x) \geq 0$, where $k = 0, 2$ indicates whether PMFN policies are adopted. (Recall that we assume that the outcome is as if the entrant follows suit, if the incumbent has already adopted a PMFN policy.) We can establish three facts about the relationship between $\pi_2^{0*}(x)$ and $\pi_2^{2*}(x)$, which form the basis for this analysis.

First, from the results proved in the earlier sections, we know that as $x \to 0$ and $d \to b$, $\pi_2^{2*}(x) > \pi_2^{0*}(x)$. Second, for x not too large relative to a (specifically, $x < 2a/7$), both profit functions are downsloping in x ($\frac{\partial \pi_2^{k*}(x)}{\partial x} < 0$, for $k = 0, 2$). This follows from straightforward algebraic manipulation of the derivatives of $\pi_2^{k*}(x)$ with respect to x. This condition is the one that ensures negativity of $\frac{\partial \pi_2^{2*}(x)}{\partial x}$, which is the stronger of the two conditions. Third, for small x, PMFNs make profits diminish more rapidly in the demand disadvantage ($\frac{\partial \pi_2^{2*}(x)}{\partial x} < \frac{\partial \pi_2^{0*}(x)}{\partial x} < 0$). This is intuitive given the earlier result that PMFNs make implied demand decrease more rapidly in the demand disadvantage. This follows from the straightforward comparison of the derivatives of $\pi_2^{k*}(x)$; the desired inequality can be show to hold if and only if $\frac{1-\gamma^2}{(4-\gamma^2)^2} < \frac{7}{36}$, which can be shown to hold for all $\gamma \in [0, 1]$.

5.3 The effects on entry when entrant's quality is exogenous

Together, these facts yield the scenario captured in Figure 2.[5] For small demand disadvantages, PMFN policies raise equilibrium post-entry profits. However, because PMFNs also make profits more sensitive to the demand disadvantage, this relationship may reverse for large enough x. As the demand disadvantage increases, the presence of PMFNs causes the entrant's profit to fall more quickly, implying that the ordering of profits $\pi_2^{0*}(x)$ and $\pi_2^{2*}(x)$ may potentially reverse. As a result, whether the incumbent's PMFN policy encourages or discourages entry depends on the exogenous demand disadvantage x of the entrant and its associated fixed cost $f_2(x)$.

INSERT FIGURE 2 HERE

Figure 2 depicts the effect of PMFNs on entry for any pair of exogenous x and $f_2(x)$. At the top of the figure, fixed entry costs are so high that the entrant does not enter regardless of whether the incumbent adopts a PMFN policy. At the bottom, fixed entry costs are so low that the entrant enters regardless of whether the incumbent adopts a PMFN policy. At left is a region in which the profit-increasing effects of PMFNs encourage the entry of the relatively similar entrant. To be clear, here the entrant would not enter absent a PMFN policy, but does enter when the incumbent

[5] It is easy to graph a numerical example corresponding to this graph. For example, for $a = 10$, $b = 4$, $d = 3$, and $x \in [0, 1]$, the figure looks much like this, with a slight convexity to both profit curves and an intersection at about $\frac{1}{2}$.

adopts PMFN. At right is a region in which the augmentation of the demand disadvantage by the PMFN policy is so strong that it outweighs the profit-increasing effects of PMFNs, and entry of the more demand-disadvantaged entrant is deterred. Again, in this region the entrant would have entered absent the incumbent's PMFN policy but is deterred by that policy. This figure clearly demonstrates both the legitimacy and the limits to the conventional wisdom that PMFNs curtail entry by low-end platforms. The conventional wisdom applies in the shaded region, but only there, when the entrant contemplates entry with an exogenous competitive position. These arguments are summarized in the following proposition (which, in addition, relies only on continuity arguments).

Proposition 9 *Assume that all costs are approximately zero ($c_1, c_2, c_S \simeq 0$) and that a potential entrant has an exogenous differentiated position ($x > 0$). Then the incumbent's adoption of a PMFN policy encourages entry (raises post-entry profits relative to those that arise absent PMFNs) if the entrant is not too differentiated; if the policy discourages entry (lowers post-entry profits relative to those that arise absent PMFNs), it is only for entrants with a sufficiently large difference in position.*

5.4 The effects on entry when entrant's quality is endogenous

We can also consider the effect on entry by an entrant that endogenously chooses its competitive position x, by evaluating $\pi_2^{k*}(x) - f_2(x) \geq 0$ for an endogenously chosen $x_2^{k*} = \arg\max_x \pi_2^{k*}(x) - f_2(x)$. For $f_2(x)$ convex enough, the net profit will be concave for $k = 0, 2$, and we maintain this assumption throughout this section. We also restrict x to some compact interval, $x \in X$. Because increases in x correspond to lower quality, it is natural to model f_2 as decreasing. Convexity of $f_2(x)$ then implies that the largest cost savings come from the first departures from symmetry ($x = 0$), with these cost savings becoming smaller at the margin as the platform becomes more downward-differentiated (x increases). Note that the third fact above (that the slope of profit in x is greater under PMFNs) means that PMFNs will bias the entrant's optimal x down (toward more similar platforms). This is most easily seen by considering the fact that the first-order condition under PMFNs at the no-PMFN optimal x must be negative. As a result, if there is an interior optimal x under either regime, then $x_2^{2*} < x_2^{0*}$ (i.e., regardless of whether the other regime has an interior or corner optimum).

Proposition 10 *Assume that a potential entrant chooses its position $x \in X$ after observing the incumbent's PMFN adoption decision, and that the entrant's optimal x is interior to X either with or without PMFNs (or both). Then if entry occurs regardless of PMFN adoption, the entrant chooses a less differentiated position (strictly smaller x) when the incumbent adopts a PMFN policy.*

Whether entry is encouraged or deterred due to the incumbent's PMFN now rests on the profit that is obtainable by the entrant at its optimal competitive position, which may vary with the incumbent's PMFN decision. We must separately determine x_2^{k*}, and then evaluate $\pi_2^{k*}(x_2^{k*}) - f_2(x_2^{k*})$ for each k.

Two possibilities arise. It may be that the optimized net profit $\pi_2^{k*}(x_2^{k*}) - f_2(x_2^{k*})$ is higher under 0PMFN or 2PMFN. When it is higher under 0PMFN this indicates that the incumbent's PMFN policy may deter entry, in the sense that it is reducing the maximal profit available to the entrant. When it is higher under 2PMFN then the incumbent's PMFN policy may encourage entry, in the sense that it is increasing the maximal profit available to the entrant. Given the analysis of the exogenous-x case, it seems natural that the former (entry-deterring) scenario is more likely when the optimal x absent PMFNs is high, which will be the case when cost savings associated with higher x are significant. Similarly, the latter (entry-encouraging) scenario is more likely when the optimal x absent PMFNs is low, as when cost savings are relatively small.

It is possible to use numerical examples to illustrate these possibilities. For simplicity, assume that $f_2(x) = F - w\sqrt{x}$, which is convex as assumed. Fixing w, one can then find the optimal x (which will not depend on the fixed component of cost F), and the profits at that optimal x, net of all costs except F. This then yields the threshold F^k at which entry is realized under the various scenarios. Comparison of this F^k under the 0PMFN and 2PMFN scenarios then determines whether entry is encouraged or discouraged (or unaffected) by the incumbent's PMFN policy. In both of the following examples, $a = 10$, $b = 4$, $d = 3$, and $x \in [0, 1]$.

First consider a case in which cost savings are significant enough to create an interior x_2^{0*} but still relatively small: $w = 1$. Here, $x_2^{0*} = 0.2$ and $x_2^{2*} = 0$. The threshold fixed costs are $F^0 = 8.2$ and $F^2 = 11.1$. Thus, for low fixed costs ($F < 8.2$), there is entry regardless of the incumbent's adoption of a PMFN policy, and the chosen x is reduced by the incumbent's PMFN policy. For intermediate entry costs ($F \in (8.2, 11.1)$), entry occurs only if the entrant incumbent adopts a PMFN policy. For high entry costs ($F > 11.1$), there is no entry regardless of the incumbent's PMFN adoption decision.

Now consider a case with more significant cost savings: $w = 7$. Now, $x_2^{0*} = 1.0$ and $x_2^{2*} = 0.25$. The threshold fixed costs are $F^0 = 13.85$ and $F^2 = 12.75$. For low entry costs ($F < 12.75$), there is entry regardless of the incumbent's adoption of a PMFN policy, and the chosen x is reduced by the incumbent's PMFN policy. For intermediate entry costs ($F \in (12.75, 13.85)$), entry occurs only if the entrant incumbent *does not* adopt a PMFN policy. For high entry costs ($F > 13.85$), there is no entry regardless of the incumbent's PMFN adoption decision. This case is depicted in Figure 3.

INSERT FIGURE 3 HERE

This case, in which cost savings are sufficiently high that an entrant would choose a substantially different position from the incumbent absent PMFN policies, illustrates precisely the conventional wisdom. Here, for low fixed costs, there is entry regardless of the PMFN policy, but the presence of the policy distorts the entrant's choice of position and leads the entrant to choose a less differentiated and higher-end business model. For intermediate fixed costs, the PMFN deters entry that would have occurred absent the policies, because the entrant would have maximized its profits by choosing a very differentiated position that is penalized too heavily by the PMFN. This illuminates the potential for both deterrence of low-cost business model entry and the distortion of business model choice when entry does occur.

Comparing this case with the prior case, in which cost savings were more modest, also demonstrates the limitations of the conventional wisdom. When an entrant would not choose a very differentiated position absent the incumbent's PMFN policy, the skewing of that position by the PMFN is unlikely to deter entry; in fact, it is quite possible that the price-raising effects of the PMFN will encourage entry that would not have occurred absent the PMFN. Obviously, a full analysis of whether the encouragement, deterrence, or skewing of entry increases or decreases social welfare requires much more structure on both demand and costs, and is beyond the scope of this paper.

6 Conclusion

We study the effects on pricing and entry of platform MFN policies–a type of policy not widely studied in the extant literature, but one that is of increasing interest and importance in antitrust enforcement. It is worth reemphasizing that these platform MFN policies are not the same as traditional MFN policies, which have been the subject of considerable theoretical inquiry (see, for example, Cooper (1986) and Besanko and Lyon (1993)). In our main model, in which one supplier (our "seller") sells through two symmetric intermediary retailers (our "platforms"), a traditional MFN policy is of no consequence. Consider adapting our model to the alternative contracting arrangement in which the supplier sets wholesale prices for the retailers, with the retailers subsequently (and simultaneously) setting retail prices (which is the arrangement to which a traditional MFN applies). A traditional MFN policy would then consist of contractual provisions that ensure uniform wholesale prices (that is, the supplier cannot sell to any retailer at a price lower than the price at which it sells to the other retailer). Absent MFN policies, the supplier optimally chooses symmetric wholesale prices to maximize its profit given the anticipated markups of its retailers. Constraining the supplier to set uniform wholesale prices through an MFN policy therefore has no effect.[6] Similarly, traditional MFN policies would have a less dramatic effect on the incentives of low-end business model entrants. While a traditional MFN policy would prevent the upstream producer from favoring a low-end entrant with a lower wholesale price (and might therefore reduce the entrant's post-entry profits somewhat), it would not prevent the low-end entrant from competing on price altogether, as is the case with a platform MFN. Thus, the effects of platform MFN policies are different from those of traditional MFN policies and warrant careful theoretical examination.

We show that platform MFN agreements tend to raise fees charged by platforms and prices charged by sellers, and that these policies are adopted in equilibrium and increase platform profits when the platforms are close substitutes. However, when platforms are not close substitutes platform MFNs may raise prices so high that industry profits fall. We also show that the adoption of a platform MFN agreement by an incumbent platform can discourage entry by an entrant if it is sufficiently downward-differentiated; however, when the potential entrant has a business model relatively similar to the incumbent's, platform MFNs actually work to encourage entry through their price-raising effects. Moreover, when entry occurs regardless of the incumbent's adoption of a platform MFN policy, platform MFNs have the effect of distorting the entrant's choice of business model towards a model more similar to that of the incumbent. These results have important implications for ongoing antitrust scrutiny of these policies in ebook, credit card, and health care markets.

7 Appendix

With linear demand, platform 2's profits at the 2MFN fee equilibrium are:

$$\pi_2^{2*} = \pi_2^2(f_1^2, f_2^2) = \frac{1}{36(b-d)}\left(2a - (b-d)(c_1 + c_2 + 2c_s)\right)$$

[6] A long literature in this field considers more complex contracting games, including the scenario in which there is secret bilateral contracting rather than simple posting of wholesale prices (see, for example, O'Brien and Shaffer (1992)). Even in such a model, an MFN policy (if enforceable despite the secret recontracting) simply restores the outcome achieved with posted wholesale prices, by eliminating the possibility of secret price cuts.

and platform 2's profits in the 1MFN mixed-strategy fee equilibrium when undercut by platform 1 are:

$$\pi_2^0(b_1^0(\hat{f}_2),\hat{f}_2) = (1/2)(\hat{f}_2) - c_2)(a + dc_s - b(\hat{f}_2 + c_s) + (1/2b)\left(d(a + b(c_1 - cs) + d(\hat{f}_2 + c_s)\right)$$

where $\hat{f}_2$ is given by:

$$\hat{f}_2 = \frac{b-d}{b^2 - 3bd + 2d^2}(2(a - (b-d)c_s) - bc_1) \pm \sqrt{2}\sqrt{b(a - (c_1 + c_s)(b-d))^2(b-d)}$$

Substituting $\hat{f}_2$ into $\pi_2^0(b_1^0(\hat{f}_2),\hat{f}_2)$ and defining $Z = \pi_2^2(f_1^2, f_2^2) - \pi_2^0(b_1^0(\hat{f}_2),\hat{f}_2)$, any parameter values for which $Z \geq 0$ support PMFN adoption by platform 2. It is helpful to define $h = \frac{d}{b} \in (0,1)$ as a measure of substitutability between the platforms; by substituting $d = hb$, this simplifies the expressions greatly. Under the maintained assumption of symmetry ($c_1 = c_2$), it can be shown that

$$sign(Z) = sign(2\left(38 + h - 28h^2\right) \pm 9\sqrt{2-2h}\left(-6 - 3h + 2h^2\right)).$$

For any h, $\left(38 + h - 28h^2\right) > 0$ and $\left(-6 - 3h + 2h^2\right) < 0$. Therefore the negative root guarantees $Z \geq 0$. For the positive root, it can be shown that $Z \geq 0$ for h larger than the value of a complex expression that can be shown numerically to be approximately 0.303.

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Figure 1: Best-responses with asymmetric PMFN adoption

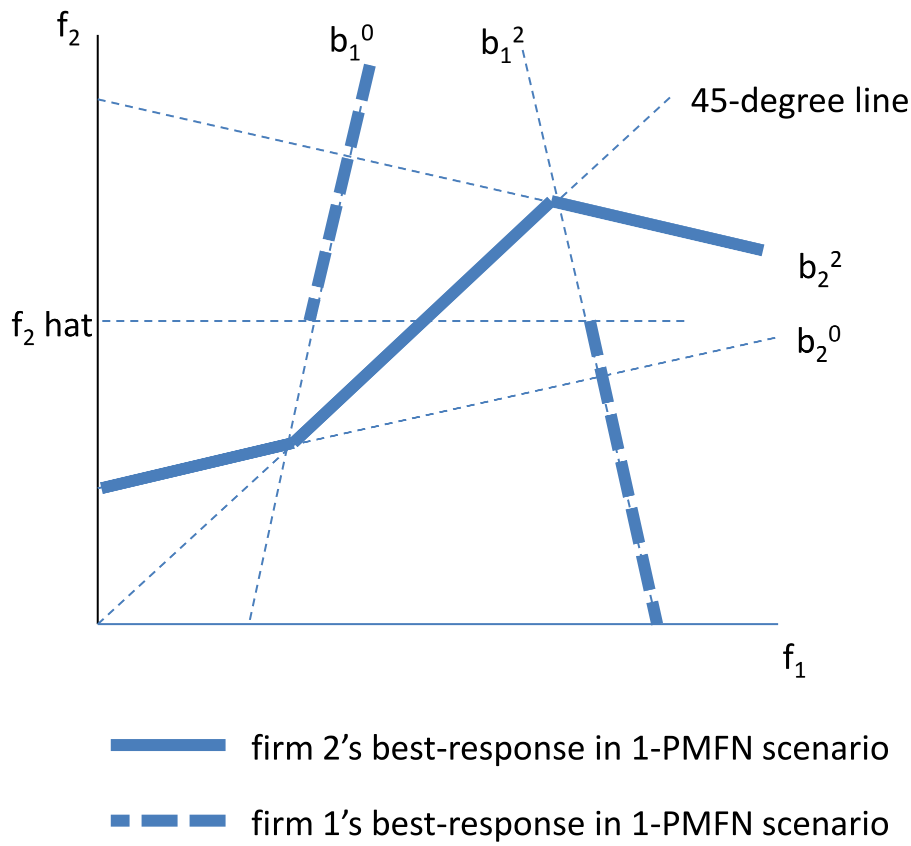


Figure 2: The effects of PMFNs on entry with exogenous position

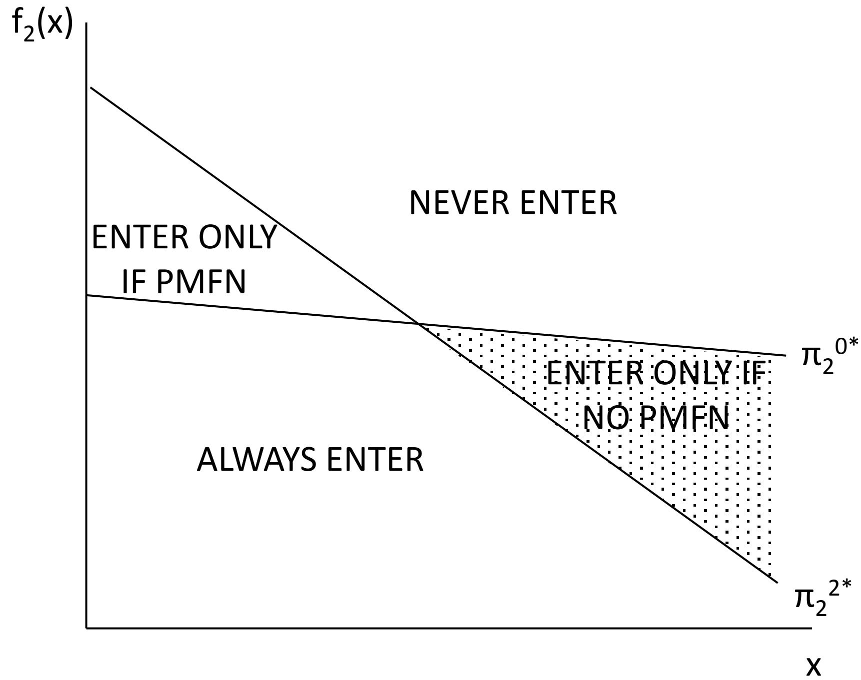
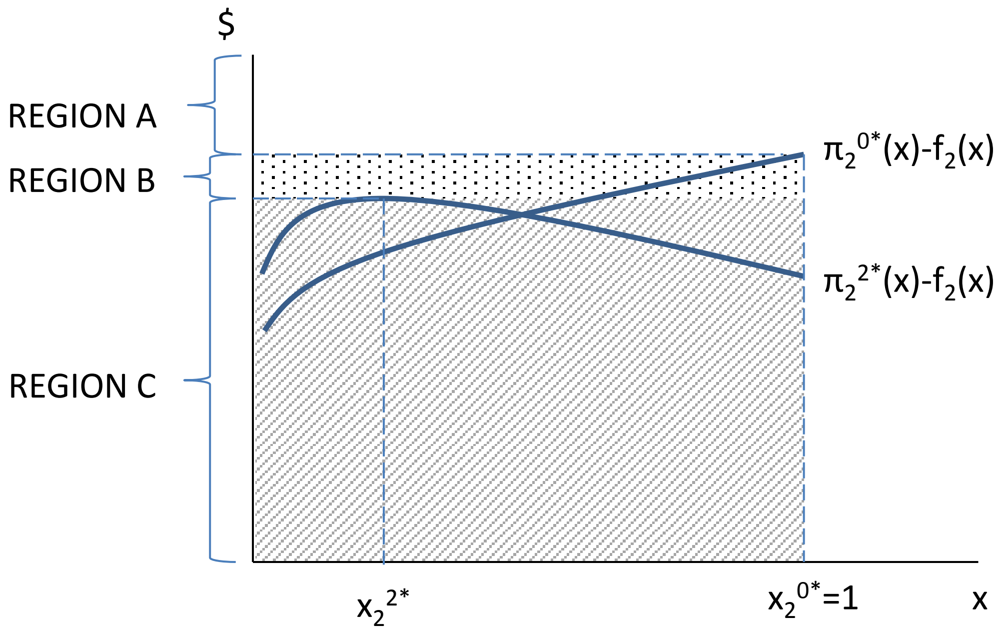


Figure 3: The effects of PMFNs on entry with endogenous position



F in REGION A: incumbent's PMFN has no effect; no entry
F in REGION B: incumbent's PMFN deters entry
F in REGION C: incumbent's PMFN does not deter entry,
but does distort entrant's position