

Price Chokeholds with Minimum Margin Agreements

Kevin Mi*

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Abstract

Platforms often enforce pricing policies onto sellers such as the minimum margin agreement (MMA). MMAs require that platforms receive a guaranteed profit-margin on seller goods. If the margin is not met then any difference between the actual margin is taken from the seller. I develop a model where a seller sells through a direct channel and serves as a supplier for a separate platform. Under MMAs, a platform can threaten the seller to flood the market demand by pricing low and capturing a guaranteed profit. I show that MMAs potentially lead to an increase in platform facilitated purchases and inflate both direct and intermediated prices. Platforms prefer being able to implement MMAs given they have sufficiently high bargaining power over wholesale price. Furthermore, I find that MMAs may be more prevalent when the seller faces competition and platforms can steer buyers towards specific goods.

Keywords: platforms, intermediaries, wholesale, showrooming

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*Department of Economics, Michigan State University, E-mail: kwmi@msu.edu

1 Introduction

First-party sellers, also known as wholesale sellers or resellers, supply platforms with their good, in which platforms then resell the good to buyers while also controlling pricing, shipping, marketing, etc. Sellers hope that the platform will provide access to consumers that they would otherwise not be able to reach. Under these circumstances, platforms have attempted to enforce policies towards sellers that affect how sellers price their good on or off the platform. One such policy known as the “Guaranteed Minimum Margin Agreement” (MMA) has recently been brought up in *Brown et al. v. Amazon.com, Inc.* (2023) and *California v. Amazon.com, Inc.* (2022). MMAs are agreements that guarantee the intermediary a certain profit-margin from first-party sellers. Moreover, the plaintiffs in *Brown et al. v. Amazon.com, Inc.* (2023) note that larger corporations (e.g. Nike, P&G, Apple, etc.) are often targeted for MMAs by being restricted as first-party sellers.

“To illustrate how the MMAs work, a supplier may agree, for example, to sell its product at a wholesale price of \$5 per unit and that it will compensate Amazon if it receives less than \$4 over its marginal cost. If Amazon sells ... the supplier’s product for \$9 or more, the supplier owes Amazon no money. But if, in this example, Amazon lowers its price to \$8 to match a competitor’s price that month, then the supplier will owe Amazon \$1 for every product sold ...” (*Brown et al. v. Amazon.com, Inc.*, 2023)¹

The *Brown et al. v. Amazon.com, Inc.* (2023) lawsuit claims MMAs violate Section 1 of the Sherman Act and constitute as an abuse of monopoly power. The plaintiffs argue that platforms utilize MMAs to squeeze more profits out of sellers by reducing online retail competition and artificially raising prices. In addition, sellers are often forced to accept such policies, as platforms can still inadvertently enforce them by taking sellers off prominent search positions, e.g. Amazon chooses which sellers to show on their Buy Box.

MMAs have been prevalent in the past, appearing in the retail fashion industry.² Because many small suppliers struggle to find floor space in department stores and due to the volatility in the fashion industry, vendors typically have weak bargaining power and find themselves susceptible to MMAs. However, the challenge sellers face on online platforms differ in that many sellers have their own channels to distribute their goods, which often applies for large sellers. That is, if an intermediary imposes MMAs, sellers would either want

¹I omit details about quantity thresholds required for MMAs to be in effect in my model.

²MMAs have also been referred to as a guaranteed profit-margin contract in previous literature.

to avoid the MMA contract binding by increasing prices on other platforms or leaving the platform altogether. Motivated by the arguments presented in the lawsuit and the seller’s option to sell through their own channel, I first aim to answer the two following questions.

1. What are the welfare implications of MMAs when sellers have their own direct channel?
2. Under what circumstances do sellers join the platform when they enforce MMAs?

When considering MMAs as a viable policy, one’s first intuition may be the following: with MMAs in effect, why can’t the platform just price so low to flood the market and obtain a guaranteed profit? Using the example provided above, if the guaranteed profit-margin stated in the MMA is \$4, the platform should theoretically be able to price low (e.g. setting price to 0 effectively giving away the seller’s product for free), and capture \$4 times the market size in profits. There is an intuitive answer if we are considering a dynamic environment. Platforms and sellers have a mutual relationship. Sellers rely on platforms, because they provide benefits to buyers and often have an advantage in terms of user experience, reliability, etc. Intermediaries rely on sellers to gain profit. In practice if platforms price this way, sellers would no longer sell through the intermediated channel in future periods. Thus in a dynamic setting, reputational consequences may hinder flooding the market demand. However in a static setting, are platforms incentivized to flood the market?

In this paper, I model a first-party seller’s decision to join an intermediary with and without MMA implemented. The seller competes with a monopolist intermediary through their own direct channel. Additionally, consumers have a heterogeneous bias towards the platform. I generalize results based on a wholesale price that is bargained for before the game begins. This means that my results are not limited to only the extreme cases where either the seller or intermediary control wholesale price. I then endogenize parameters to determine the effects of a potential ban on MMAs.

I find that platforms only prefer the option of implementing MMAs if they have a sufficiently high bargaining power over the seller. In such a scenario, the effect of MMAs are similar to that of previously studied price coherence policies. MMAs cause excessive intermediation, reduce marketplace leakage, and most importantly may increase prices on both the intermediated and direct channels. Indeed, intermediaries can extract additional consumer and seller surplus such that it is lower than when MMA is not implemented. Moreover, I show that for any good that has a valuation above its production cost, there exists a wholesale price and guaranteed profit-margin such that MMA can be implemented and the seller will join the platform. Lastly, MMA is more viable after accounting for seller competition and platform steering. This result is mainly driven by a lower outside option for the seller.

After a brief literature review, the paper proceeds as follows. In Section 2, I provide a baseline model without MMA being implemented and I analyze the model in Section 3. In Section 4 I solve the baseline model under MMAs and endogenize parameters. Section 5 extends the model to account for platform steering and competing sellers. Section 6 briefly discusses implications and concludes.

1.1 Literature Review

There is an extensive literature focusing on platform pricing policies imposed on independent sellers. More specifically, literature on price parity clauses (PPC) have shown that PPC can cause an increase in the price of direct purchases and decrease marketplace leakage/showrooming. (Edelman and Wright, 2015, Boik and Corts, 2016, Wang and Wright, 2020, and Hagiu and Wright 2024) The key difference between these studies and my paper is that price-setting on the platform is no longer controlled by the seller and platform profits are not obtained through transaction fees. Other papers have addressed the dual role of platforms - as a marketplace owner and seller including Zhu and Liu (2018), Chen and Tsai (2019), Anderson and Bedre-Defolie (2022), and Hagiu et al. (2022). The main concern with the dual-role is the possibility of “self-preferencing” where platforms favor their own products over independent sellers. I address a similar possibility in Section 5 where the platform can either steer consumers towards its own product or the seller’s good.

Several works have analyzed the traditional wholesale model where suppliers set wholesale prices and retailers set retail prices. (Foros et al. 2013 and Johnson 2017) While their work focuses on the trade-offs of relinquishing control rights to different parties, my aim is specifically the mechanism of how MMAs affect wholesale suppliers. Therefore in my environment, the monopolist platform has already chosen to operate as a reseller and this key trade-off is ignored.

I contribute to the limited literature on MMAs. Early studies of literature focused on how MMAs affected the retail and fashion industry. Krishnan and Soni (1997) examines a competitive setting between two manufacturers and two retailers. They show that MMAs can extract profits from manufacturers by playing brands against each other. Lee and Rhee (2008) model a vendor supplying a good to a retailer finding that MMAs can provide win-win outcomes for both the retailer and vendor. Zheng et al. (2023) build upon this literature and consider the setting with a single manufacturer supplying to two retailers, one of which enforces MMAs. They find that win-win, lose-lose, win-lose, and lose-win outcomes for the manufacturers and retailer that imposed MMA are all possible. My model strays away from the fact that manufacturers cannot serve as their own “retailer” in other channels. In

reality, a first-party seller may serve both as a platform and supplier (e.g. online marketplaces and physical retail). Additionally, my framework considers the cases where sellers and the platform do not have full control over parameters in MMAs such as the wholesale price and guaranteed profit-margin. To the best of my knowledge, my paper is also the first to model MMAs under platform steering.

The environment in my paper closely follows Hagiu and Wright (2024). Hagiu and Wright (2024) model an independent seller controlling prices on a platform and their own direct channel to explore various ways platforms can prevent showrooming including PPC. Instead, the seller in my framework serves as a supplier to the platform such that there are no transaction fees and the seller only controls pricing on the direct channel. I also focus more on welfare implications and possible outcomes of MMAs.

2 Baseline model

Suppose there is a single platform M , a single first-party seller (supplier) S , and measure one of consumers that purchase at most one unit of S 's good. S 's good is valued homogenously at v by all consumers and it incurs a marginal cost of c to produce, where $v \geq c$. The buyer's have an outside option with valuation zero.

S sells their good to M at wholesale price w , where $v \geq w \geq c$. Here, I do not necessarily assume S or M have full bargaining power over w . Wholesale price w is known by both S and M before any decisions are made. There are two channels such that consumers can purchase from: an intermediated channel through M and a direct channel through S . S and M set prices p_d and p_m , respectively on their channels. Consumers observe the prices and decide whether to purchase a good and from which channel.

Consumers have a bias for M 's intermediated channel. They face a disutility s with distribution G on the interval $[0, \bar{s}]$, with positive density on $(0, \bar{s})$ when buying through S 's direct channel and no cost of purchasing through M . Like Hagiu and Wright (2024), this s can have two different interpretations. One interpretation is that buyer's have no knowledge about S or S 's specific good. In this case, s reflects the cost of switching to S 's direct channel and searching for the good.³ In our model, this is interpreted as S having an outside option of zero profit if they choose not to join M . The other interpretation of s is that S 's good is known to the consumer already, but they face a some disutility of using S 's direct channel relative to using M . This can be reflected in S 's direct channel being less credible/reliable, having a worse user interface, etc. I reflect this through S 's outside option as selling on its direct channel without joining M . M serves different roles in the two interpretations of s . In

³This interpretation can be thought of as showrooming.

the first interpretation, M serves as a platform that offers beneficial product discoveries to consumers. In the second, M serves as a superior marketplace that offers a better experience or external benefits for the consumer (e.g. Amazon.com offers Prime benefits such as faster shipping). Because this second interpretation is more interesting (in the first interpretation the seller always joins the platform if there will be non-negative profits), we focus solely on s as an inconvenience cost.

The timing of the game is as follows: (i) Both S and M observe wholesale price w . S decides whether to join M or not and sets price p_d ; (ii) If S joins M , M observes p_d and sets p_m ; (iii) consumers observe the set price(s) and make their purchasing decision.

2.1 Discussion of assumptions

I will first discuss some key assumptions in the baseline model. I assume that S and M bargain over wholesale price w before the game begins. This means my analysis covers all cases of w . There are a few reasons for this. In practice, sellers may vary in negotiating proficiency and negotiating a contract may take a long period of time. For example, Amazon.com's negotiating process is on an annual basis that requires several meetings with the seller. Sellers also differ based on product type. One would most likely find a higher wholesale price relative to production cost for phones sold by Apple or Samsung versus toilet paper sold by P&G. Lastly, A supplier who dominates a large portion of the product market would have more bargaining power over wholesale price.

I assume consumers have an implicit bias in favor of M . According to a survey conducted by PowerReviews that surveyed 8,153 U.S. consumers in March 2023, more than half of the respondents first start their search on Amazon when shopping online.⁴ Additionally, according to data from Statista, a few key reasons internet users in the U.S. shop on Amazon are: fast and free shipping, Prime membership, easy returns, superior shopping experience, product reviews/recommendations, etc.⁵ Thus, the assumption of consumer bias for M is somewhat grounded in reality.

I focus on a single seller to capture the fact that larger corporations and brands are targeted for MMAs. M actually serves as a marketplace for various sellers (first-party or independent). However, these sellers are not ex-ante identical. I argue that S 's good is so much differentiated either by brand preference or quality that my analysis only applies to a single seller on M . For example, if a consumer is searching on Amazon for a specific Nike shoe, a shoe produced by a smaller brand such as Skechers is not considered a substitute in my model. Even if the different sellers are ex-ante identical other than the market size

⁴See <https://searchengineland.com/50-of-product-searches-start-on-amazon-424451>.

⁵See [statista.com/statistics/670499/us-amazon-usage-reason/](https://www.statista.com/statistics/670499/us-amazon-usage-reason/).

interested in each seller, my analysis would still apply even if wholesale price w remains the same among sellers, because S and M 's profit would just scale by the market size.

An important assumption is that if S joins the platform, M prices p_m after observing p_d . This means that M is a price follower and S is the price setter. Several recent lawsuits make a similar claim that monopolist online platforms act as price followers (e.g. *Brown et al. v. Amazon.com, Inc.* (2023) and *California v. Amazon.com, Inc.* (2022)). One can interpret this as M always monitoring p_d , and reacting to price changes. In reality, the good that S sells wholesale to M will already have prices posted on their direct channel.

3 Baseline analysis

I proceed by solving for the subgame perfect NE. All proofs can be found in Appendix A. Throughout the paper, I use superscript N to represent “under no MMA implementation” and I to represent “under MMA implementation” for equilibrium prices and profits.

Suppose S joins M . A consumer with disutility s purchases on M iff

$$v - p_m \geq \max\{v - p_d - s, 0\}.$$

Consumers will purchase from M if their utility will be greater than their outside option or purchasing directly. M will never set $p_m > v$, because then M 's market demand is 0.

M 's problem is setting $p_m \leq v$ to maximize profit

$$\pi_m = (p_m - w)(1 - G(p_m - p_d)). \quad (1)$$

Let $p_m(p_d, w)$ be the solution to the first-order condition (F.O.C.)

$$1 - G(p_m - p_d) - g(p_m - p_d)(p_m - w) = 0.$$

That is,

$$p_m(p_d, w) = w + \frac{1 - G(p_m(p_d, w) - p_d)}{g(p_m(p_d, w) - p_d)} \geq w. \quad (2)$$

Assuming G satisfies the monotone hazard rate condition and g is continuous over $(0, \bar{s})$, $p_m(p_d, w)$ is the unique solution.

Lemma 1 *If G satisfies the monotone hazard rate condition and g is continuous over $(0, \bar{s})$, $p_m(p_d, w)$ is increasing in p_d and w .*

M 's profit maximizing price $p_m^*(p_d, w)$ is

$$p_m^*(p_d, w) = \begin{cases} p_m(p_d, w) & \text{if } p_m(p_d, w) \leq v \\ v & \text{otherwise} \end{cases}. \quad (3)$$

If S sets a high enough p_d , M will set their price to v . By backwards induction, S sets $p_d \geq c$ and maximizes the following profit

$$\pi_s = (p_d - c)G(p_m^*(p_d, w) - p_d) + (w - c)(1 - G(p_m^*(p_d, w) - p_d)). \quad (4)$$

Denote $p_d(w)$ and $\hat{p}_d(w)$ as the profit maximizing price when $p_m^*(p_d, w) = p_m(p_d, w)$ and $p_m^*(p_d, w) = v$, respectively.

Denote $\bar{p}_d(w)$ as the direct price such that $p_m(\bar{p}_d(w), w) = v$. By Lemma 1, $\bar{p}_d(w)$ is unique. Thus, S 's profit maximizing price $p_d^*(w)$ is

$$p_d^*(w) = \begin{cases} p_d(w) & \text{if } p_m(p_d(w), w) \leq v \\ \bar{p}_d(w) & \text{if } p_m(p_d(w), w) \geq v \text{ and } p_m(\hat{p}_d(w), w) \leq v \\ \hat{p}_d(w) & \text{if } p_m(\hat{p}_d(w), w) \geq v \end{cases}. \quad (5)$$

Both M and S 's optimal prices and corresponding profits will depend on w . When $p_m(p_d(w), w) \leq v$, both S and M can price compete without any price restrictions. In the case that $p_m(\hat{p}_d(w), w) \geq v$, S anticipates M will set v , given their profit-maximizing direct price. The last scenario arises when S wants to price high, but p_m is capped at v . However, if S anticipates M will set price v , their profit-maximizing price is too low such that M will actually set a price lower than v . Therefore, S 's profit-maximizing decision is to set price $\bar{p}_d(w)$.

I now assume s follows a uniform distribution to obtain more specific results. Specifically,

$$G(s) = \frac{s}{\mu}$$

where $G(s) = 0$ for $s < 0$ and $G(s) = 1$ for $s > \mu$. This ensures closed form solutions and allows us to perform comparative statics to changes in μ . A higher μ corresponds to increases in switching costs by first-order stochastic dominance.⁶

Proposition 1 *Suppose S joins the platform, $G(s) = \frac{s}{\mu}$ and $\bar{s} = \mu$. The equilibrium direct*

⁶Given $\mu_2 > \mu_1 > 0$, $G_2(s)$ stochastically dominates $G_1(s)$.

price, intermediated price, seller profit, and platform profit, respectively, are as follows:

$$\begin{aligned}
p_d^N(w, \mu) &= \begin{cases} \frac{\mu}{2} + w & \text{if } w \leq v - \frac{3\mu}{4} \\ 2v - \mu - w & \text{if } v - \frac{3\mu}{4} < w \leq v - \frac{2\mu}{3} \\ \frac{v+w}{2} & \text{if } v - \frac{2\mu}{3} < w \leq v \end{cases} \\
p_m^N(w, \mu) &= \min \left\{ \frac{3\mu}{4} + w, v \right\} \\
\Pi_s^N(w, \mu) &= \begin{cases} \frac{\mu}{8} + w - c & \text{if } w \leq v - \frac{3\mu}{4} \\ (2v - \mu - w)(1 - \frac{v-w}{\mu}) + w \frac{v-w}{\mu} - c & \text{if } v - \frac{3\mu}{4} < w \leq v - \frac{2\mu}{3} \\ \frac{(v-w)^2}{4\mu} + w - c & \text{if } v - \frac{2\mu}{3} < w \leq v \end{cases} \\
\Pi_m^N(w, \mu) &= \begin{cases} \frac{9\mu}{16} & \text{if } w \leq v - \frac{3\mu}{4} \\ \frac{(v-w)^2}{\mu} & \text{if } v - \frac{3\mu}{4} < w \leq v - \frac{2\mu}{3} \\ (v-w)(1 - \frac{v-w}{2\mu}) & \text{if } v - \frac{2\mu}{3} < w \leq v \end{cases}
\end{aligned}$$

Seller profit increases in w , intermediated price weakly increases in w , and platform profit weakly decreases in w .

Proposition 1 describes how S and M respond to w . The effect of w comes from the fact that w serves as M 's marginal cost and as S 's additional profit avenue. This means that if the seller could choose wholesale price, they would set it to v , extracting all the consumer surplus. Indeed, the seller would give up all market demand to M and receive the maximum profit possible. On the other hand, if the platform can choose wholesale price, they would set it to c .

Now, consider S 's decision to join M . Let Π_0 denote the profit of S 's outside option. Inconvenience cost s represents consumer "disutility", but they know of the product and channel beforehand. Consumers purchase from the direct channel iff $v - p_d - s \geq 0$. Specifically, S 's problem is setting p_d to maximize profit $(p_d - c)G(v - p_d)$. Let $\check{p}_d$ be the unique solution to the F.O.C.

$$G(v - p_d) - (p_d - c)g(v - p_d) = 0.$$

The solution satisfies the following condition

$$\check{p}_d = c + \frac{G(v - \check{p}_d)}{g(v - \check{p}_d)}. \quad (6)$$

S will only set this profit-maximizing price if $v - \check{p}_d \leq \bar{s}$. Otherwise, they would set $p_d = v - \bar{s}$.

The seller's profit when only selling on the direct channel in the second interpretation of s is

$$\Pi_0 = \begin{cases} \frac{G(v-\check{p}_d)^2}{g(v-\check{p}_d)} & \text{if } v - \check{p}_d \leq \bar{s} \\ v - \bar{s} - c & \text{if } v - \check{p}_d \geq \bar{s} \end{cases}$$

In the second case, $\bar{s}$ is sufficiently small such that seller S would rather price low to capture the entire market. One can think of this as the valuation of the good being so high, that losing any consumers is worse than having a slight increase in profit margin. In the first case, S will actually trade off an increase in prices for less demand.

Observe that seller S only joins if $\Pi_s^N(w, \mu) > \Pi_0$. To obtain more specific results, I assume $G(s)$ follows the same uniform distribution as before. Under the second interpretation of s , $p_d = \min\{\frac{v+c}{2}, v - \mu\}$ and

$$\Pi_0(\mu) = \begin{cases} \frac{(v-c)^2}{4\mu} & \text{if } v - c \leq 2\mu \\ v - \mu - c & \text{if } v - c \geq 2\mu \end{cases}.$$

Observe that if $v - c \geq 2\mu$, S will join M if $w \geq v - \frac{9\mu}{8}$. When $v - c$ is relatively large to μ , sellers demand a wholesale price close to that of the direct price if they had sold by themselves. When $v - c \leq 2\mu$, S 's decision to join is dependent on the exogenous parameters. I go through S 's decision to join the platform more in Appendix B.

4 Minimum Margin Agreements

Suppose the intermediary can now require a minimum margin agreement (MMA) for the first-party seller. Let some exogenous ϵ denote a guaranteed profit-margin such that if $p_m - w < \epsilon$, then the seller S must pay M back the difference $\epsilon - (p_m - w)$ after consumers make their purchases.⁷ I assume the MMAs' binding conditions are based on fixed profit-margins rather than profit-margin rates used in Zheng et al. (2023).

The timing of the game is now as follows: (i) Both S and M observe wholesale price w and guaranteed profit-margin ϵ . M decides whether to implement MMA or not; (ii) S observes M 's decision and chooses whether to join M or not, and sets price p_d ; (iii) If S joins M , M observes p_d and sets p_m ; (iv) consumers observe the set price(s) and make their purchasing decision.

Before proceeding, it may be helpful to discuss why S would still join M under MMA.

⁷One may argue that ϵ is bargained for just like how we interpret w . Another argument used in Zheng et al. (2023) is that similar ϵ 's are used among different manufacturers within the same industry.

First, observe that M can always price low enough (e.g. set $p_m \leq 0$) such that they flood the entire market and earn ϵ profit. This results in profit loss for S . However, recall that a consumer deciding to purchase on M is comparing $v - p_m$ and $v - p_d - s$, assuming that individual rationality conditions are met. If the seller raises their direct price p_d to $p_d + x \leq v$ and the platform raises their intermediated price p_m to $p_m + y < v$, where $0 < y < x$, more consumers will purchase from the platform at the inflated price. Therefore, flooding the market may not be the best strategy as M has a price chokehold on direct price. That is, S may potentially still prefer increasing their direct price over leaving the platform. However, if sellers do not have a direct channel for distribution, platforms always have an incentive to take the guaranteed profit under MMA resulting in the seller not joining. This is the driving force on why platforms target large corporations.

Suppose M chooses to implement MMA and S joins. The maximum profit that M can earn under any wholesale price w is when seller S sets $p_d = v$. M would subsequently set $p_m = v$ earning $v - w$ profit, where each consumer purchases from the platform. If $\epsilon < \Pi_m^N(w, \mu)$, flooding the entire market demand is inferior to just competing in the scenario without MMA. Thus, the interesting case to analyze is when $\epsilon \in [\Pi_m^N(w, \mu), v - w]$.⁸ M 's maximized profit is

$$\max\{\epsilon, (p_m^*(p_d, w) - w)(1 - G(p_m^*(p_d, w) - p_d))\}.$$

To avoid MMA binding, S must set p_d such that M 's profit is at least ϵ .⁹ I assume $G(s)$ follows the same uniform distribution previously discussed in the baseline analysis to obtain specific results.

Proposition 2 *Suppose s is distributed according to $G(s) = \frac{s}{\mu}$ with $\bar{s} = \mu$, M implements MMA, and S joins M . For $\epsilon \in [\Pi_m^N(w, \mu), v - w]$, S and M 's profit-maximizing prices are*

⁸Note that in theory, ϵ can exceed $v - w$. There are a few reasons I do not consider this scenario. Platform M would never bargain above this threshold and implement MMA as the seller would never join. Also, instead of bargaining above this threshold, the seller can just bargain below $\Pi_m^N(w, \mu)$. Sellers would not want to practically bargain for a higher ϵ .

⁹I refer to "binding" as when $p_m - w < \epsilon$ and S must pay back M .

respectively the following

$$p_d^I(w, \mu, \epsilon) = \begin{cases} 2\epsilon + w - \mu & \text{if } \mu \leq \epsilon \leq \frac{(v-w)^2}{\mu} \\ 2\sqrt{\epsilon\mu} + w - \mu & \text{if } \epsilon \leq \frac{(v-w)^2}{\mu} \text{ and } \epsilon \leq \mu \\ \frac{\epsilon\mu}{v-w} + v - \mu & \text{if } \epsilon \geq \frac{(v-w)^2}{\mu} \end{cases}$$

$$p_m^I(w, \mu, \epsilon) = \begin{cases} \epsilon + w & \text{if } \mu \leq \epsilon \leq \frac{(v-w)^2}{\mu} \\ \sqrt{\epsilon\mu} + w & \text{if } \epsilon \leq \frac{(v-w)^2}{\mu} \text{ and } \epsilon \leq \mu \\ v & \text{if } \epsilon \geq \frac{(v-w)^2}{\mu} \end{cases}$$

Moreover, given w , direct prices increase, intermediated prices weakly increase, and market-place intermediation increases compared to the baseline.

There is a lot to unpack here. One immediate observation is that $p_m^I(w, \mu, \epsilon) \geq w + \epsilon$. Indeed, even though M implements MMA, seller S will intentionally inflate prices to make sure it will never bind. Therefore, the danger of MMA to seller S lies in the underlying threat of M flooding the market and not from paying back M when MMA binds under price competition.

To give some intuition on the three cases highlighted in Proposition 2, consider when the wholesale prices are low versus high. When wholesale prices are low, ϵ may be relatively low or high, because the possible profit gains $(v - w - \Pi_m^N(w, \mu))$ of epsilon are greater. For large enough ϵ , seller S gives up the market to M . This is when MMA is most costly to the seller and benefits M the most. When ϵ is sufficiently low, seller S is still incentivized to capture some of the market demand. In the case that wholesale prices are high, ϵ is small and as ϵ grows to $v - w$, S gives up more of the market. Interestingly, now their losses from MMA are much lower and the profit gain squeezed from MMA for M is likewise lower compared to that of the previous two cases.

Now, I assess seller S 's decision to join M . S 's profit if they join M under MMA is

$$\Pi_s^I(w, \mu, \epsilon) = \begin{cases} (2\epsilon - \mu)(1 - \frac{\epsilon}{\mu}) + w - c & \text{if } \mu \leq \epsilon \leq \frac{(v-w)^2}{\mu} \\ (2\sqrt{\epsilon\mu} - \mu)(1 - \sqrt{\frac{\epsilon}{\mu}}) + w - c & \text{if } \epsilon \leq \frac{(v-w)^2}{\mu} \text{ and } \epsilon \leq \mu \\ (\frac{\epsilon\mu}{v-w} + v - \mu)(1 - \frac{\epsilon}{v-w}) + w\frac{\epsilon}{v-w} - c & \text{if } \epsilon \geq \frac{(v-w)^2}{\mu} \end{cases} \quad (7)$$

where S will join the platform if $\Pi_s^I(w, \mu, \epsilon) \geq \Pi_0(\mu)$.

Lemma 2 Suppose s follows distribution $G(s) = \frac{s}{\mu}$ with $\bar{s} = \mu$ and M decides to implement

MMA. If $v - c \geq 2\mu$, S joins platform M if (w, ϵ) is in the set $R \equiv R_1 \cup R_2 \cup R_3$ where

$$R_1 \equiv \{(w', \epsilon') | 3\sqrt{\epsilon'\mu} - 2\epsilon' + w' \geq v, \epsilon' \leq \frac{(v - w')^2}{\mu}, \epsilon' \leq \mu\} \text{ and}$$

$$R_2 \equiv \{(w', \epsilon') | \epsilon' \geq \frac{(v - w')^2}{\mu}\} \text{ and } R_3 \equiv \{(w', \epsilon') | \epsilon' \leq \Pi_m(w', \mu), w' \geq v - \frac{9\mu}{8}\}.$$

Lemma 2 lists the conditions needed for S to join under MMA. R_1 characterizes the case when w and ϵ are both relatively small such that both S and M are still competing for consumers. R_2 denotes the region where M prices at v . In such a case, the losses from MMA are minimal. Giving up market demand incurs less losses as the direct and wholesale price is high enough such that selling on the direct channel with a lower price (due to consumer's disutility) is worse. R_3 includes the set of points such that S will join M regardless of MMA implementation as the ϵ is too low and w is sufficiently high.

Figure 1 illustrates seller and platform decisions given w and ϵ . Recall that when $v - c \geq 2\mu$, S joins M if $w \geq v - \frac{9\mu}{8}$ under no implementation of MMA. This threshold still applies under MMA. Figure 1 highlights M 's ability to extract additional profit when implementing MMA. Larger producers who satisfy the condition $v - c \geq 2\mu$ would have more bargaining power when negotiating wholesale price. However as w increases, ϵ 's effect on S 's threat of not joining the platform decreases. Therefore, S faces a trade-off between fighting for a high wholesale price and being likely to follow an MMA contract for $w \in (v - \frac{9\mu}{8}, v - \mu)$. Once wholesale price is at least $v - \mu$, the platform can always implement MMA.

For seller and platform decisions when $v - c \leq 2\mu$, refer to Appendix B. The regions highlighted under this case depend on the exogenous model parameters. However combining these findings leads to the following corollary.

Corollary 1 *Suppose s follows distribution $G(s) = \frac{s}{\mu}$ with $\bar{s} = \mu$. Under production cost c and valuation of good $v > c$, there exists some wholesale price w and guaranteed profit-margin ϵ such that the platform will implement MMA and the seller joins.*

It is easy to verify that region II shown in Figure 1 is a subset of $R_1 \cup R_2$ from Lemma 2 when $v - c \geq 2\mu$. The general proof (i.e. including when $v - c \leq 2\mu$) is shown in Appendix A. Corollary 1 highlights the fact that MMA may be applicable in any market. Indeed, if a platform has enough bargaining power one would see MMA being implemented. Note that if a platform has control over wholesale price and the profit-margin, then the platform-optimal wholesale price is actually weakly greater than without MMA.¹⁰ This is driven by the fact that S inflates prices on the direct channel under the optimal ϵ to avoid MMA binding to the point where S is indifferent between joining and not joining.

¹⁰To see examples of this refer to Appendix B where $v - c \leq 2\mu$.

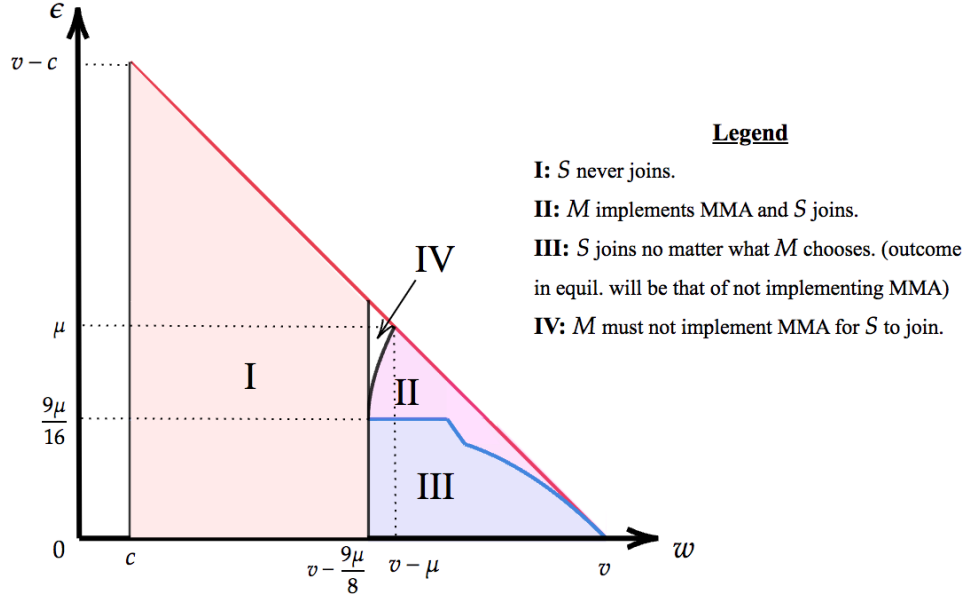


Figure 1: Different colored regions indicating S and M 's decisions in equilibrium given (w, ϵ) and $v - c \geq 2\mu$.

4.1 Endogenous w and ϵ

Previously, w and ϵ were exogenous parameters. Now, w is negotiated through Nash bargaining and ϵ is set by M before the game begins. I continue assuming $v - c \geq 2\mu$ as it provides consistent results from previous sections (e.g. S 's wholesale price threshold to join M). Observe that the largest ϵ such that S will still join (i.e. (w, ϵ) lies in Region II of Figure 1) can be characterized by the following function:

$$y(w) = \begin{cases} \frac{[3\sqrt{\mu} + \sqrt{9\mu - 8(v-w)}]^2}{16} & \text{if } v - \frac{9\mu}{8} \leq w \leq v - \mu \\ v - w & \text{if } w \geq v - \mu \end{cases} \quad (8)$$

Because ϵ represents the guaranteed profit-margin and the profit obtained under MMA for the platform, M will opt to set $\epsilon = y(w)$. Before analyzing the bargaining problem under MMA, observe that $y(w)$ and $\Pi_s^I(w, \mu, y(w))$ is increasing for $w \in (v - \frac{9\mu}{8}, v - \mu)$.¹¹ Therefore, if $w < v - \mu$ both S and M would prefer a higher wholesale price. Indeed, under a Nash bargaining scenario, S and M would solely bargain over $w \in [v - \mu, v]$ which implies that both S and M would set their price to v . Thus, M captures all of the consumer demand and S only profits from the intermediated channel.

¹¹Recall that we only consider the last two conditions for $\Pi_s^I(w, \mu, y(w))$ in (7) as S will not join under the first condition.

Let α denote the bargaining power of M where $0 \leq \alpha \leq 1$. When $\alpha = 1$, M has control over wholesale price and when $\alpha = 0$, S decides the wholesale price. By the logic of Nash bargaining and omitting a few formal steps, the optimal wholesale price w^I must be the solution to

$$\max_{w \in [v-\mu, v]} y(w)^\alpha \Pi_s^I(w, \mu, y(w))^{1-\alpha} = \max_{w \in [v-\mu, v]} (v-w)^\alpha (w+\mu-v)^{1-\alpha}. \quad (9)$$

The solution to (9) gives us $w^I = v - \alpha\mu$ and the following equilibrium profits for M and S , respectively, as

$$\Pi_m^I(w^I, \mu, y(w^I)) = \alpha\mu \text{ and } \Pi_s^I(w^I, \mu, y(w^I)) = v - \alpha\mu - c.$$

The interpretation of the optimal wholesale price is natural. As the bargaining power of M increases (α increases), the bargained wholesale price decreases reflecting a higher enforced guaranteed profit-margin ϵ . On the other hand, as α decreases, the bargained wholesale price increases, shrinking the possible guaranteed profit-margin and increasing S 's profit-margin through the intermediated channel.

It will be useful to also consider the bargaining solution when M cannot implement MMA. Formally, let $U^N \equiv \{(\pi_m, \pi_s) : 0 \leq \pi_m \leq \Pi_m^N(w, \mu), v - \mu - c \leq \pi_s \leq \Pi_s^N(w, \mu) \text{ for some } w \in [v - \frac{9\mu}{8}, v]\}$ represent the set of feasible payoffs for M and S where the disagreement point $d = (0, \Pi_0(\mu)) \in U^N$. The Nash bargaining problem is characterized as $\langle U^N, d \rangle$. Note that U^N is compact by definition, but not convex.¹² Following Zhou (1997)¹³, the Nash bargaining solution $f^N(U^N, d)$ solves the following maximization problem:

$$\max_{(\pi_m, \pi_s) \in U^N} \pi_m^\alpha (\pi_s - (v - \mu - c))^{1-\alpha}.$$

Similar to before, let $w^N = \arg \max_{w \in [v-\frac{3\mu}{4}, v]} (\Pi_m^N(w, \mu))^\alpha (\Pi_s^N(w, \mu))^{1-\alpha}$ denote the optimal wholesale price that solves the equivalent maximization problem. Solving for w^N depends on α , which leads us to the following lemma.

Proposition 3 *Suppose $v - c \geq 2\mu$ and $G(s) = \frac{s}{\mu}$ for $s \in [0, \mu]$. The three following results hold:*

¹²To show that U^N is not convex, consider the following example. For convexity to hold, then the points $\beta(0, v - c) + (1 - \beta)(\frac{9\mu}{16}, v - \frac{5\mu}{8} - c) \in U^N \forall \beta \in [0, 1]$. When $w = v - \frac{2\mu}{3}$, it must be that $(1 - \beta)\frac{9\mu}{16} \leq \frac{4\mu}{9}$ and $v - c - (1 - \beta)\frac{5\mu}{8} \leq v - c - \frac{5\mu}{9}$. The first inequality holds if $\beta \geq \frac{17}{81}$ and the second inequality holds if $\beta \leq \frac{1}{9}$. Thus, this is a contradiction and U^N is not convex.

¹³Zhou (1997) offers an extension of Nash (1950) and shows that the Nash bargaining solution for non-convex problems will keep the Independent of Irrelevant Alternatives and Invariance to Equivalent Utility Representation axioms, but replace Pareto Efficiency with Strict Individual Rationality.

- (i) If $\alpha > \frac{2}{5}$, then the optimal negotiated wholesale price $w^N = v - \frac{3\mu}{4}$.
- (ii) $w^I \geq w^N \forall \alpha < \frac{3}{4}$ and $w^N > w^I \forall \alpha > \frac{3}{4}$.
- (iii) M prefers being able to implement MMAs if $\alpha > \frac{9}{16}$.

Proposition 3 demonstrates the effect of MMA implementation on wholesale prices. If S has sufficient bargaining power, the negotiated wholesale price will actually increase under MMA and vice versa. This result driven by two key factors. First, under MMA, M prefers increasing wholesale price up to $v - \mu$ to increase the guaranteed profit-margin. In contrast, under no MMA, M only prefers increasing wholesale price up to $v - \frac{3\mu}{4}$ which is the point that it starts decreasing. So when M has high bargaining power, M will negotiate for a higher w under no MMA. The second key factor is demonstrated by the first statement in the proposition. Under no MMA implementation, the profit gains from the seller is ruled out by the profit losses from the platform when $\alpha > \frac{2}{5}$, so the negotiated wholesale price stays at its lowest. Under MMA, the negotiated wholesale price becomes a convex combination of the highest and lowest mutually-acceptable wholesale price.

The third statement of Proposition 3 states that for sufficiently high α , specifically $\alpha > \frac{9}{16}$, M benefits from MMAs being possibly implemented. However, banning MMAs can actually benefit the platform when M has sufficiently low bargaining power, due to a decrease in bargained wholesale price from the effects mentioned above.

5 Platform Steering

As of now, seller S faces no competition on platform M . This can be interpreted as marketplaces containing a wide variety of different sellers, each in their own unique product category, as discussed in Hagiu and Wright (2024). In this section I relax this assumption. Specifically, now M produces and sells their own product. This allows M to steer consumers away from S 's good on the platform.

Assume M sells a good, competing against S 's good, homogenously valued at u at the same production cost c where $c \leq u \leq v$ and $\Delta \equiv v - u \leq 2\mu$. The restriction on Δ guarantees that price competition between M and S is a possible outcome. Consumers each have at most a unit demand for one of the products. The timing of the game is now as follows: (i) Both S and M observe wholesale price w and guaranteed profit-margin ϵ . M decides whether to implement MMA or not; (ii) S observes M 's decision and chooses whether to join M or not, and sets price p_d ; (iii) If S joins M , M observes p_d and simultaneously sets p_{mh} and p_{ml} . Otherwise, M just sets p_{ml} ; (iv) consumers observe the set price(s) and

make their purchasing decision. I denote p_{mh} as the price set by M for S 's good, as it can be interpreted as a "high quality" good. p_{ml} denotes M 's produced good. All other elements of the game are exactly the same as before.

First, observe that if S joins M , M can choose which good is purchased on the platform. Suppose a consumer chooses to purchase on M , comparing $v - p_{mh}$ and $u - p_{ml}$. M can set p_{mh} and p_{ml} such that all consumers are steered towards one good. For example, when $\Delta = 0$ (i.e. $u = v$) M can potentially steer all consumers purchasing from M towards their own good. This is because if M steers consumers towards S 's good at some p_{mh} , the same amount of consumer demand on M can be achieved by steering towards M 's good with $p_{ml} = p_{mh}$. However, the profit-margin for M is weakly greater when steering towards their own good, i.e. $p_{ml} - c \geq p_{mh} - w$ when $p_{mh} = p_{ml}$. Thus, M 's decision in (iii) is like that of choosing which direction to steer consumers purchasing on M . It is important to note that steering towards M 's own good is not necessarily the optimal choice for M in this case. When $\Delta = 0$, M may prefer to steer towards S 's good, because the profit gain for S on the platform gives S less incentive to price compete through the direct channel.

Allowing for platform steering among vertically differentiated sellers makes the model analysis more complicated, even without considering MMAs. This is because optimal demand now depends on Δ in addition to the difference in prices set by S and M . As previously discussed, the choice in directing consumers faces a trade-off between S losing incentive to price compete with M and a potential increase in profit-margin. Despite the complexities, we can find some key results as seen in the following proposition.¹⁴

Proposition 4 *Suppose that platform M sells a good with value u competing against a seller with value $v \geq u$, and inconvenience costs are distributed according to $G(s) = \frac{s}{\mu}$ with $\bar{s} = \mu$. If S joins in equilibrium, there exists some unique $\tilde{w} \in [c, v]$ such that M steers all consumers to purchase S 's good on the platform for all wholesale price $w \leq \tilde{w}$. M steers all consumers to purchase M 's good on the platform for all $w > \tilde{w}$. In addition, M 's profit is weakly greater than in the baseline, weakly increasing in u , and weakly decreasing in v .*

Proposition 4 shows that M 's profit is weakly greater with steering. Intuitively, steering gives M another option to sell through the platform when faced with a high cost (i.e. high wholesale price). Increasing the quality of good relative to S 's and introducing competition can only benefit M . To see this, take our previous example of $\Delta = 0$. For valuation $v = u > c + \frac{2\mu}{3}$, M prefers to steer consumers towards its own good when $w \geq v - \frac{2\mu}{3}$. Otherwise, M

¹⁴The proof includes the characterization of equilibrium prices and profits. One can easily verify that the optimal intermediated price is weakly increasing in μ similar to the baseline model. Also, recall that the subgame when M steers consumers towards purchasing S 's good is solved already.

steers towards S 's good on the platform. Thus, competing and steering allows the platform to set a wholesale price cap for sellers.

Corollary 2 *Suppose that platform M sells a good with value u competing against a seller with value $v \geq u$, inconvenience costs are distributed according to $G(s) = \frac{s}{\mu}$ with $\bar{s} = \mu$, and $v - c \geq \max\{2\mu, \mu + \frac{(\mu+\Delta)^2}{9\mu}\}$. The set of wholesale prices and profit-margins such that MMA can be implemented where S can join the platform without competition and steering is a subset of the set with competition and steering.*

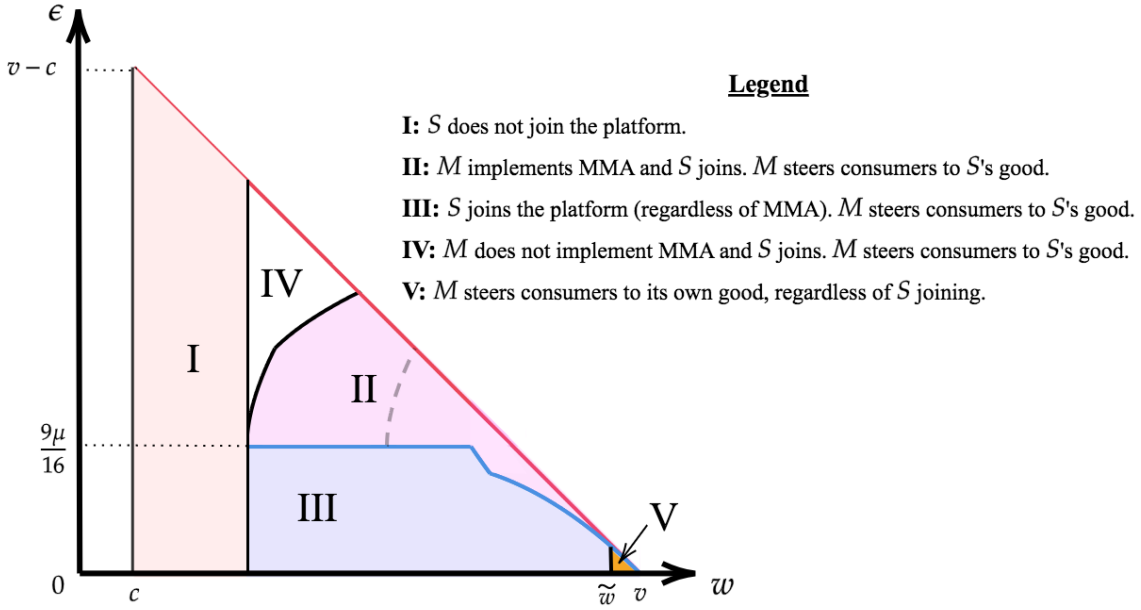


Figure 2: Different colored regions indicating S and M 's decisions in equilibrium given (w, ϵ) . Here, $v - c \geq 2\mu$ and $\Delta = \frac{v-c}{2}$. The vertical line that splits regions II, III, and V is specifically $w = \tilde{w}$ for $\epsilon \in [0, v - \tilde{w}]$ where $\tilde{w}$ is described in the proof for Proposition 4.

Corollary 2 highlights the fact MMAs may be more prevalent under competition and steering. This result is mainly driven by a lower outside option for S under competition if they do not join the platform. In the baseline model, consumers relied on S 's direct channel for purchases if M did not host S 's good. Figure 2 illustrates S and M 's equilibrium decisions. Note that the regions described here should be interpreted differently than in Figure 1. In Region I, S does not join the platform, but notice that the wholesale price such that S is indifferent between joining is now lower than that of the baseline. Region II encompasses scenarios of effective MMA implementation where M implements MMA, S is willing to join the platform, and M prefers to host S 's good. The faded dotted line represents

the baseline line that separated Region II and IV in Figure 1. Observe that Region II is now larger compared to before. In Regions III and IV, S joins the platform and M hosts S 's good. M steers consumers to its own good in Region V as described from Proposition 4.

A key observation from Figure 2 is that the wholesale price must not be too low or high for M to steer towards its own good. If w is sufficiently low, the gains for S from joining the platform is not enough to trade off the costs of price competition. If w is sufficiently high, selling S 's good is too costly for M , so they would rather compete against S with their lower quality good.

6 Discussion

Brown et al. v. Amazon.com, Inc. (2023) has brought up MMAs as an antitrust concern through two major claims: (i) it violates "Section 1 of the Sherman Act's prohibition against price-fixing by setting a *de facto* minimum retail price for the products under agreement" and (ii) it constitutes as "an abuse of monopoly power." Proposition 2 backs the first claim as the seller increases prices such that the platform price is greater than or equal to $w + \epsilon$. Some of the arguments in the lawsuit seem contradictory. For example, they discuss that Amazon is always looking to price competitively and offer highly discounted pricing, while being a price follower. My model indicates that this in theory is not very likely. When a platform prices after the seller, its prices are weakly greater than that of the sellers (assuming some general bias towards the platform). However, it is true that MMAs reduce seller incentives to undercut the platform price, i.e. $p_m^N(w, \mu) - p_d^N(w, \mu) \geq p_m^I(w, \mu, \epsilon) - p_d^I(w, \mu, \epsilon)$. In this scenario, the reduction is not directly driven by the implementation of MMAs, but rather indirectly through the price inflation to prevent the agreement binding.

Proposition 2 also supports the second claim to a certain degree. Showrooming/marketplace leakage is an important problem faced by many platforms in early development. However, MMAs seem to be most realistic in a scenario where platforms have enough bargaining power. Proposition 3 implies that M needs to have sufficiently high bargaining power to benefit from MMA implementation. Otherwise, having the option to enforce MMAs may end up decreasing platform profits. Thus, MMAs do not generally apply for small platforms, but rather for platforms with high market power. Therefore, the implementation of MMAs may be an indication of monopolistic behavior in itself.

There are three key points the lawsuits do not address: (i) the threat of flooding the market; (ii) importance of control over wholesale price; (iii) platform steering under MMAs. First and most importantly, the lawsuits do not highlight the threat of flooding the market that platforms have under MMAs. This is the main factor that drives sellers to inflate

prices through their direct channels. Furthermore, the control over wholesale price cannot be overstated. As my model suggests, if suppliers set the wholesale price then both wholesale price and M 's price would be v . All of the consumer surplus would be extracted to the seller making MMA impossible. Thus from a consumer perspective, price fixing from MMAs is equivalent to the scenario where sellers can set wholesale price. Both M and S would price their good at v and consumers only purchase through the intermediary. The lawsuit also does not discuss the potential outcomes of steering with MMAs. As Corollary 2 suggests, accounting for competing sellers and platform steering may increase the prevalence of MMAs driven by a larger reliance in joining the platform for the seller.

6.1 Conclusion

In this paper, I study the mechanism that drives the plausibility of MMAs and its welfare implications. I provide a stylized model composed of a seller who supplies the platform of a good. Both the seller and platform have their own respective distribution channels that they can set their price on. Consumers have heterogeneous bias towards the platform. I solve for the equilibrium given any possible wholesale price and guaranteed profit-margin.

I have shown that MMAs are not only a possibility, but may have anticompetitive effects. A platform may enforce MMAs to induce an increase in prices across the marketplace and reduce leakage and showrooming. Sellers inflate their prices through their direct channel to make sure that MMAs do not bind. However, platforms only prefer the option of implementing MMAs if they have sufficiently high bargaining power over the seller.

This raises the question on why MMAs are not more prevalent in marketplaces. One possible explanation is that MMA requires constant monitoring of prices and a large cost of enforcement and implementation. For example, in practice, the terms found in MMAs may be negotiated throughout the year. A platform may prefer to enlist a supplier without MMAs in the short run compared to waiting a year to realistically implement MMAs. Another may come from the fact that most sellers who act as suppliers have more market power in their industry. That is, first-party sellers are typically developed in terms of production and distribution. Lastly, less mature platforms may not be incentivized to implement MMA if their goal is to attract sellers and increase their consumer base.

It is important to highlight a few caveats with the model. I do not account for network effects in my analysis. One would think that platforms value a supplier joining to earn some form of profit, but also to increase indirect network effects for buyers. Additionally, I do not consider simultaneous pricing between seller and platform to reflect the arguments made in the aforementioned lawsuits. Sequential pricing allows the platform to perfectly observe

seller pricing and make best responses.

There are a few possible extensions to this model for future work. First, one can extend this model to account for competing platforms that the seller supplies to along with selling through the direct channel. Another interesting direction could be to explore seller choice in type (e.g. first-party v. independent). One could either explore how it changes the platform bargaining and pricing behavior under MMA or how independent seller profits are affected when MMAs are introduced for competing suppliers. Finally, one could adapt this model into a dynamic game with the possibility of a returning consumer base.

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Appendix A.

6.2 Proof of Lemma 1.

Let $p_d > p'_d \geq 0$ be such that $p_m(p_d, w) \leq p_m(p'_d, w)$. This means

$$\begin{aligned} \frac{1 - G(p_m(p'_d, w) - p'_d)}{g(p_m(p'_d, w) - p'_d)} &\geq \frac{1 - G(p_m(p_d, w) - p_d)}{g(p_m(p_d, w) - p_d)} \\ \iff p_m(p_d, w) - p_d &\geq p_m(p'_d, w) - p'_d \\ \iff p_m(p_d, w) - p_m(p'_d, w) &\geq p_d - p'_d \end{aligned}$$

which is a contradiction. Thus, $p_m(p_d, w)$ is increasing in p_d .

Now, let $w > w' \geq 0$ be such that $p_m(p_d, w) \leq p_m(p_d, w')$. This means

$$\begin{aligned} w' + \frac{1 - G(p_m(p_d, w') - p_d)}{g(p_m(p_d, w') - p_d)} &\geq w + \frac{1 - G(p_m(p_d, w) - p_d)}{g(p_m(p_d, w) - p_d)} \\ \iff \frac{1 - G(p_m(p_d, w') - p_d)}{g(p_m(p_d, w') - p_d)} - \frac{1 - G(p_m(p_d, w) - p_d)}{g(p_m(p_d, w) - p_d)} &\geq w - w' \end{aligned}$$

implying $p_m(p_d, w') - p_m(p_d, w) < 0$ which is a contradiction. Thus $p_m(p_d, w)$ is increasing in w . ■

6.3 Proof of Proposition 1.

Solving equation (2) gives:

$$p_m(p_d, w) = \frac{\mu + w + p_d}{2}.$$

By equation (3), $p_m^*(p_d, w) = \min\{\frac{\mu + w + p_d}{2}, v\}$ which implies $\bar{p}_d(w) = 2v - \mu - w$. When $p_m^*(p_d, w) = \frac{\mu + w + p_d}{2}$, the seller's following profit-maximization problem is

$$\max_{p_d} (p_d - c) \frac{\mu + w - p_d}{2\mu} + (w - c) \frac{\mu + p_d - w}{2\mu}.$$

When $p_m^*(p_d, w) = v$, the seller's following profit-maximization problem is

$$\max_{p_d} (p_d - c) \frac{v - p_d}{\mu} + (w - c) \frac{\mu + p_d - v}{\mu}.$$

Solving for the F.O.C.s gives $p_d(w) = w + \frac{\mu}{2}$ and $\hat{p}_d(w) = \frac{v + w}{2}$. Equation (5) gives the equilibrium direct price $p_d^*(w)$ and the equilibrium intermediated price is $p_m^*(w, \mu) = p_m^*(p_d^*(w), \mu)$.

Plugging the equilibrium prices into equations (1) and (4) gives the equilibrium profits. Note that $p_d^*(w, \mu)$ is not increasing in w or μ . The rest of the proposition follows by taking partial derivatives. ■

6.4 Proof of Proposition 2.

Recall that $p_m^*(p_d, w) = \min\{\frac{\mu+w+p_d}{2}, v\}$. Observe that S 's profit is negative if M floods the entire market by pricing low and obtaining the guaranteed ϵ profit. Also, note that S 's marginal profit with respect to p_d is the following:

$$\frac{\partial \pi_s}{\partial p_d} = G(p_m^*(p_d, w) - p_d) + (p_d - w)g(p_m^*(p_d, w) - p_d)\left(\frac{\partial p_m^*(p_d, w)}{\partial p_d} - 1\right). \quad (\text{A1})$$

This will be used when we consider the following three cases:

1. S sets $p_d \leq 2v - \mu - w$, implying M sets $p_m^*(p_d, w) = \frac{\mu+w+p_d}{2}$. Platform M 's profit is $\frac{(\mu+p_d-w)^2}{4\mu} \geq \epsilon \iff p_d \geq 2\sqrt{\epsilon\mu} + w - \mu$ for $\epsilon \leq \frac{(v-w)^2}{\mu}$. We need to add another restriction to make sure $0 \leq G(p_m^*(p_d, w)) \leq 1$ which is satisfied when $\epsilon \leq \mu$. The optimal price in this case can be found by first solving equation (A1).

$$\frac{\partial \pi_s}{\partial p_d} = \frac{\mu + w - p_d}{2} - \frac{p_d - w}{2} = \frac{\mu}{2} + w - p_d < 0$$

The inequality holds because recall that $\Pi_m^N(w, \mu) < \epsilon < v - w$. Thus, this case only applies for $w \in (c, v - \mu)$ and $\Pi_m^N(w, \mu) = \frac{9\mu}{16}$ which means $p_d \geq w + \frac{\mu}{2}$. The optimal price for the seller S is the lowest $p_d = 2\sqrt{\epsilon\mu} + w - \mu$.

2. S sets $p_d \geq 2v - \mu - w$ which implies $p_m^*(p_d, w) = v$. This means M 's profit is $(v - w)(1 - G(v - p_d)) \geq \epsilon$ which is satisfied if $p_d \geq \frac{\epsilon\mu}{v-w} + v - \mu$ for $\epsilon \geq \frac{(v-w)^2}{\mu}$. Under this case, equation (A1) gives

$$\frac{\partial \pi_s}{\partial p_d} = v + w - 2p_d < 0.$$

To see this, first note that if $p_d > \frac{v+w}{2}$ the equation holds. Based on the assumption of this case, $p_d \geq 2v - \mu - w > \frac{v+w}{2} \iff v - \frac{2\mu}{3} \geq w$. Now, we need to check when $w > v - \frac{2\mu}{3}$. Under this restriction, $\Pi_m^N(w, \mu) = (v - w)(1 - \frac{v-w}{2\mu})$ and $\epsilon > \Pi_m^N(w, \mu)$. This means $p_d \geq \frac{\epsilon\mu}{v-w} + v - \mu > \frac{v+w}{2}$. Thus, the optimal price for the seller S is $p_d = \frac{\epsilon}{v-w} + v - \mu$.

3. Consider the last case where S sets $p_d \leq 2v - \mu - w$ and $\mu \leq \epsilon \leq \frac{(v-w)^2}{\mu}$. Like case 1,

M sets $p_m^*(p_d, w) = \frac{\mu+w+p_d}{2}$. However, M captures the entire market demand, which means M 's profit will be $\frac{\mu+p_d-w}{2} \geq \epsilon \iff p_d \geq 2\epsilon + w - \mu$. Examining equation (A1) gives us

$$\frac{\partial \pi_s}{\partial p_d} = -\frac{p_d - w}{2\mu} < 0.$$

Thus, seller S sets the lowest p_d again.

Denote the profit-maximizing direct price as $p_d^I(w, \mu, \epsilon)$. The profit-maximizing intermediated price $p_m^I(w, \mu, \epsilon) = p_m^*(p_d^I(w, \mu, \epsilon), w)$. It is easy to see the direct prices strictly increase and intermediated prices weakly increase. Let $D^N = 1 - G(p_m^N(w, \mu) - p_d^N(w, \mu))$ and $D^I = 1 - G(p_m^I(w, \mu, \epsilon) - p_d^I(w, \mu, \epsilon))$ be the demand M receives under no MMA and MMA, respectively. For changes in marketplace intermediation, compare D^N and D^I for all given wholesale prices.

$$D^N = \begin{cases} \frac{3}{4} & \text{if } w \leq v - \frac{3\mu}{4} \\ \frac{v-w}{\mu} & \text{if } v - \frac{3\mu}{4} < w \leq v - \frac{2\mu}{3} \\ 1 - \frac{v-w}{2\mu} & \text{if } v - \frac{2\mu}{3} < w \leq v \end{cases}$$

$$D^I = \begin{cases} 1 & \text{if } \mu \leq \epsilon \leq \frac{(v-w)^2}{\mu} \\ \sqrt{\frac{\epsilon}{\mu}} & \text{if } \epsilon \leq \frac{(v-w)^2}{\mu} \text{ and } \epsilon \leq \mu \\ \frac{\epsilon}{v-w} & \text{if } \epsilon \geq \frac{(v-w)^2}{\mu} \end{cases}$$

where $\epsilon \in (\Pi_m^N(w, \mu), v - w)$. Directly comparing easily shows that $D^I > D^N$ for given w such that $c \leq w < v$. ■

6.5 Proof of Lemma 2.

Recall that if $v - c \geq 2\mu$, $\Pi_0 = v - \mu - c$. Thus after comparing $\Pi_0(\mu)$ and $\Pi_s^I(w, \mu, \epsilon)$, the seller will join if any of the following three cases hold:

$$\begin{cases} 3\epsilon - \frac{2\epsilon^2}{\mu} \geq v - w & \text{if } \mu \leq \epsilon \leq \frac{(v-w)^2}{\mu} \\ 3\sqrt{\epsilon\mu} - 2\epsilon + w \geq v & \text{if } \epsilon \leq \frac{(v-w)^2}{\mu} \text{ and } \epsilon \leq \mu \\ 2\mu + w - \frac{\epsilon\mu}{v-w} \geq v & \text{if } \epsilon \geq \frac{(v-w)^2}{\mu} \end{cases}$$

For the first case, $w + 3\epsilon - \frac{2\epsilon^2}{\mu}$ is decreasing in ϵ under the specified conditions. The highest value $w + 3\epsilon - \frac{2\epsilon^2}{\mu}$ can be is when $\epsilon = \mu$ which means $\mu \geq v - w$ must hold for this case to

hold. But $\epsilon \geq \mu$ which implies $\frac{(v-w)^2}{\mu} \geq v-w$, so this case will only hold when $\epsilon = \mu$ and $v = w + \mu$. But this is a contradiction as we assume $\epsilon < v-w$, so this first case will never hold.

The third case occurs for $\frac{(v-w)^2}{\mu} \leq \epsilon < v-w$ implying $v-w < \mu$. Applying similar logic, note that the left hand side of the third case constraint is decreasing in ϵ . Evaluating the constraint when $\epsilon = v-w$, we have $\mu + w \geq v$ which always holds under this case. Thus, the union of R_1 and R_2 reflects the regions such that S joins the platform. ■

6.6 Proof of Corollary 1.

Observe that the expression for the third case of Equation (7) is strictly decreasing in ϵ for $\epsilon > v-w - \frac{(v-w)^2}{2\mu}$. Formally,

$$\begin{aligned} \left. \frac{\partial \Pi_s^I(w, \mu, \epsilon)}{\partial \epsilon} \right|_{\epsilon \geq \frac{(v-w)^2}{\mu}} &= \frac{2\mu}{v-w} - \frac{2\mu\epsilon}{(v-w)^2} - 1 < 0 \\ &\iff \epsilon > v-w - \frac{(v-w)^2}{2\mu}. \end{aligned}$$

Thus, evaluating $\Pi_s^I(w, \mu, \epsilon)|_{\epsilon=v-w} = w - c$ gives a lower bound on S 's profit under MMA. This means for S to join under MMA, it must be that $w \geq c + \frac{(v-c)^2}{4\mu}$. It is easy to verify that $w < v$ such that w is a plausible price. So for any $v > c$, there exists some combination of w and ϵ such that the seller will prefer to join the platform. ■

6.7 Proof of Proposition 3.

I first prove the first statement of the lemma by showing that the F.O.C. to solve for w^N is decreasing in w when $\alpha > \frac{2}{5}$. Specifically, it suffices to show

$$\alpha \frac{\partial \Pi_m^N(w, \mu)}{\partial w} / \frac{\partial \Pi_s^N(w, \mu)}{\partial w} < -(1-\alpha) \frac{\Pi_m^N(w, \mu)}{\Pi_s^N(w, \mu)}, \forall w \in (v - \frac{3\mu}{4}, v) \quad (\text{A2})$$

When $v - \frac{3\mu}{4} < w \leq v - \frac{2\mu}{3}$, (A2) becomes

$$\begin{aligned}
& \frac{-2\alpha(v-w)}{\mu} / \left[-2 + 4\frac{(v-w)}{\mu} \right] < \frac{-(1-\alpha)(v-w)^2}{\mu\Pi_s^N(w, \mu)} \\
& \iff \alpha\Pi_s^N(w, \mu) > (1-\alpha) \left[\frac{2(v-w)^2}{\mu} - (v-w) \right] \\
& \iff \alpha(3v-2w-\mu-c) > \frac{(1-\alpha)(v-w)(3v-w-\mu)}{\mu} \\
& \iff \underbrace{\alpha(w-c)}_{>0} + \underbrace{(3v-w-\mu)}_{>0} \left[\alpha - \frac{(1-\alpha)(v-w)}{\mu} \right] > 0.
\end{aligned}$$

Therefore, a sufficient condition is $\alpha - \frac{(1-\alpha)(v-w)}{\mu} > 0 \iff \alpha > \frac{v-w}{v-w-\mu} \geq \frac{2}{5}$. Now, consider when $v - \frac{2\mu}{3} < w < v$. (A2) becomes

$$\begin{aligned}
& \alpha \frac{-1 + \frac{v-w}{\mu}}{1 - \frac{v-w}{2\mu}} < -(1-\alpha) \frac{(v-w)(1 - \frac{v-w}{2\mu})}{\Pi_s^N(w, \mu)} \tag{A3} \\
& \iff \alpha \left[-1 + \frac{v-w}{\mu} \right] \Pi_s^N(w, \mu) < -(1-\alpha)(v-w)(1 - \frac{v-w}{2\mu})^2 \\
& \iff \alpha > \underbrace{\frac{(v-w)(1 - \frac{v-w}{2\mu})^2}{(v-w)(1 - \frac{v-w}{2\mu})^2 + (1 - \frac{v-w}{\mu})\Pi_s^N(w, \mu)}}_{\text{decreasing in } w}.
\end{aligned}$$

Therefore, evaluating the above condition at $w = v - \frac{2\mu}{3}$ gives us the sufficient condition

$$\alpha > \frac{8\mu}{9} / \left[\frac{\mu}{3} + v - c \right].$$

Note that the highest value for the right hand side of this condition arises when $v - c$ is smallest (i.e. $v - c = 2\mu$), so the sufficient condition can be simplified to $\alpha > \frac{8}{21}$. Because the F.O.C. is decreasing in w , then $w^N = v - \frac{3\mu}{4}$ (the lowest wholesale price).

The second statement of the lemma is immediate for when $\alpha > \frac{2}{5}$. Thus, it suffices to show that the statement holds even for when $\alpha < \frac{2}{5}$. First, we can rule out the case such that $w^N \in [v - \frac{3\mu}{4}, v - \frac{2\mu}{3}]$ as $w^N < w^I = v - \alpha\mu$ will always hold true. Thus, showing

$$\hat{w}^N \equiv \arg \max_{w \in [v - \frac{2\mu}{3}, v]} (\Pi_m^N(w, \mu))^\alpha (\Pi_s^N(w, \mu))^{1-\alpha} \leq w^I \text{ s.t. } 0 \leq \alpha \leq \hat{\alpha}.$$

We can further rule out all the $\alpha \in (\hat{\alpha}, \frac{2}{5}]$ where $\hat{\alpha}$ denotes the lowest α such that the F.O.C.

is decreasing in w , $\forall w \in [v - \frac{2\mu}{3}, v]$. Solving the F.O.C. using (A3) but with equality gives

$$\frac{(v-w)(1 - \frac{v-w}{2\mu})^2}{(v-w)(1 - \frac{v-w}{2\mu})^2 + (1 - \frac{v-w}{\mu})\Pi_s^N(w, \mu)} - \alpha = 0. \quad (\text{A4})$$

Note that the second order condition is negative. Plugging in $w = v - \alpha\mu$ into the F.O.C. yields

$$\frac{\alpha\mu(1 - \frac{\alpha}{2})^2}{\alpha\mu(1 - \frac{\alpha}{2})^2 + (1 - \alpha)(\frac{\alpha^2\mu}{4} + v - \alpha\mu - c)} - \alpha = 0$$

which only holds when $\alpha = 0$. If $\alpha > 0$, it is easy to verify the condition is negative, thus it must be that $\hat{w}^N < w^I$, completing the proof.

Note that the proof for the second statement implies the third statement for $\alpha \in [\hat{\alpha}, 1]$. We just need to show that $\Pi_m^N(\hat{w}^N) \geq \alpha\mu$ for $\alpha < \hat{\alpha}$. By the proof for the second statement, because the S.O.C. is negative, we just need to show that $\hat{w}^N$ is less than the wholesale price such that $\Pi_m^N(w, \mu) = (v-w)(1 - \frac{v-w}{2\mu}) = \alpha\mu$ which occurs at $w = v - \mu(1 - \sqrt{1-2\alpha})$. Plugging into the LHS of (A4) gives

$$\begin{aligned} & \frac{\mu(1 - \sqrt{1-2\alpha})(\frac{1+\sqrt{1-2\alpha}}{2})^2}{\mu(1 - \sqrt{1-2\alpha})(\frac{1+\sqrt{1-2\alpha}}{2})^2 + \sqrt{1-2\alpha}[\frac{\mu(1-\sqrt{1-2\alpha})^2}{4} + v - \mu - c + \mu\sqrt{1-2\alpha}]} - \alpha < 0 \\ \iff & \frac{1-\alpha}{\alpha}\mu(1 - \sqrt{1-2\alpha})(\frac{1+\sqrt{1-2\alpha}}{2})^2 < \sqrt{1-2\alpha} \left[\frac{\mu(1 - \sqrt{1-2\alpha})^2}{4} + v - \mu - c + \mu\sqrt{1-2\alpha} \right] \\ \iff & (1-\alpha)\frac{\mu}{2}(1 + \sqrt{1-2\alpha}) < (1-2\alpha)\frac{\mu}{2} + (1-\alpha)\frac{\mu}{2}\sqrt{1-2\alpha} + \sqrt{1-2\alpha}(v - \mu - c) \\ \iff & \frac{\alpha\mu}{2} < \underbrace{\sqrt{1-2\alpha}}_{> \frac{\alpha}{2} \text{ for } \alpha < \hat{\alpha}} \underbrace{(v - \mu - c)}_{\geq \mu}. \blacksquare \end{aligned}$$

6.8 Proof of Proposition 4.

I first solve for equilibrium prices and profits assuming S joins M under no MMA implementation and M steers consumers towards their own good. A consumer with disutility s purchases on M iff $u - p_{ml} \geq \max\{v - p_d - s, 0\}$. M will never set $p_{ml} > u$, so M 's problem is setting $p_{ml} \leq u$ to maximize profit

$$\tilde{\pi}_m = (p_{ml} - c)(1 - G(\Delta + p_{ml} - p_d)).$$

Let $\tilde{p}_{ml}(p_d)$ be the solution to the F.O.C.

$$1 - G(\Delta + p_{ml} - p_d) - g(\Delta + p_{ml} - p_d)(p_{ml} - c) = 0,$$

such that

$$\tilde{p}_{ml}(p_d) = c + \frac{1 - G(\Delta + \tilde{p}_{ml}(p_d) - p_d)}{g(\Delta + \tilde{p}_{ml}(p_d) - p_d)}.$$

Similar to before, if we assume G satisfies the monotone hazard rate condition and g is continuous over $(0, \bar{s})$, then $\tilde{p}_{ml}(p_d)$ is the unique solution and increasing in p_d . M 's profit-maximizing price $p_{ml}^*(p_d)$ is

$$\tilde{p}_{ml}^*(p_d) = \begin{cases} \tilde{p}_{ml}(p_d) & \text{if } \tilde{p}_{ml}(p_d) \leq u \\ u & \text{if } \tilde{p}_{ml}(p_d) \geq u \end{cases}. \quad (\text{A5})$$

By backwards induction, S sets $p_d \geq c$ to maximize the following profit maximization problem: $\max_{p_d \geq c} \tilde{\pi}_s = (p_d - c)G(\Delta + \tilde{p}_{ml}^*(p_d) - p_d)$. When $\tilde{p}_{ml}(p_d) \leq u$, S 's profit maximizing price $\tilde{p}_d^{**}$ is then

$$\tilde{p}_d^{**} = c + \frac{G(\Delta + \tilde{p}_{ml}^*(\tilde{p}_d^{**}) - \tilde{p}_d^{**})}{g(\Delta + \tilde{p}_{ml}^*(\tilde{p}_d^{**}) - \tilde{p}_d^{**})}.$$

Therefore, S 's general profit maximizing price $\tilde{p}_d^*$ is

$$\tilde{p}_d^* = \begin{cases} \tilde{p}_d^{**} & \text{if } \tilde{p}_{ml}(\tilde{p}_d^{**}) \leq u \\ \dot{p}_d & \text{if } \tilde{p}_{ml}(\tilde{p}_d^{**}) \geq u \text{ and } \tilde{p}_{ml}(\dot{p}_d) \leq u \\ \check{p}_d & \text{if } \tilde{p}_{ml}(\check{p}_d) \geq u \text{ and } \tilde{p}_{ml}(\tilde{p}_d^{**}) \geq u \end{cases} \quad (\text{A6})$$

where $\dot{p}_d$ is the direct price such that $p_{ml}(\dot{p}_d) = u$ and $\check{p}_d$ is derived from equation (6). The logic is similar to that of the baseline analysis. Because M is price-capped at u , M and S price compete up to a certain threshold. If S anticipates M prices at u , then their direct price will be $\dot{p}_d$. However, this is only optimal under the condition that that M 's profit-maximizing price (given $\dot{p}_d$) is greater than u . In the case that it is less than u , then S 's optimal direct price is such that M 's intermediated price is exactly u . Solving for (A5) and (A6) using the uniform distribution of s from before gives us the following equilibrium direct

and intermediated prices respectively:

$$\tilde{p}_d^* = \begin{cases} c + \frac{\mu + \Delta}{3} & \text{if } \frac{2\mu - \Delta}{3} \leq u - c \\ v + u - c - \mu & \text{if } \frac{2\mu - \Delta}{3} \geq u - c \text{ and } \mu - \frac{v - c}{2} \leq u - c \\ \frac{c + v}{2} & \text{if } \min\{\frac{2\mu - \Delta}{3}, \mu - \frac{v - c}{2}\} \geq u - c \end{cases}$$

$$\tilde{p}_{ml}^* = \min\{c + \frac{2\mu - \Delta}{3}, u\}.$$

The resulting equilibrium profits for S and M are respectively:

$$\tilde{\pi}_s^* = \begin{cases} \frac{(\mu + \Delta)^2}{9\mu} & \text{if } \frac{2\mu - \Delta}{3} \leq u - c \\ (v + u - 2c - \mu)(1 - \frac{u - c}{\mu}) & \text{if } \frac{2\mu - \Delta}{3} \geq u - c \text{ and } \mu - \frac{v - c}{2} \leq u - c \\ \frac{(v - c)^2}{4\mu} & \text{if } \min\{\frac{2\mu - \Delta}{3}, \mu - \frac{v - c}{2}\} \geq u - c \end{cases}$$

$$\tilde{\pi}_m^* = \begin{cases} \frac{(2\mu - \Delta)^2}{9\mu} & \text{if } \frac{2\mu - \Delta}{3} \leq u - c \\ \frac{(u - c)^2}{\mu} & \text{if } \frac{2\mu - \Delta}{3} \geq u - c \text{ and } \mu - \frac{v - c}{2} \leq u - c \\ (u - c)(1 - \frac{v - c}{2\mu}) & \text{if } \min\{\frac{2\mu - \Delta}{3}, \mu - \frac{v - c}{2}\} \geq u - c \end{cases}$$

It is easy to verify that $\tilde{\pi}_s^*$ and $\tilde{\pi}_m^*$ are both weakly greater than 0 given the different cases and that $\tilde{\pi}_m^*$ is weakly increasing in u and weakly decreasing in v . Therefore, given any μ , there must exist some unique $\tilde{w} \in [c, v]$ such that $\tilde{\pi}_m^* \geq \Pi_m^N(w, \mu) \forall w \leq \tilde{w}$ and $\tilde{\pi}_m^* < \Pi_m^N(w, \mu) \forall w > \tilde{w}$ as $\Pi_m^N(w, \mu)$ is decreasing in w . ■

6.9 Proof of Corollary 2.

Consider the case where $v - c \geq 2\mu$. Using the results from the proof of Proposition 4, this implies $\tilde{\pi}_s^* = \frac{(\mu + \Delta)^2}{9\mu}$ and $\tilde{\pi}_m^* = \frac{(2\mu - \Delta)^2}{9\mu}$ as $v - c \geq 2\mu$ is the sufficient condition for $\frac{2\mu - \Delta}{3} \leq u - c$ shown by the following:

$$\begin{aligned} v - c \geq 2\mu &\Rightarrow v - c + 2(u - c) \geq 2\mu \\ &\Rightarrow 2\mu - \Delta \leq 3(u - c) \\ &\Rightarrow \frac{2\mu - \Delta}{3} \leq u - c. \end{aligned}$$

S will join under no MMA if $\tilde{\pi}_s^* \leq \Pi_s^N(w, \mu) \iff w \geq \frac{(\mu+\Delta)^2}{9\mu} - \frac{\mu}{8} + c$. Our assumption of $v - c \geq \mu + \frac{(\mu+\Delta)^2}{9\mu}$ implies

$$v - \frac{9\mu}{8} \geq \frac{(\mu + \Delta)^2}{9\mu} - \frac{\mu}{8} + c.$$

Thus, if S joins under no MMA in the baseline, S will join under no MMA with competition and steering.

Now, S will join under MMA with competition and steering if $\Pi_s^I(w, \mu, \epsilon) \geq \tilde{\pi}_s^*$. Note that M will implement MMA if $\tilde{\pi}_m^* \leq \epsilon$, but this will not affect S 's decision to join the platform. If $\epsilon < \tilde{\pi}_m^*$, M will steer consumers towards its own good, regardless of MMA implementation, so S 's joining decision does not matter. Thus, it suffices to show that $R_1 \cup R_2 \subseteq \{(w, \epsilon) | \tilde{\pi}_s^* \leq \Pi_s^I(w, \mu, \epsilon)\}$ where R_1 and R_2 are derived from Lemma 2 and $\epsilon \in [\Pi_m^N(w, \mu), v - w]$. This is immediate given that $\tilde{\pi}_s^* = \frac{(\mu+\Delta)^2}{9\mu} \leq v - \mu - c = \Pi_0(\mu)$ again by assumption. ■

Appendix B.

Appendix B covers the case when $v - c \leq 2\mu$ and s is interpreted as a inconvenience cost. I first find the conditions when S joins M under the baseline model (i.e. $\Pi_s^N(w, \mu) \geq \Pi_0(\mu) = \frac{(v-c)^2}{4\mu}$). It is easy to verify that there exists some $\hat{w}$ such that for all $w \geq \hat{w}$, S joins M . Consider the subcase where $\hat{w} \leq v - \frac{3\mu}{4}$. To find a sufficiency condition, I solve the condition when S joins M under the highest $\hat{w}$ possible as $\Pi_s^N(w, \mu)$ is strictly increasing for $w \in (c, v)$. Specifically,

$$\begin{aligned} \frac{\mu}{8} + v - \frac{3\mu}{4} - c \geq \frac{(v-c)^2}{4} &\iff (v-c)^2 - 4\mu(v-c) + \frac{5}{2}\mu^2 \leq 0 \\ &\iff v - c \geq (2 \pm \frac{\sqrt{6}}{2})\mu \end{aligned}$$

where $v - c \geq (2 + \frac{\sqrt{6}}{2})\mu$ is ruled out by assumption of this case. Now, consider the subcase where $v - \frac{2\mu}{3} \leq \hat{w} \leq v$. Similarly solving for the condition when S joins M under the lowest $\hat{w}$ possible gives

$$\begin{aligned} \frac{\mu}{9} + v - c - \frac{2\mu}{3} \geq \frac{(v-c)^2}{4\mu} &\iff (v-c)^2 - 4\mu(v-c) + \frac{20\mu^2}{9} \geq 0 \\ &\iff v - c \leq (2 \pm \frac{4}{3})\mu \end{aligned}$$

where $v \leq (2 + \frac{4}{3})\mu$ is redundant.

This gives us three subcases:

1. $\hat{w} \leq v - \frac{3\mu}{4}$: This occurs when $v - c \geq (2 - \frac{\sqrt{6}}{2})\mu$. Seller S still wants to price compete with M and $v - c$ is sufficiently high such that M is not price restricted at v .
2. $v - \frac{3\mu}{4} \leq \hat{w} \leq v - \frac{2\mu}{3}$: This occurs when $(2 - \frac{\sqrt{6}}{2})\mu \geq v - c \geq \frac{2\mu}{3}$. Seller S will price such that M 's price is exactly v .
3. $v - \frac{2\mu}{3} \leq \hat{w} \leq v$: This occurs when $\frac{2\mu}{3} \geq v - c$. When $v - c$ is sufficiently small relative to the inconvenience cost, M is price capped at v and seller S prefers to let M capture more of the market demand as it is more costly for consumers to purchase directly.

The three region maps for the subcases are shown in Figures 3, 4, and 5. Specific values for $\hat{w}$ can be calculated by solving the implicit function $\Pi_s(\hat{w}, \mu) = \Pi_0(\mu)$. Observe that in subcase 3, region I does not exist. Indeed, if $v - c$ is sufficiently low (i.e. μ is sufficiently high) then the seller S would always join the platform. We can interpret this as S 's direct channel being inferior to the platform's to the degree that the seller joins regardless of wholesale price.

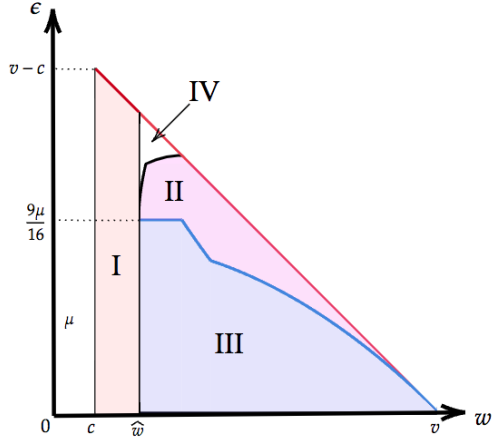


Figure 3: Region map for subcase 1 (i.e. $v - c \geq (2 - \frac{\sqrt{6}}{2})\mu$)

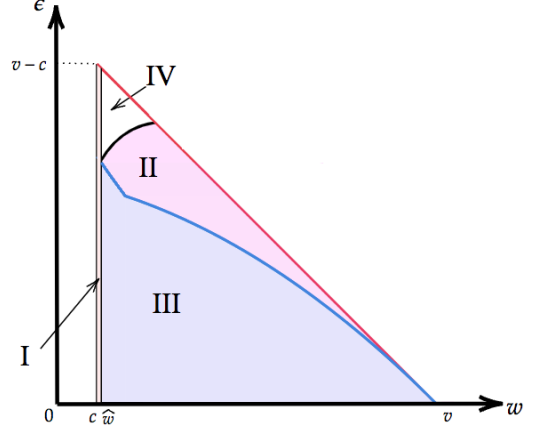


Figure 4: Region map for subcase 2 (i.e. $(2 - \frac{\sqrt{6}}{2})\mu \geq v - c \geq \frac{2\mu}{3}$)

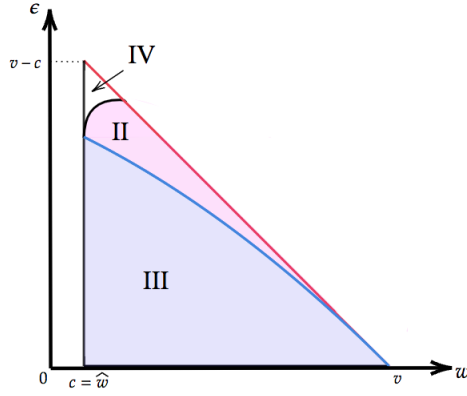


Figure 5: Region map for subcase 3 (i.e. $\frac{2\mu}{3} \geq v - c$)

Note: Regions for Figures 3, 4, and 5 have the same interpretation as Figure 1.