A Rationale for the "Meeting Competition Defense" under Primary-line Injury[1]

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Abstract

This paper finds that price discrimination tends to enhance social welfare under oligopoly when the number of firms in the strong market is higher than in the weak market. As a result, we obtain a fundamental justification for the "meeting competition" defense (MCD) under the Robinson-Patman Act (RPA): In cases of primary-line injury, when the strong market is more competitive than the weak market, the use of MCD may allow price discrimination to improve social welfare. This outcome holds true regardless of whether price discrimination occurs in the final good market or intermediate good market, and it is robust to the nature of competition.

Key words: third-degree price discrimination, Robinson-Patman Act, meeting competition defense, oligopoly, welfare.

JEL: D42, L12, L13.

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1. **Introduction**

This paper examines the welfare effects of third-degree price discrimination (henceforth simply price discrimination) when the number of competitors varies across markets, this feature being a hallmark of many, if not most, antidiscrimination lawsuits. Even though price discrimination has the potential to harm competition on three different levels (see, for example, Schwartz (1986)), we concentrate on primary-line injury, which is defined as injury to the direct competitor(s) of a discriminating firm.

Consider a two-market seller that is charged with price discrimination under the Robinson Patman Act (RPA), which prohibits differences in price between purchases of commodities of like grade and quality. The seller, however, can disprove the initial presumption of illegality by proving that it offered the lower price to a particular purchaser in order to meet, but not to beat, the price of a rival (see, for example, Scherer and Ross (1990)). This affirmative defense against price discrimination allegations is known as "meeting competition" defense (MCD).[4]

In this paper, we find a fundamental justification for the use of MCD in cases of primary-line injury. Specifically, when MCD allows a two-market firm to set a lower price in the market with fewer competitors, price discrimination tends to increase total output and, consequently, social welfare. Therefore, the unintended adverse impact of banning price discrimination on social welfare would be offset by this defense.

The MCD is attributed to the asymmetry between markets in terms of differences in the number of competitors. Thus, we consider a two-market firm that sells its product in two geographically separated markets (final good or intermediate good markets) that differ in the number of competing firms.

[4] Other possible defense is the cost justification defense, but this is often difficult to prove because of the complicated accounting analysis required to establish the defense. As a result, it is rarely used.

First, we examine the welfare effects of the use of MCD when price discrimination occurs in the final good market. Our final good market model should be interpreted not only as sales to final buyers but also as a model in which demand functions are the derived demands of downstream firms.[5] Moreover, the economic analysis of the use of MCD is also relevant for cases not covered by the RPA. As a case in point, in *American Airlines v. AMR Corp.*, the claim was filed in accordance with Section 2 of the Sherman Act instead of the RPA because the RPA covers predatory pricing for goods, and FTC states that airline flights are services, not goods. American Airlines effectively used MCD to defend its action.[6]

Second, we examine the effects on social welfare of MCD when price discrimination occurs in the intermediate good market. The RPA is fundamentally applicable to sales in intermediate good markets, such as those in which downstream firms are retailers, and prohibits input price discrimination. *Utah Pie Co. v. Continental Baking Co.* and *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp.* are the most commonly studied primary-line cases.

In order to assess the RPA and the use of MCD, we consider different models under two alternative scenarios: (1) *Price discrimination is permitted* (or is, at least theoretically, conceivable due to MCD), meaning that pricing and quantity decisions can be made by the two-market seller independently between the two markets; (2) *Price discrimination is prohibited*; meaning that in order to comply with the price uniformity requirement, the two-market seller must adjust prices and/or quantities in the two markets.

We find that when the number of firms is higher in the strong market than in the weak market, price discrimination tends to increase social welfare. Therefore, we obtain a rationale for the

[5] We refer readers to Viscusi et al. (2018) for an apt example, where duPont's patented superstrength synthetic fiber Kevlar is used as an input in undersea cables (the strong market) and tires (the weak market).

[6] Another case that involves final good markets and both the Sherman Act and RPA is *Matsushita Electric Industrial Co., Ltd. v. Zenith Radio Corp*. In this case, several Japanese companies were charged by American competitors with conspiring to fix low television prices in the United States and high prices in Japan with the intention of driving American companies out of business in the United States.

use of MCD under the RPA. Importantly, we also find that this result is robust to the competition type (i.e., price versus quantity competition) and the market type (i.e., final good and intermediate good).

The paper is organized as follows. Section 2 connects our research to the relevant literature. In Section 3, we consider the effects of price discrimination on social welfare alongside the potential role of MCD in the final good market. In Section 4, we analyze the economic effects of price discrimination in the intermediate good market. Section 5 presents concluding remarks. All proofs of our main analyses are deferred to Appendix A. In Appendix B we go over the problem of price discrimination in the final good market under price competition.

2. **Literature Review**

Our paper builds upon and contributes to three streams of research: price discrimination in final good markets; price discrimination in intermediate good markets; and the antitrust literature on price discrimination.

We adopt the approach in Varian (1989), tying social welfare to the desirability of price discrimination in situations that fall under the RPA. In order to examine the RPA and the use of MCD in intermediate and final good markets, we also follow Varian (1985, 1989) to state upper and lower bounds to the change in social welfare.[7]

We demonstrate that when the strong market has more firms than the weak market, price discrimination increases total output under primary-line injury, both in final good markets and

[7] From the upper bound, we obtain the well-known result that under monopoly an increase in total output is a necessary condition for price discrimination to enhance social welfare. Pigou (1920) and Robinson (1933) show that with linear demand specifications, price discrimination does not affect total output but reduces social welfare. The same result is obtained by Schmalensee (1981) with non-linear demands, separated markets and constant marginal costs; by Varian (1985) with imperfect arbitrage and non-decreasing marginal costs; and by Schwartz (1990) with decreasing marginal costs. Aguirre et al. (2010) find sufficient conditions for price discrimination to enhance social welfare contingent upon the shape of demand and inverse demand functions.

intermediate good markets. This provides a rationale for the use of MCD. Within this framework, we characterize particular circumstances where price discrimination improves social welfare.[8] However, we demonstrate that the potential welfare-enhancing benefits of the use of MCD are not necessarily linked to an increase in total output. When products are not perfect substitutes, we identify the conditions under which price discrimination increases welfare even though it lowers total output under both price competition and quantity competition.

Price discrimination in oligopolistic markets is extensively studied in extant literature. Neven and Phlips (1985) consider a multimarket Cournot duopoly with homogenous product along with a linear demand specification, and conclude that allowing firms to discriminate across markets results in a loss of social welfare, even though total output remains the same (see Stole (2007) for an elegant proof). Aguirre (2019) shows that many results obtained under monopolistic price discrimination in literature can be extended to a Cournot oligopoly. Moreover, he finds that differences in the number of competing firms across markets can be more important than the shape of market demand to determine the effect of price discrimination on total output.

The economic effects of price discrimination in oligopolistic markets are also studied in settings where firms produce differentiated products and compete on price. Holmes (1989) considers a Bertrand duopoly with product differentiation, and shows that the effect of price discrimination on total output depends on the sum of an adjusted-concavity condition and an elasticity-ratio condition (see Dastidar (2006) for a related extension). Adachi and Matsushima (2014) show that price discrimination can enhance social welfare when firms' products are substitutes in the market where the discriminatory price is higher and are

[8] Hausman and Mackie-Mason (1988) show that price discrimination may lead to Pareto welfare improvement by opening new markets. Here we show that price discrimination increases social welfare when the two-market firm only serves the weak market under price discrimination.

complements in the market where it is lower. Taking into account a Bertrand oligopoly with product differentiation, Aguirre (2019) demonstrates that price discrimination increases total output when competitive pressure is higher in the strong market.

In this paper, in order to evaluate the welfare effects of the RPA and the use of MCD, we extend the product differentiation model of price competition in Aguirre (2019), for final good markets, to consider a firm that operates in two distinct markets and faces competition in both of them. Instead of focusing only on the output effect, we also adopt a wider perspective and analyze social welfare directly.

In LEMMA 1, following Varian (1985, 1989), we state upper and lower bounds to the change in social welfare. In LEMMA 2 we analyze the effects on total output and we obtain results close to those in Aguirre (2019). Importantly, in PROPOSITION 1 we obtain three novel results: (1) If the number of firms is greater in the strong market than in the weak market, then the necessary condition for an increase in welfare by price discrimination is satisfied; (2) If price discrimination serves to open the weak market for the two-market firm, then the sufficient condition for an increase in welfare is satisfied; (3) An increase in total output is not a necessary condition for an increase in welfare. Moreover, we state in REMARK 1 specific conditions under which price discrimination increases social welfare. Finally, we also demonstrate that LEMMA 2, PROPOSITION 1 and REMARK 1 are satisfied in several competitive environments:

- Price competition with differentiated products with Shubik-Levitan demands (Section 3.1).

- Quantity competition with differentiated products with Shubik-Levitan inverse demands (Section 3.2). Note that a particular case would be Cournot competition with homogeneous product.

- Price competition with differentiated products with Spence-Dixit-Vives demand specification (Appendix B3).

Another strand of literature studies price discrimination in input markets. Katz (1987) considers an input monopolist that sells to many local firms and a chain store. He shows that under certain conditions, input price discrimination reduces total output and social welfare, and demonstrates that price discrimination can enhance social welfare only when ineffective backward integration is forbidden. DeGraba (1990) focuses on how downstream producers' long-term selection of a production method is impacted by upstream firms' discriminatory pricing. He demonstrates how price discrimination reduces social welfare by discouraging downstream firms' R&D efforts. Inderst and Valletti (2009) consider an input monopolist who is threatened by demand-side substitution and find that the input monopolist always discriminates in favor of the more efficient downstream firm.[9]

We would like to note that although some of those earlier studies on input price discrimination by a monopolist might involve primary-line cases, they do not fit well in the context of this paper. The reason is that to properly assess the part that MCD plays in primary-line injury cases, input markets must have different numbers of firms. Moreover, in order to analyze the impact of input price discrimination on social welfare, a model of successive oligopolies is needed, which is why we consider a Cournot model with an upstream sector and a downstream sector.[10] This paper generalizes Aguirre (2016) (who assumes a two-market input firm that competes only in one market with a rival) by considering a two-market input firm that faces competition of an arbitrary number of firms in both of them. We find, in

[9] Miklós-Thal and Shaffer (2021a) and Miklós-Thal and Shaffer (2021b) extend the analysis to study input price discrimination in a resale market, and analyze the effect of oligopoly price discrimination with endogenous input cost, respectively.

[10] See the seminal work of Salinger (1988); here we follow the version of Belleamme and Peitz (2015). See also Ghosh and Morita (2007) for a study of the desirability of free entry and Ghosh et al. (2022) for an analysis of horizontal mergers with successive oligopoly and upstream and downstream Cournot competition.

PROPOSITION 2, that input price discrimination by a multimarket firm tends to increase social welfare (by increasing total output) when there are more firms in the strong input market than in the weak one, while the opposite result is obtained when the weak input market displays a greater or equal number of firms.

The effects of the RPA are also the subject of a growing body of antitrust literature. The RPA has received an unprecedented amount of criticism over the course of its nearly 90-year existence, on par with any other antitrust law.[11] Blair and DePasquale (2014) analyze the act's primary prohibitions and how they may affect competition. They agree with the Antitrust Modernization Commission's 2007 report proposal: "Congress should repeal the RPA in its entirety." In fact, during the past few decades, the number of cases under the RPA has drastically fallen.[12] However, in the past two years, the RPA has had resurgence. As a first step toward reviving it, the FTC has launched a preliminary investigation into PepsiCo and Coca-Cola Co. for price discrimination (see, for example, Stein et al. (2023)).

It is interesting to note that in economics literature, the economic effects of MCD are yet largely unexplored. Aguirre (2016) studies the implications of price discrimination in a setting where a two-market firm faces competition in only one of the markets. In order to study the effects of MCD, he focuses on cases where the two-market input seller sets a lower price in the more competitive market. He shows how price discrimination reduces social welfare under linear demand when the duopolistic market is weak under both price and quantity

[11] See, for example, the criticism of Bork (1978) and the perverse effects found by Schwartz (1986) on the occasion of the fiftieth anniversary of the law.

[12] Sokol (2015) looks for structural enforcement flaws in RPA cases involving claims for primary-line and secondary-line injury. He examines the complete set of RPA cases to ascertain the possibility that a court will hold a defendant accountable under a primary-line or secondary-line RPA claim. He indicates the way that the RPA is enforced has changed structurally. As a result, the number of plaintiff victories in both primary-line and secondary-line cases has decreased over time, especially since *Brooke Group Ltd. v. Brown & Williamson Tobacco Corp*.

competition.[13] In this paper, we obtain a rationale for MCD by generalizing the analysis in Aguirre (2016) to a two-market firm selling a product in two oligopolistic markets. In cases of primary-line injury, when there are more firms competing in the strong market than in the weak market, MCD would allow price discrimination in favor of the weak market's consumers, which typically results in an increase in welfare. This result is robust to the nature of competition and the type of market (intermediate or final good) and can be seen as a general corollary of the analysis in Section 3 and 4.

3. **MCD and Price Discrimination in the Final Good Market**

In order to analyze the economic and welfare effects of price discrimination when different markets exhibit different degrees of competitiveness, we consider a stylized model where a multimarket firm sells in two geographically separated markets that differ in the extent of competition. First, we generalize the test for welfare improvement proposed by Varian (1985; 1989).

Consider a concave and differentiable aggregate utility function $u(\mathbf{q}_A, \mathbf{q}_B) + y$, where $\mathbf{q}_A$ is the vector of the n_A product varieties supplied in market *A*, $\mathbf{q}_B$ is the vector of the n_B product varieties supplied in market *B*, and y is the money to be spent on other goods. The inverse demand functions are $p_j\,(\mathbf{q}_A, \mathbf{q}_B) = \frac{\partial u(\mathbf{q}_A, \mathbf{q}_B)}{\partial q_j}$, for $j = \{1, .., n_A\}$ in market *A*, and $P_k\,(\mathbf{q}_A, \mathbf{q}_B) = \frac{\partial u(\mathbf{q}_A, \mathbf{q}_B)}{\partial q_k}$, for $k = \{1, .., n_B\}$ in market *B*. Suppose that the output configurations, $(\mathbf{q}_A^0, \mathbf{q}_B^0)$ and $(\mathbf{q}_A^1, \mathbf{q}_B^1)$ correspond to uniform pricing and price discrimination,

[13] Yenipazarli (2023) studies the effects of policy intervention on price discrimination in a distribution network where a manufacturer sells its product through two retailers in two asymmetric markets (i.e., a competitive market where two retailers engage in imperfect price competition, and a captive market monopolized by one of the retailers), and obtains a similar result.

respectively, with resulting market prices $(\mathbf{p}_A^0, \mathbf{p}_B^0)$ and $(\mathbf{p}_A^1, \mathbf{p}_B^1)$. The concavity of the utility function (equivalently, the downward-sloping demand functions) yields:

$$u(\mathbf{q}_A^1, \mathbf{q}_B^1) \leq u(\mathbf{q}_A^0, \mathbf{q}_B^0) + \sum_{j=1}^{n_A} \frac{\partial u(\mathbf{q}_A^0, \mathbf{q}_B^0)}{\partial q_j} \Delta q_j + \sum_{k=1}^{n_B} \frac{\partial u(\mathbf{q}_A^0, \mathbf{q}_B^0)}{\partial q_k} \Delta q_k.$$

$$u(\mathbf{q}_A^0, \mathbf{q}_B^0) \leq u(\mathbf{q}_A^1, \mathbf{q}_B^1) + \sum_{j=1}^{n_A} \frac{\partial u(\mathbf{q}_A^1, \mathbf{q}_B^1)}{\partial q_j} \Delta q_j + \sum_{k=1}^{n_B} \frac{\partial u(\mathbf{q}_A^1, \mathbf{q}_B^1)}{\partial q_k} \Delta q_k. \qquad (1)$$

From condition (1), a move from uniform pricing to price discrimination leads to:

$$\sum_{j=1}^{n_A} (p_j^0 - c)\Delta q_j + \sum_{k=1}^{n_B} (p_k^0 - c)\Delta q_k \geq \Delta W \geq \sum_{j=1}^{n_A} (p_j^1 - c)\Delta q_j + \sum_{k=1}^{n_B} (p_k^1 - c)\Delta q_k, \qquad (2)$$

where $\Delta w = \Delta u - \Delta c$, $\Delta q_j = q_j^1 - q_j^0,\ j = 1,..,n_A$, $\Delta q_k = q_k^1 - q_k^0$, $k = 1,..,n_B$ and c is the common constant marginal cost. The next lemma shows that these bounds provide a necessary condition and a sufficient condition for an increase in social welfare.

LEMMA 1. *Given a shift from uniform pricing to third-degree price discrimination:*

(i) A positive upper bound, $UB = \sum_{j=1}^{n_A} (p_j^0 - c)\Delta q_j + \sum_{k=1}^{n_B} (p_k^0 - c)\Delta q_k > 0$, *is a necessary condition for welfare improvement.*

(ii) A positive lower bound, $LB = \sum_{j=1}^{n_A} (p_j^1 - c)\Delta q_j + \sum_{k=1}^{n_B} (p_k^1 - c)\Delta q_k > 0$, *is a sufficient condition for welfare improvement.*

Note that when output is homogeneous across firms, the upper bound simplifies to $(p^0 - c)\left(\sum_{j=1}^{n_A} \Delta q_j + \sum_{k=1}^{n_B} \Delta q_k\right)$, and therefore we obtain the well-known result that an increase in total output is a necessary condition for price discrimination to enhance social welfare.

Now assume that a two-market firm (indexed by m) engages in competition with $(n_A - 1)$ firms in market A and $(n_B - 1)$ firms in market B. Let p^A, p^B and $\overline{p}_m$ be the equilibrium prices offered by the two-market firm m in markets A and B under price discrimination and uniform pricing, respectively, such that $p^A > \overline{p}_m > p^B$. The high-price market (market A) is referred to as the *strong* market while the low-price market (market B) is referred to as the *weak* market, in accordance with Robinson (1933). For the sake of simplicity, we focus on symmetric equilibria under price discrimination and p^A (respectively, p^B) is thereupon the equilibrium price of firms operating exclusively in market A (respectively, market B). Denote by $\overline{p}_A$ and $\overline{p}_B$ the equilibrium prices offered by single-market firms under uniform pricing in markets A and B, respectively. It holds under standard regularity conditions that $p^A \geq \overline{p}_A \geq \overline{p}_m \geq \overline{p}_B \geq p^B$.

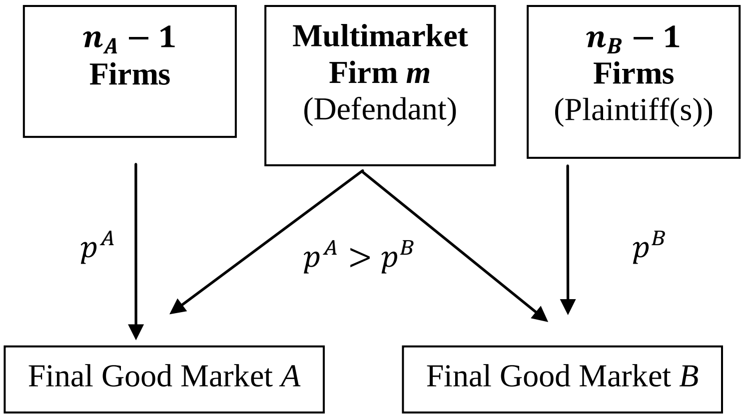

Figure 1. Primary-line injury case in the final good market.

An example of a primary-line injury case in the final good market is depicted in Figure 1. This example satisfies two appropriate characteristics to analyze the economic effects of the RPA and the MCD: (1) The two-market firm m's discriminatory pricing hurts rivals in market B, and so one of those rivals in market B (or the FTC) may file a lawsuit alleging that firm m has violated the RPA (particularly, primary-line injury); (2) Since $p^A > p^B$, the two-market seller *m* may utilize MCD to claim that it was responding in good faith to a competitor's equally low pricing. In this specific context, we first analyze Bertrand competition with product differentiation in each market, and then turn our attention to Cournot competition with product differentiation.

3.1. **Price Competition**

Consider a Bertrand oligopoly selling differentiated goods in two geographically separated markets A and B. The Shubik-Levitan demand function in market $k \in \{A, B\}$ faced by firm $i = \{1, 2, .., n_k\}$ is given by

$$q_{ik} = \frac{1}{n_k}\left[\alpha_k - p_{ik} - \gamma\left(p_{ik} - \frac{\sum_{j=1}^{n_k} p_{jk}}{n_k}\right)\right], \quad (3)$$

where $\alpha_k > 0$ and $\gamma \in [0, \infty)$ represents the extent of product substitutability in market $k \in \{A, B\}$, assumed to be constant across markets. Each firm incurs a common constant marginal cost, which is normalized to zero to aid exposition.[14]

Under price discrimination, firm $i = \{1, 2, .., n_k\}$ in market $k \in \{A, B\}$ chooses its product price p_{ik} to maximize $\pi_{ik} = p_{ik}q_{ik}$. It is trivial to show that each firm's profit function is (jointly) concave in the corresponding prices. Then, the resolution of the first order conditions yields the equilibrium prices and associated quantities as follows:

$$p^k \doteq p_i^k = \frac{\alpha_k n_k}{n_k[2+\gamma] - \gamma};$$

$$q^k \doteq q_i^k = \frac{n_k[1+\gamma] - \gamma}{n_k^2} p_i^k \text{ for } i = \{1, ,., n_k\}, k \in \{A, B\}. \quad (4)$$

[14] Adachi (2023), Chen et al. (2021) and Yenipazarli (2023) analyze the welfare effects of price discrimination in a Bertrand duopoly with differentiated products allowing firms' marginal costs to vary across markets.

Note that the two-market firm m follows the conventional thinking for third-price discrimination in equilibrium: it charges a higher price in the market having lower elasticity of the residual demand (in absolute value). Since market A is the strong market and market B is the weak market, then:

$$p^A - p^B = \frac{n_A n_B[2+\gamma][\alpha_A - \alpha_B] - [\alpha_A n_A - \alpha_B n_B]\gamma}{[n_A(2+\gamma) - \gamma][n_B(2+\gamma) - \gamma]} > 0. \qquad (5)$$

Under uniform pricing, the profit of each single-market firm $i = \{1,,.,n_k\}, i \neq m$ in market $k \in \{A,B\}$ is $\pi_{ik} = p_{ik}q_{ik}$, and the profit of the two-market firm m is $\pi_m = p_m[q_{mA} + q_{mB}]$. It is trivial to show that each firm's profit function is (jointly) concave in the corresponding prices. Then, the resolution of the first-order conditions of the profit maximization problems yields the equilibrium prices and associated quantities as follows:

$$\overline{p}_k = \frac{\alpha_k n_k^3[(2+2\gamma)n_{-k} - \gamma][(2+\gamma)n_{-k} - \gamma] - \alpha_k n_k n_{-k}^3 \gamma(2+\gamma)}{\Gamma}$$

$$+ \frac{n_k^2 n_{-k}[2\alpha_{-k} n_{-k}\gamma(1+\gamma) + 2\alpha_k n_{-k}^2(1+\gamma)(2+\gamma) - \alpha_{-k}\gamma^2]}{\Gamma}, \quad k \in \{A,B\} \qquad (6)$$

$$\overline{p}_m = \frac{\alpha_A n_A n_B^3[(2+2\gamma)n_A - \gamma] + \alpha_B n_A^3 n_B[(2+2\gamma)n_B - \gamma]}{\Gamma}, \qquad (7)$$

$$\overline{q}_k = \frac{[(1+\gamma)n_k - \gamma]}{n_k^2}\overline{p}_k, \qquad (8)$$

$$\overline{q}_m \doteq \overline{q}_m^A + \overline{q}_m^B = \left[\frac{(1+\gamma)n_A - \gamma}{n_A^2} + \frac{(1+\gamma)n_B - \gamma}{n_B^2}\right]\overline{p}_m, \qquad (9)$$

where $\overline{p}^k \doteq \overline{p}_i^k$, $\overline{q}^k \doteq \overline{q}_i^k$ for $i = \{1,,.,n_k\}$, $i \neq m$ and $k \in \{A,B\}$, and $\Gamma = (2+\gamma)\{n_B^3[(2+\gamma)n_A - \gamma][(2+2\gamma)n_A - \gamma] + n_A^3[(2+\gamma)n_B - \gamma][(2+2\gamma)n_B - \gamma]\}$.

As expected, under uniform pricing, the two-market firm *m* chooses a uniform price which is a weighted average of the product prices charged in markets *A* and *B* under discriminatory pricing: $\overline{p}_m = wp^A + (1-w)p^B$, where $w = \frac{n_B^3[(2+\gamma)n_A-\gamma][(2+2\gamma)n_A-\gamma]}{\Gamma} \in (0,1)$. Since $w \in (0,1)$, the uniform price charged by the two-market firm *m* is always bounded by the market-specific prices it charges under discriminatory pricing, viz., $p^A > \overline{p}_m > p^B$. This averaging by the two-market firm puts a downward pressure on prices charged by single-market firms in strong market *A* whereby $\overline{p}_i^A < p_i^A$, for $i = \{1,,.,n_A\}, i \neq m$. In contrast, it allows single-market firms in the weak market *B* to raise their product prices and hence $\overline{p}_i^B > p_i^B$, for $i = \{1,,.,n_B\}, i \neq m$. Note also that $w = \frac{1}{2}$ when both $n_A \to 1$ and $n_B \to 1$, meaning that when the two-market firm does not face any rivals in markets *A* and *B*, its uniform price is equal to the average of its product prices under discriminatory pricing.

The equilibrium quantities are of course affected by a shift from uniform pricing to price discrimination. Specifically, the two-market firm *m* supplies smaller (respectively, greater) quantities in the strong market *A* (respectively, weak market *B*) under price discrimination: $\overline{q}_m^A > q^A$ and $\overline{q}_m^B < q^B$. The single-market firms in market *A* (respectively, market *B*), however, supplies greater (respectively, smaller) quantities: $\overline{q}_i^A < q_i^A$ for $i = \{1,,.,n_A\}$, $i \neq m$ and $\overline{q}_i^B > q_i^B$ for $i = \{1,,.,n_B\}$, $i \neq m$. As the following lemma states, with respect to uniform pricing, the effect of price discrimination on the total output crucially depends on differences in the number of firms between the two markets.

LEMMA 2. *Effect of price discrimination on total output:*

(a) If the number of firms is greater in the strong market than in the weak market, $n_A > n_B$, *then price discrimination increases total output;*

(b) If the number of firms is equal across markets, $n_A = n_B$, then price discrimination keeps total output unchanged; and

(c) If the number of firms is greater in the weak market, $n_A < n_B$, then price discrimination decreases total output.

The results of LEMMA 2 are similar to those obtained by Aguirre (2019) in his price competition model with product differentiation.[15] Drawing upon LEMMA 1 and LEMMA 2, the following proposition characterizes the welfare implications of price discrimination.

PROPOSITION 1. *Given $\alpha_k > 0, n_k \geq 2$ for $k \in \{A, B\}$, and $\gamma \in (0, \infty)$:*

(a) If the number of firms in the strong market is greater than or equal to that in the weak market, $n_A \geq n_B$, then the necessary condition for price discrimination to enhance social welfare (given by LEMMA 1*) is satisfied;*

(b) If the multimarket firm only serves the weak market under price discrimination, then the sufficient condition for an increase in welfare (given by LEMMA 1*) is satisfied; and*

(c) The upper bound on the welfare change may be positive even when price discrimination reduces total output.

By part (a) of PROPOSITION 1, when there are fewer rivals in the weak market *B* (compared to the strong market *A*), the discriminatory pricing practice of the firm operating in both markets harms localized competitors in that market. This, in turn, is likely to enhance social welfare. Thus, when discriminatory pricing benefits the weak market with smaller number of competitors, MCD could help to negate the inadvertent negative effects of banning price discrimination by the two-market firm in order to improve the social welfare. This pinpoints a

[15] In the Appendix, we show that this lemma holds under the Spence-Dixit-Vives alternative demand specification with price competition. In the next subsection, we demonstrate that the effect of total output is similar under quantity competition with imperfect substitutes.

rationale for the effective use of MCD. Part (b) is a direct extension of the monopoly case (see, for example, Varian 1989). Note, however, there is no room for a Pareto improvement since local firms in the weak market prefer uniform pricing over discriminatory pricing.

Part (c) of PROPOSITION 1 reveals that an increase in total quantity is not a necessary condition for price discrimination to enhance social welfare.[16] The upper bound is $\overline{p}_i^A \Delta Q_{-m}^A + \overline{p}_m(\Delta q_m^A + \Delta q_m^A) + \overline{p}_i^B \Delta Q_{-m}^B$. Note that $\Delta Q_{-m}^A > 0$ and $\Delta Q_{-m}^B < 0$, and given that the marginal valuation of the increase in total output by the strong market's single-market firms is higher than the marginal valuation of the decrease in total output by the weak market's single-market firms, then the upper bound might be positive even thought total output decreases with price discrimination.

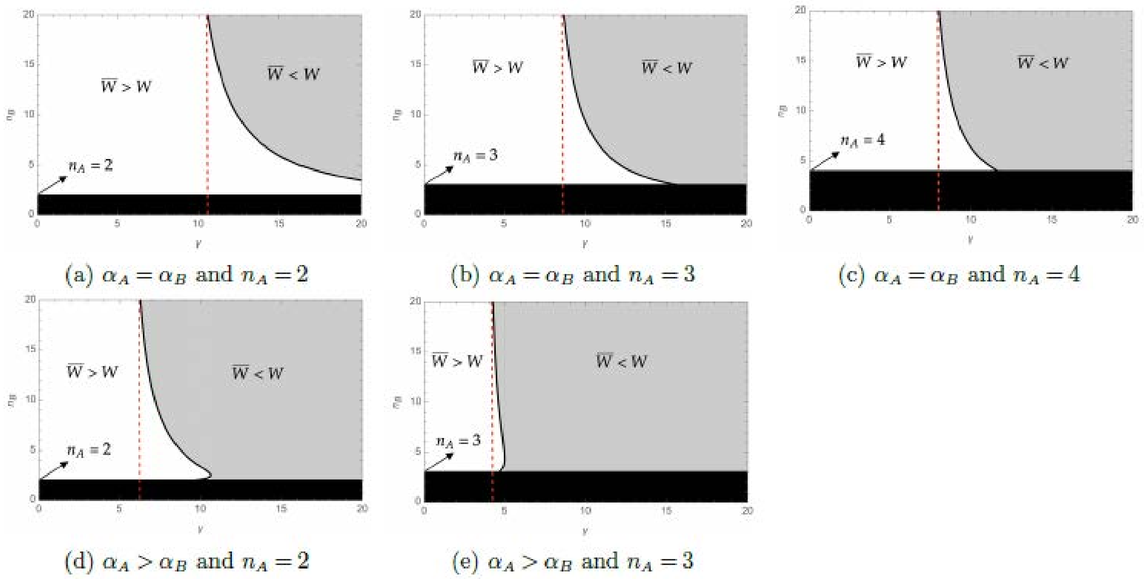

Figure 2. Comparison of social welfare obtained under discriminatory pricing (W) and uniform pricing ($\overline{W}$) when the number of competitors is higher in the weak market, $n_B > n_A$.

[16] This result is in contrast with the monopoly case (see footnote 7) and holds both under the Spence-Dixit-Vives alternative demand specification (see the Appendix) and under quantity competition (see Subsection 3.2). This result appears under product differentiation when the number of competitors varies between markets. In the literature on oligopoly price discrimination, this effect has gone unnoticed because symmetric models with the same firms selling in the same markets are typically considered (see, for example, Holmes, 1989, Dastidar, 2006, Adachi and Matsushima, 2014, Chen et al., 2021 and Adachi, 2023). Under symmetry the upper bound is $(p^0 - c)\left(\sum_{j=1}^{n_A} \Delta q_j + \sum_{k=1}^{n_B} \Delta q_k\right)$, and hence an increase in output is a necessary condition to increase welfare.

For intuition, suppose that $n_A < n_B$ and $\alpha_A > \alpha_B$. These conditions guarantee that market *A* (respectively, market *B*) is the strong market (respectively, the weak market) and that the total output decreases with a shift from uniform pricing to price discrimination. Figure 2 illustrates how the social welfare can be higher under discriminatory pricing relative to uniform pricing (in the grey shaded regions) even though total output decreases (unless the extent of product substitutability γ is quite small). It is evident that the shaded region where discriminatory pricing outperforms uniform pricing (with regard to the social welfare) expands following an increase in the demand potential and/or the number of competitors in the strong market *A*.

Finally, in order to emphasize the rationale for MCD when the number of firms is greater in the strong market, we conclude this section with the following result:

REMARK 1. *Price discrimination increases social welfare if the following conditions are satisfied: (i) The number of firms is greater in the strong market than in the weak market ($n_A > n_B$); (ii) The strong market exhibits a higher demand potential than the weak market ($\alpha_A > \alpha_B$); (iii) For the two market firm, the strong market is more profitable than the weak market ($\frac{\alpha_A}{n_A} > \frac{\alpha_B}{n_B}$) and (iv) The substitutability parameter γ is high enough.*[17]

3.2. **Quantity Competition**

Under Cournot-type quantity competition, the Shubik-Levitan inverse demand function in market $k \in \{A, B\}$ is given by:

$$p_{ik} = \alpha_k - \frac{n_k q_{ik} + \gamma \sum_{j=1}^{n_k} q_{jk}}{1 + \gamma} \tag{10}$$

[17] To obtain this result, a modest positive degree of substitutability among competing products is necessary. Note that when products are independent, $\gamma = 0$, we would obtain the monopoly result: Price discrimination reduces social welfare with linear demand (unless it serves to open new markets) since it keeps total output unchanged.

Under price discrimination, firm $i \in \{1,..,n_k\}$ in market $k \in \{A,B\}$ chooses its output to maximize its profit $\pi_{ik} = p_k\left(q_{1k},..,q_{n_k}\right)q_{ik}$. It is easy to show that each firm's profit function is (jointly) concave in the corresponding quantities. From the simultaneous resolution of the first-order conditions, we obtain the equilibrium quantities, each market total output, and the associated prices:

$$q^k = q_i^k = \frac{\alpha_k(1+\gamma)}{2n_k+\gamma(n_k+1)};\ \text{for } i = \{1,,.,n_k\}, k \in \{A,B\}$$

$$Q^k = \frac{\alpha_k n_k(1+\gamma)}{2n_k+\gamma(n_k+1)};\ \text{for } k \in \{A,B\}$$

$$p^k = p_i^k = \frac{\alpha_k(n_k+\gamma)}{2n_k+\gamma(n_k+1)}\ k \in \{A,B\}. \qquad (11)$$

Since market *A* is the strong market and market *B* is the weak market, then:

$$p^A - p^B = \frac{\alpha_A(n_A+\gamma)[2n_B+\gamma(n_B+1)] - \alpha_B(n_B+\gamma)[2n_A+\gamma(n_A+1)]}{[2n_A+\gamma(n_A+1)][2n_B+\gamma(n_B+1)]} > 0. \qquad (12)$$

Under uniform pricing, the profit function of the two-market firm *m* is $\overline{\pi}_m = p_A(Q_A)q_{mA} + p_B(Q_B)q_{mB}$. The two-market seller has to adjust its output across markets under uniform pricing in order to satisfy $p_{mA} = p_{mB}$; that is,

$$\alpha_A - \frac{n_A q_{mA} + \gamma\sum_{j=1}^{n_A} q_{jA}}{1+\gamma} = \alpha_B - \frac{n_B q_{mB} + \gamma\sum_{j=1}^{n_B} q_{jB}}{1+\gamma}$$

$$\Leftrightarrow q_{mA} = \frac{(\alpha_A-\alpha_B)(1+\gamma) + n_B q_{mB} + \gamma[\sum_{j=1}^{n_B} q_{jB} - \sum_{j=1,j\neq m}^{n_A} q_{jA}]}{n_A+\gamma}$$

Therefore, the profit function of the two-market firm under uniform pricing becomes:

$$\overline{\pi}_m = [\alpha_B - \frac{n_B q_{mB}+\gamma\sum_{j=1}^{n_B} q_{jB}}{1+\gamma}][\frac{(\alpha_A-\alpha_B)(1+\gamma)+n_B q_{mB}+\gamma\left[\sum_{j=1}^{n_B} q_{jB}-\sum_{j=1,j\neq m}^{n_A} q_{jA}\right]}{n_A+\gamma} + q_{mA}].$$

From the first order conditions of the maximization problems, we obtain that the equilibrium outputs (taking into account that all single market firms that operate in market $k \in \{A, B\}$ will produce the same quantity at equilibrium) solve the following four-equation system:

$$\bar{q}_i^A = \frac{\alpha_A(1+\gamma) - \gamma\bar{q}_m^A}{n_A[2+\gamma]}, \qquad i = 1, .., n_A, i \neq m \quad (13)$$

$$\bar{q}_i^B = \frac{\alpha_B(1+\gamma) - \gamma\bar{q}_m^B}{n_B[2+\gamma]}, \qquad i = 2, .., n_B, i \neq m \quad (14)$$

$$\bar{q}_m^A = \frac{(\alpha_A - \alpha_B)(1+\gamma) + n_B\bar{q}_m^B + \gamma\bar{q}_m^B + \gamma(n_B - 1)\bar{q}_i^B - \gamma(n_A - 1)\bar{q}_i^A}{n_A + \gamma}, \quad (15)$$

$$\bar{q}_1^B = \frac{(1+\gamma)[\alpha_B(n_A + 2n_B + 3\gamma) - \alpha_A(n_B + \gamma)] - \gamma(n_B - 1)(n_A + 2n_B + 3\gamma)\bar{q}_i^B + \gamma(n_B + \gamma)(n_A - 1)\bar{q}_i^A}{2(n_B + \gamma)(n_A + n_B + 2\gamma)}. \quad (16)$$

In the Appendix, we demonstrate that, compared to uniform pricing, the effects of price discrimination on total output and social welfare under Cournot competition are similar to those under price competition. That is, LEMMA 2, PROPOSITION 1 and REMARK 1 maintain under quantity competition. When the products are perfect substitutes, $\gamma \to \infty$, we obtain similar results in parts (a) and (b) of PROPOSITION 1. However, the main difference appears in part (c) because under Cournot competition with homogeneous product an increase in total output is a necessary condition for an increase in welfare.

So far, we have shown that the rationale for MCD in final good markets when the number of firms is greater in the strong market is robust to the nature of competition. In the next section, we will find that this fundamental justification for MCD maintains in intermediate goods markets.

4. **MCD and Price Discrimination in the Intermediate Goods Market**

To analyze how price discrimination affects social welfare in the intermediate good markets, we consider a primary-line injury case where a firm injures a rival by employing discriminatory pricing. We consider a Cournot industry with an upstream and a downstream sector.[18] A two-market upstream firm (indexed by mU) produces a homogeneous intermediate good at a constant marginal cost $c > 0$, and sells it in two monopolized downstream markets A and B. There are $n_A - 1$ additional firms supplying the intermediate good in market A and $n_B - 1$ additional firms supplying the intermediate good in market B. In the downstream sector, the intermediate good is an input and firms transform one unit of input into one unit of a final good at a constant marginal cost, which we assume zero for simplicity. The inverse demand for the final good in market k is $p_k(Q_k) = \alpha_k - \beta_k Q_k$, for $k \in \{A, B\}$, and we assume that each market is monopolized by firm $k \in \{A, B\}$. A typical primary-line injury case in the intermediate good market is shown in Figure 3.

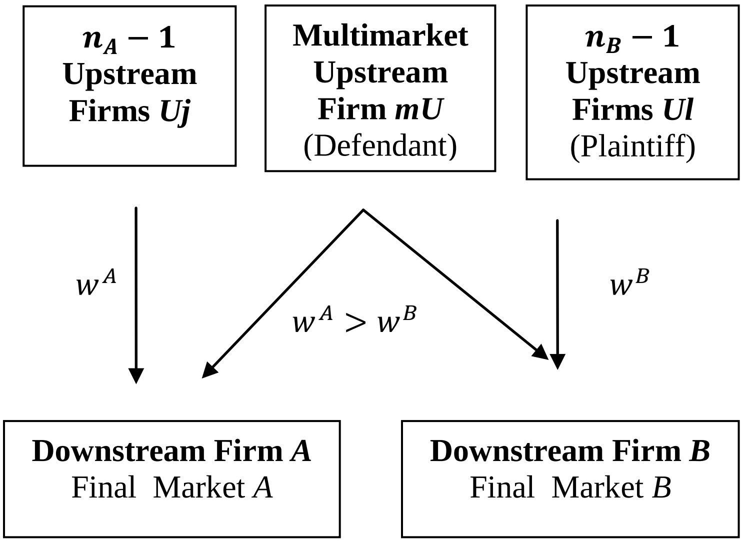

Figure 3. Primary-line injury case in the intermediate good market.

[18] To keep the analysis as simple as possible, we follow the treatment of vertical relationships in Chapter 17 of Belleflamme and Peitz (2015).

We model the problem as a two-stage game and then solve it by backward induction, so the equilibrium concept is subgame perfect equilibrium. At the first stage, upstream firms simultaneously choose upstream quantities (i.e., firm *mU* decides how much input to supply to markets *A* and *B*; each firm *Uj* decides how much input to supply to market *A*; and each firm *Uk* decides how much input to supply to market *B*). The market clearing input prices (from the point of view of downstream firms), denoted by $w_k, k \in \{A, B\}$, are determined by matching the total amount of input required by downstream firms in each market with that supplied by upstream firms. At the second stage, the monopolistic firm in each final good market chooses its quantity.

It is assumed that the downstream firms take w_k as given.[19] The profit function of the monopolistic firm in market $k \in \{A, B\}$ is $\pi_k(Q_k) = [p_k(Q_k) - w_k]Q_k = (\alpha_k - \beta_k q_k - w_k)Q_k$. The monopolistic retail quantity and price in market $k \in \{A, B\}$ are obtained as a function of w_k as follows:

$$Q_k(w_k) = \frac{\alpha_k - w_k}{2\beta_k} \text{ and } p_k(w_k) = \frac{\alpha_k + w_k}{2}. \tag{17}$$

The inverse demand for the intermediate good in market $k \in \{A, B\}$ is defined accordingly as $w_k(x_k) = \alpha_k - 2\beta_k x_k$, given that in equilibrium $x_k = Q_k$.

Under price discrimination in the intermediate good markets, the profit function of the two-market upstream firm in markets *A* and *B* are $\pi_{mU}^A(x_{mU}^A, x_{-mU}^A) = (\alpha_A - 2\beta_A x_{mU}^A - 2\beta_A x_{-mU}^A - c)x_{mU}^A$ and $\pi_{mU}^B(x_{mU}^B, x_{-mU}^B) = (\alpha_B - 2\beta_B x_{mU}^B - 2\beta_B x_{-mU}^B - c)x_{mU}^B$. The profit function of the upstream firm *Uj* in the input market *A* is $\pi_{Uj}^A\left(x_{Uj}^A, x_{-Uj}^A\right) = \left[\alpha_A - 2\beta_A\left(x_{Uj}^A + x_{-Uj}^A\right) - c\right]x_{Uj}^A$, for $j = 1, \ldots, n_A, j \neq m$, and the profit function of the upstream firm *Ul* in the input market *B* is $\pi_{Ul}^B(x_{Ul}^B, x_{-Ul}^B) = [\alpha_B - 2\beta_B(x_{Ul}^B + x_{-Ul}^B) - c]x_{Ul}^B$, for $l =$

[19] See, for instance, Belleflamme and Peitz (2015), footnote #102, for a nice justification of this assumption.

$1, .., n_A, l \neq m$. The equilibrium wholesale price, quantity, and price for the final good in market $k \in \{A, B\}$ are then given by:

$$w^k = \frac{\alpha_k + n_k c}{(n_k + 1)}, x^k = Q^k = \frac{n_k(\alpha_k - c)}{2(n_k + 1)\beta_k}, \text{and } p^k = \frac{(n_k + 2)\alpha_k + n_k c}{2(n_k + 1)}. \qquad (18)$$

Since the upstream market A is the strong market and the upstream market B is the weak market, then the input price difference satisfies: $w^A - w^B = \frac{\alpha_A(n_B+1) - \alpha_B(n_A+1) + (n_A - n_B)c}{(n_A+1)(n_B+1)} > 0$.

Under uniform pricing, the two-market upstream firm has to charge a uniform price and therefore the equality $w_A(x_A) = \alpha_A - 2\beta_A x^A_{mU} - 2\beta_A x^A_{-mU} = \alpha_B - 2\beta_B x^B_{mU} - 2\beta_B x^B_{-mU} = w_B(x_B)$ must hold. Stated differently, the two-market upstream firm must adjust its sales in market A in order to meet the following restriction: $x^A_{mU} = \frac{\alpha_A - \alpha_B + 2\beta_B(x^B_{mU} + x^B_{-mU})}{\beta_A} + x^A_{-mU}$. Consequently, we can write the profit function of the two-market seller as follows: $\pi_{mU} = [\alpha_B - 2\beta_B x^B_{mU} - 2\beta_B x^B_{-mU} - c]\left(\frac{\alpha_A - \alpha_B + 2\beta_B(x^B_{mU} + x^B_{-mU})}{\beta_A} + x^A_{-mU} + x^B_{mU}\right)$. Solving the first-order conditions yields the uniform wholesale price and the equilibrium quantity in market $k \in \{A, B\}$ as follows:

$$\overline{w} = \frac{\alpha_A\beta_B + \alpha_B\beta_A + (\beta_A n_B + \beta_B n_A)c}{[(n_B + 1)\beta_A + (n_A + 1)\beta_B]}, \qquad (19)$$

$$\overline{x}^k = \overline{Q}^k = \frac{\alpha_k\beta_k(n_{-k} + 1) + \alpha_k\beta_{-k}n_k - \alpha_{-k}\beta_k - (\beta_k n_{-k} + \beta_{-k}n_k)c}{2[(n_{-k} + 1)\beta_k + (n_k + 1)\beta_{-k}]\beta_k}. \qquad (20)$$

The change in total quantity due to a move from uniform pricing to price discrimination by the two-market firm is:

$$\Delta Q = \Delta x = \frac{(n_A - n_B)\,[w^A - w^B]}{2[(n_B + 1)\beta_A + (n_A + 1)\beta_B]}. \qquad (21)$$

This context satisfies two appropriate properties to analyze the economic effects of the RPA and MCD: (1) Due to the harm that price discrimination by the two-market upstream firm causes to competitors in the input market *B*, one or more of these firms, as well as the FTC, may file a complaint against firm mU on the grounds that RPA was violated, specifically by invoking a primary line injury; (2) Since $w^A > w^B$, the two-market upstream firm may use MCD to claim that it was acting in good faith in order to match (nor beat) a competitor's equally low pricing. Finally, the following proposition states, relative to uniform pricing, the welfare effect of input price discrimination.

PROPOSITION 2. *Given* $\alpha_k > 0, \beta_k > 0$, *and* $n_k \geq 2$ *for* $k \in \{A, B\}$*:*

(a) If the number of competitors is greater in the strong market than in the weak market, (i.e., $n_A > n_B$*), then the necessary condition for price discrimination to increase social welfare (given by LEMMA* 1 which now translates into an increase in total output) *is satisfied; and*

(b) If the upstream multimarket firm only serves the weak market under price discrimination, then the sufficient condition for an increase in welfare (given by LEMMA 1*) is satisfied.*

Part (a) of this proposition shows that if there are more competitors in the strong market than in the weak market, $n_A > n_B$, then MCD may be used successfully when input price discrimination tends to increase social welfare. In contrast with Aguirre (2016), we find a justification for MCD in the intermediate good market that is comparable to that of the final goods market. If the number of competitors in the weak market is greater than (or equal to that) in the strong market, $n_A \leq n_B$, then social welfare decreases with input price discrimination. Note that in this case MCD may be used when price discrimination reduces social welfare and therefore this defense lacks justification. Part (b) is straightforward, since input price discrimination would cause output to remain unchanged in the strong market, while increasing it in the weak market.

5. **Concluding Remarks**

The effect of price discrimination by a multimarket firm on total output and social welfare is contingent upon variations in the degree of competitiveness across markets. We have analyzed the effects of price discrimination in primary-line injury cases. When the number of firms is greater in the strong market than in the weak market, we have found that the necessary condition for price discrimination to increase social welfare is satisfied. If the two-market firm only serves the weak market under price discrimination (and not under uniform pricing), then the sufficient condition for an increase in social welfare is met. It is also important to remark that our results are robust to different types of competition (price or quantity competition) and different types of market (final or intermediate). An important consequence of our analysis is that we provide a novel rationale for MCD.

Moreover, if the strong market is also the *big* market (both from the point of view of the industry and for the point of view of the multimarket seller), more firms in the strong market guarantee an increase of social welfare. And last, but not least, another relevant result is that, when firms produce imperfect substitutes, an increase in total output is not a necessary condition for price discrimination to increase social welfare when the number of firms varies between markets. This finding maintains both when firms compete on price under product differentiation allowing alternative demand structures and under quantity competition with product differentiation.

This study could be extended in a number of ways. For instance, contracts among sellers and buyers are linear in our model and buyers (both end-consumers of goods or downstream firms) take prices set by producers of final goods or the upstream sector (in a take-it-or-leave-it environment) as given. It would be interesting to investigate how non-linear contracts (see, for example, Inderst and Shaffer, 2009, and Miklós-Thal and Shaffer, 2021a) and bargaining power and negotiation among firms (see, for example, O'Brien and Shaffer, 1994, and O'Brien, 2014) could have an impact on the economic and welfare implications of price discrimination when the number of competitors varies across markets.

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Appendix A: Proofs of Lemmas and Propositions

A.1. Proof of LEMMA 1

Given condition (1), a move from uniform pricing to price discrimination leads to $\sum_{j=1}^{n_A}(p_j^0 - c)\Delta q_j + \sum_{k=1}^{n_B}(p_k^0 - c)\Delta q_k \geq \Delta W \geq \sum_{j=1}^{n_A}(p_j^1 - c)\Delta q_j + \sum_{k=1}^{n_B}(p_k^1 - c)\Delta q_k$, where $\Delta w = \Delta u - \Delta c$, $\Delta q_j = q_j^1 - q_j^0$, $j = 1,..,n_A$, $\Delta q_k = q_k^1 - q_k^0$, $k = 1,..,n_B$ and c is the common constant marginal cost. Consequently, the left-hand side term in the inequality represents an upper bound on the welfare change and the right-hand side term a lower bound. Therefore, a positive upper bound is a necessary condition and a positive lower bound a sufficient condition for an increase in welfare.

A.2. Proof of LEMMA 2

The change in total output due to a movement from uniform pricing to price discrimination can be expressed as $\Delta Q = \frac{(p^A - p^B)}{\Gamma}[(2+2\gamma)n_B - \gamma][(2+2\gamma)n_A - \gamma]\{[(1+\gamma)n_A - \gamma][(2+\gamma)n_B - \gamma]n_A^2 - [(1+\gamma)n_B - \gamma][(2+\gamma)n_A - \gamma]n_B^2\}$, where $\Gamma = (2+\gamma)\{n_B^3[(2+\gamma)n_A - \gamma][(2+2\gamma)n_A - \gamma] + n_A^3[(2+\gamma)n_B - \gamma][(2+2\gamma)n_B - \gamma]\}$. Given that we assume that market *A* is the strong market, $p^A > p^B$: (a) If the number of firms is greater in the strong market, $n_A > n_B$, then $\Delta Q > 0$; (b) If the number of firms is constant across markets, $n_A = n_B$, then $\Delta Q = 0$; and (c) If the number of firms is greater in the weak market, $n_A < n_B$, then $\Delta Q < 0$.

A.3 Proof of PROPOSITION 1

With the equilibrium expressions, the upper bound in LEMMA1 can be expressed as follows: $\text{UB} = k_A(n_A - 1)\overline{p}^A\left(p^A - \overline{p}^A\right) + k_A\overline{p}_m(p^A - \overline{p}_m) + k_B(n_B - 1)\overline{p}^B(p^B - \overline{p}^B) + k_B\overline{p}_m(p^B - \overline{p}_m)$, where $k_A \doteq n_A(1+\gamma) - \gamma$ and $k_B \doteq n_B(1+\gamma) - \gamma$. Note that since market *A* is the strong market, we have that $p^A > \overline{p}^A > \overline{p}_m > \overline{p}^B > p^B$. Therefore, UB $= k_A(n_A - 1)\overline{p}^A \left(p^A - \overline{p}^A\right) + k_A\overline{p}_m(p^A - \overline{p}_m) + k_B(n_B - 1)\overline{p}^B \left(p^B - \overline{p}^B\right) + k_B\overline{p}_m(p^B - \overline{p}_m) > k_A(n_A - 1)\overline{p}_m \left(p^A - \overline{p}^A\right) + k_A\overline{p}_m(p^A - \overline{p}_m) + k_B(n_B - 1)\overline{p}_m \left(p^B - \overline{p}^B\right) + k_B\overline{p}_m(p^B - \overline{p}_m) = \overline{p}_m\Delta Q$. From LEMMA 2 we obtain that when the number of firms in the strong market is greater than or equal to that in the weak market, then $\Delta Q \geq 0$. This implies that the upper bound is positive, UB > 0, and that the necessary condition for price discrimination to increase social welfare is satisfied (part (a)). When the two-market firm only serves the weak market under price discrimination, then the sufficient condition in LEMMA 1 is satisfied (part (b)). When competitive pressure is greater in the weak market, price discrimination reduces total output, $\Delta Q < 0$. Given that UB $> \overline{p}_m\Delta Q$, the upper bound might be positive and, consequently, price discrimination might increase social welfare without increasing total output (part (c)).

A.4. Proof of LEMMA 2 under Cournot competition

The change in total output due to a move from uniform pricing to price discrimination is:

$\Delta Q = \frac{(n_A - n_B)\gamma(1+\gamma)^2(2n_A+\gamma)(2n_B+\gamma)(p^A - p^B)}{\Delta}$ where

$$\Delta = 8n_A^2 n_B^2(n_A + n_B) + 8n_A n_B(n_B^2 + n_A^2(1 + n_B) + n_A n_B(4 + n_B))\gamma + 2(n_B^3 + n_A n_B^2(14 + 3n_B) + n_A^3(1 + n_B(3 + n_B)) + n_A^2 n_B(14 + n_B(12 + n_B)))\gamma^2 + (n_A^3(1 + n_B) + n_B^2(8 + n_B) + n_A n_B(2 + n_B)(12 + n_B) + 2n_A^2(4 + n_B(7 + 2n_B)))\gamma^3 + (n_A + n_B)(7 + 3n_B + n_A(3 + n_B))\gamma^4 + (2 + n_A + n_B)\gamma^5$$

Therefore, if the number of firms is greater (equal/lower) in market A, total output increases (remains constant/decreases) with price discrimination.

A.5. Proof of PROPOSITION 1 under Cournot competition

It is straightforward from LEMMA1 and LEMMA 2.

A.6. Proof of PROPOSITION 2

Thisis a direct consequence of LEMMA 1. For Part (a) note that the change in total output due to a move from uniform pricing to price discrimination is $\Delta Q = \frac{(n_A - n_B)\,[w^A - w^B]}{2[(n_B+1)\beta_A + (n_A+1)\beta_B]}$. Given that the intermediate good market *A* is the strong market, $w^A > w^B$, if the number of firms is greater in the strong input market than in the weak input market, $n_A > n_B$, then $\Delta Q > 0$. Note that $(p_A^0 - c)\Delta q_A + (p_B^0 - c)\Delta q_B < p_A^0 \Delta Q$ since $p^A > p_A^0 > p_B^0 > p^B$ (which is guaranteed if $\alpha_A > \alpha_B$). Hence, the necessary condition for an increase in social welfare is satisfied only when $\Delta Q > 0$. If $n_A \leq n_B$, then $\Delta Q \leq 0$, and, consequently, social welfare decreases with input price discrimination. When the upstream two-market firm only serves the weak input market under price discrimination, then the sufficient condition in LEMMA 1 is satisfied (part (b)).

A.7. REMARK 1

In order to prove REMARK 1, we have used Mathematica. It is necessary the parameter of substitutability to be high enough, $\gamma \geq 10$.

Appendix B: Price Discrimination in the Final Good Market Under Price Competition

B.1. Shubik-Levitan Demand Specification

In a fully supplied market, this demand structure has an intuitive interpretation: the demand for a specific product decreases directly with its own price and additionally if its price increases above the average price. In addition, total demand nq is independent of the number of product varieties n and the product differentiation parameter γ for a common price since $nq = \alpha - p$. Therefore, there is no market expansion (demand) effect. As a consequence, the degree of competition and product substitutability can vary without affecting the size of the market so that we can isolate the competition effect. In general, the foundations for this demand function assume that the representative consumer's utility in a market with n product varieties is: $u(\mathbf{q}) = \alpha \sum_{i=1}^{n} q_i - \frac{1}{2}(\sum_{i=1}^{n} q_i)^2 - \frac{n}{2(1+\gamma)}\left[\sum_{i=1}^{n} q_i^2 - \frac{(\sum_{i=1}^{n} q_i)^2}{n}\right]$, where $\gamma \in [0, \infty)$ is the extent of product differentiation such that the products are completely independent if $\gamma = 0$ and they approach to perfect substitutability when $\gamma \to \infty$. The direct and inverse demand functions are derived, respectively, as follows: $q_i = \frac{1}{n}\left[\alpha - p_i - \gamma\left(p_i - \frac{\left(\sum_{j=1}^{n} q_j\right)^2}{n}\right)\right]$ for $i = \{1, .., n\}$ and $p_i = \alpha - \frac{nq_i + \gamma\left(\sum_{j=1}^{n} q_j\right)}{1+\gamma}$ for $i = \{1, .., n\}$.

B.2. Spence-Dixit-Vives Demand Specification

This demand structure exhibits the classical economic properties that the utility of owning a product decreases as the consumption of the substitute product increases, and the representative consumer's marginal utility for a product diminishes as the consumption of the product increases. It also implies that the value of using multiple substitutable products is less than the sum of the separate values of using each product on its own.

It is assumed that a representative consumer has a quadratic and strictly concave utility function $u(\mathbf{q}) = \alpha \sum_{i=1}^{n} q_i - \frac{1}{2}\left[\sum_{i=1}^{n} q_i^2 + \gamma \sum_{i=1}^{n} \sum_{j \neq i, j=1}^{n} q_i q_j\right]$, where $\gamma \in (0,1)$ represents the degree of substitutability between the varieties. When $\gamma = 0$, the varieties are independent, and when $\gamma \to 1$, the varieties are perfect substitutes. With $\delta = \frac{\alpha}{1+(n-1)\gamma}$, $\beta = \frac{1+(n-2)\gamma}{(1-\gamma)[1+(n-1)\gamma]}$, and $\varphi = \frac{\gamma}{(1-\gamma)[1+(n-1)\gamma]}$, the direct and inverse demand functions are: $q_i = \delta - \beta p_i + \varphi \sum_{j \neq i}^{n} p_j$ for $i = \{1, .., n\}$ and $p_i = \alpha - q_i - \gamma \sum_{j \neq i}^{n} q_j$ for $i = \{1, .., n\}$.

B.3. Economic Effects of Price Discrimination with Spence-Dixit-Vives Demand

Firm *m* operates in two perfectly separated markets, *A* and *B*, and faces $n_A - 1$ single-market rivals in market *A* and $n_B - 1$ single-market rivals in market *B*. The demand function in market $k \in \{A, B\}$ is:

$$q_{ik} = \frac{\alpha_k}{1+(n_k-1)\gamma} - \frac{[1+(n_k-2)\gamma]p_{ik}}{(1-\gamma)[1+(n_k-1)\gamma]} + \frac{\gamma \sum_{j\neq i}^{n_k} p_{jk}}{(1-\gamma)[1+(n_k-1)\gamma]}, \text{for } i = \{1,.,n_k\}. \qquad (B1)$$

Equilibrium prices and outputs under price discrimination are given by:

$$p^k \doteq p_i^k = \frac{\alpha_k(1-\gamma)}{[2+(n_k-3)\gamma]}; \, q^k \doteq q_i^k = \frac{\alpha_k[1+(n_k-2)\gamma]}{[2+(n_k-3)\gamma][1+(n_k-1)\gamma]} \text{ for } i = \{1,,.,n_k\}, k \in \{A, B\} \quad (B2)$$

Equilibrium prices and outputs under uniform pricing are given by:

$$\overline{p}_k = \frac{(n_{-k}-1)\varphi_{-k}(\varphi_k\delta_{-k}-\varphi_{-k}\delta_k)-[\varphi_{-k}(n_{-k}-2)-2\beta_{-k}][\varphi_k(\delta_k+\delta_{-k})+2\delta_k(\beta_k+\beta_{-k})]}{\Omega}, \; k \in \{A, B\}$$

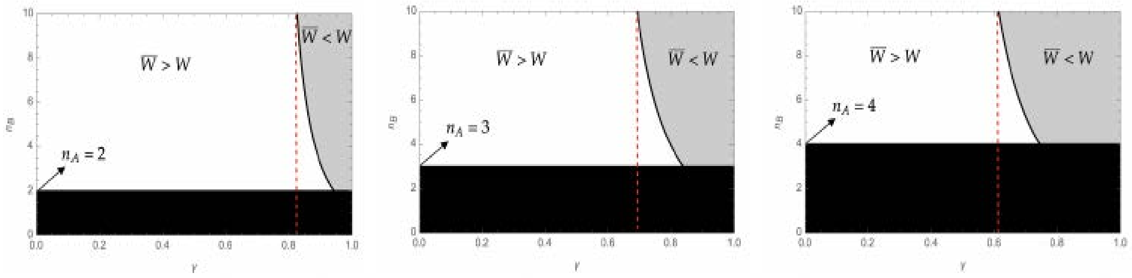
$$\overline{p}_m = \frac{\delta_B(2\beta_B+\varphi_B)[2\beta_A-\varphi_A(n_A-2))]+\delta_A(2\beta_A+\varphi_A)[2\beta_B-\varphi_B(n_B-2))]}{\Omega},$$

$$\overline{q}_k = \beta_k\overline{p}_k \text{ and } \overline{q}_m \doteq \overline{q}_m^A + \overline{q}_m^B = (\beta_A + \beta_B)\overline{p}_m. \qquad (B3)$$

where $\overline{p}^k \doteq \overline{p}_i^k$, $\overline{q}^k \doteq \overline{q}_i^k$ for $i = \{1,,.,n_k\}$, $i \neq m$ and $k \in \{A, B\}$, and $\Omega = \varphi_A^2(n_A - 1)[\varphi_B(n_B - 2) - 2\beta_B] + \varphi_B^2(n_B - 1)[\varphi_A(n_A - 2) - 2\beta_A] + 2(\beta_A + \beta_B)[\varphi_A(n_A - 2) - 2\beta_A][\varphi_B(n_B - 2) - 2\beta_B]$.

Since market *A* is the strong market, $p^A > p^B$, it is easy to check that results in LEMMA 2 hold. Moreover, given that $p^A > \overline{p}_A > \overline{p}_m > \overline{p}_B > p^B$ and that $\overline{q}_m^A > q^A$, $\overline{q}_m^B < q^B$, $\overline{q}_i^A < q_i^A$ for $i = \{1,,.,n_A\}$, $i \neq m$ and $\overline{q}_i^B > q_i^B$ for $i = \{1,,.,n_B\}$, $i \neq m$, then from LEMMA 1 $UB = \overline{p}_m\Delta q_m^A + \overline{p}^A \sum_{i=1,i\neq m}^{n_A} q_i^A + \overline{p}_m\Delta q_m^B + \overline{p}^B \sum_{i=1,i\neq m}^{n_B} q_i^B > \overline{p}_m\Delta q_m^A + \overline{p}_m \sum_{i=1,i\neq m}^{n_A} q_i^A +$

$\overline{p}_m \Delta q_m^B + \overline{p}_m \Sigma_{i=1,i\neq m}^{n_B} q_i^B = \overline{p}_m \Delta Q$. Therefore, the results in PROPOSITION 1 hold. Figure 5 illustrates how social welfare can increase even if total output decreases.



(a) $\alpha_A = \alpha_B$ and $n_A = 2$ (b) $\alpha_A = \alpha_B$ and $n_A = 3$ (c) $\alpha_A = \alpha_B$ and $n_A = 4$

Figure 5. Comparison of social welfare under discriminatory pricing (W) and uniform pricing ($\overline{W}$) when $n_A < n_B$.