E C O N O M I C S   B U L L E T I N

Multiproduct Monopolist and Full−line Forcing: The Efficiency Argument Revisited

Thibaud Vergé
CMPO and Department of Economics, University of Bristol

Abstract

Shaffer (1991) shows that a multiproduct monopolist selling differentiated products through a unique retailer cannot earn monopoly profit using brand specific two−part tariffs and that full−line forcing restores monopoly power. We extend this analysis to more general contracts and shows that full−line forcing is efficient as it increases both industry profits and consumers' surplus.

I would like to thank Estelle Malavolti, Bruno Jullien and Patrick Rey for helpful discussions. All remaining errors are mine.
Citation: Vergé, Thibaud, (2001) "Multiproduct Monopolist and Full−line Forcing: The Efficiency Argument Revisited." *Economics Bulletin,* Vol. 12, No. 4 pp. 1−9
Submitted: July 4, 2001. **Accepted:** October 4, 2001.
URL: http://www.economicsbulletin.com/2001/volume12/EB−01L40002A.pdf

1 Introduction

The economic literature has provided many possible motivations for tying or full-line forcing, such as price discrimination, cost optimization or leverage theory. The price discrimination argument is generally applied to complementary products and states that full-line forcing allows a multi-product monopolist to increase the surplus extracted from homogeneous (Burstein, 1960a, b) or heterogeneous consumers (Bowman, 1957). On the other side, the cost-savings motive emphasizes substitutable goods and shows that the monopolist has incentives to tie-in the sales of substitutable inputs in order to induce production cost minimization (Slade, 1997). Finally, the last justification relates to the widely contested leverage theory.[1] The intuition is that the multi-product monopolist may use tying to extend his monopoly power and eliminate competition in the tied-good market. The common point of these models is that they all assume a direct relationship between producers and final consumers.

Shaffer (1991) provides a first attempt to analyse full-line forcing in a vertical relationship. An upstream monopolist selling differentiated products (imperfect substitutes) through a unique retailer cannot earn the monopoly profit with brand specific two-part tariffs. The retailer indeed earns a strictly positive rent attributable to the retailer's discretion over brand choice. Shaffer also shows that full-line forcing (as well as other vertical restraints like resale price maintenance and aggregate rebates) is a possible tool to avoid retailer's rent and restore monopoly profit.

However, Shaffer does not consider the welfare effects of such restraints. The objective of this note is twofold. Considering a similar framework, we show that brand specific two-part tariffs lead to retail prices above the monopoly level. Full-line forcing is therefore a useful tool for the producer allowing him to restore his monopoly profit, but it also lowers retail prices thereby increasing consumers' surplus. The second purpose of our analysis is to show that two-part tariffs are not optimal, and that the producer would prefer to use non-linear tariffs and more specifically direct mechanisms. However, these contracts are not sufficient to fully restore the monopoly profits and also lead to retail prices above the monopoly level.

2 The Framework

A multi-product monopolist produces two imperfectly susbtitutable goods, A and B, under constant returns to scale. This producer is unable to reach directly the final consumers and needs to sell his products through a unique retailer. The retailer operates under constant returns to scale. In order to simplify the analysis, we normalize, without loss of generality, all these constant marginal costs to 0. The timing is the following:

1. The producer makes one or several take-it-or-leave-it offers to the retailer.

2. The retailer accepts or rejects each offer and determines the quantities sold on the final market.

[1] For a comprehensive survey of the leverage theory and related criticisms, see Whinston (1990).

The two products A and B are seen by the consumers as imperfect substitutes. For sake of simplicity, we assume that the inverse demand functions are symmetric and given by $P(q_A, q_B) = P_A(q_A, q_B) = P_B(q_B, q_A) = 1 - q_A - \alpha q_B$, where $0 < \alpha < 1$.

- **Benchmark: Joint Profit Maximizing Outcome**

Let us consider the joint profit maximizing, or monopoly, situation as a benchmark. The joint profit maximizing quantities are solutions of

$$\left(q_A^M, q_B^M\right) = \underset{(q_A, q_B)}{\arg\max} \left(P(q_A, q_B) q_A + P(q_B, q_A) q_B\right)$$

Using our linear framework, this easily leads to

$$q_A^M = q_B^M = q^M = \frac{1}{2(1+\alpha)}$$

In this case, the retail prices on both markets are $p^M = \frac{1}{2}$. The monopoly profit and the corresponding consumers' surplus[2] are then

$$\pi^M = 2p^M q^M = \frac{1}{2(1+\alpha)} \text{ and } CS^M = \frac{1}{4(1+\alpha)}$$

3 Brand Specific Two-Part Tariffs

Let us suppose in this section that the producer offers two different two-part tariffs, one for each product, (w_A, F_A) and (w_B, F_B). In this case, the analysis is identical to Shaffer (1991). Denote by $\widetilde{\pi}(w_A, w_B)$ and $\widehat{\pi}(w_A)$, the retail profits earned by the distributor when he decides to sell respectively both products and product A only, that is:

$$\begin{aligned} \widetilde{\pi}(w_A, w_B) &= \max_{(q_A, q_B)} \left[(P(q_A, q_B) - w_A) q_A + (P(q_B, q_A) - w_B) q_B\right] \qquad (1) \\ \widehat{\pi}(w_A) &= \max_{q_A} \left[(P(q_A, 0) - w_A) q_A\right] \end{aligned}$$

Shaffer's analysis shows that the producer has to leave a strictly positive rent to the retailer to give him incentives to resell both products. The maximal franchise for a given product is therefore equal to the additional surplus created by the presence of this product in the retailer's shelves, that is:

$$F_A = \widetilde{\pi}(w_A, w_B) - \widehat{\pi}(w_B) \text{ and } F_B = \widetilde{\pi}(w_A, w_B) - \widehat{\pi}(w_A)$$

The producer's maximization program is then

$$\max_{(w_A, w_B)} \left(w_A \widetilde{q}_A(w_A, w_B) + w_B \widetilde{q}_B(w_B, w_A) + F_A + F_B\right)$$

where $\widetilde{q}_A(w_A, w_B)$ and $\widetilde{q}_B(w_A, w_B)$ are the quantities at which (1) is maximized.

[2] This inverse demand functions are derived from the quasi-linear utility function

$$U(y, q_A, q_B) = y + q_A + q_B - \frac{1}{2}\left(q_A^2 + q_B^2\right) - \alpha q_A q_B$$

leading to the consumers' surplus: $CS(q_A, q_B) = \frac{1}{2}\left(q_A^2 + q_B^2\right) + \alpha q_A q_B$.

Proposition 1 *Brand specific two-part tariffs lead to a consumers' surplus lower than in the monopoly situation,* $CS^{TPT} < CS^{M}$.

Proof. See Appendix A. ■

The intuition of this result is the following: the producer faces a trade-off between maximizing the industry profit thereby choosing wholesale prices such that the retailer decides to resell the monopoly quantities, or limiting the rent left to the retailer. In this linear model, the rent is a decreasing function of the wholesale prices, and the rent effect dominates the joint profit effect as long as $p < p^{TPT}$. The producer therefore chooses wholesale prices leading to retail prices above the monopoly level to limit the retailer's rent.

When the products are close substitutes ($\alpha > \sqrt{2} - 1$), the rent effect is so important that the producer prefers to resell only one good to avoid paying any rent to the retailer. However, this still leads to lower profit and consumers' surplus than in the monopoly case.

As shown by Shaffer, full-line forcing (using a global affine tariff (w_A, w_B, F)[3]) allows the manufacturer to eliminate the retailer's rent and to restore monopoly profit. The retailer is indeed unable to select the products as he has only the choice between selling both or none of them. Full-line forcing not only increases the producer's profit, it also reduces the retail prices and thereby increases the consumers' surplus.

4 Optimal Brand Specific Tariffs

The objective of this section is to extend Shaffer's analysis to more general wholesale contracts. In most models of vertical restraints, two-part tariffs are optimal as they solve the double marginalisation problem and are therefore sufficient to maximize the joint profit and to allow the upstream monopolist to extract the entire profit through the franchise fee. In the present case, brand specific two-part tariffs are not sufficient, and we want to see whether more general brand specific tariffs could do better. We now assume that the producer offers two tariffs $T_A(q_A)$ and $T_B(q_B)$.[4]

Suppose that the distributor chooses to carry both products. He thus determines the quantities $\widetilde{q}_A$ and $\widetilde{q}_B$ sold the final consumers in order to maximize his retail profit

$$\pi_D(q_A, q_B) = P\left(q_A, q_B\right) q_A + P\left(q_B, q_A\right) q_B - T_A(q_A) - T_B(q_B)$$

If he chooses to sell only product A, he earns $\max\limits_{q_A}\left[P\left(q_A, 0\right) q_A - T_A(q_A)\right].$

Thus, if the manufacturer want to sell positive quantities of his two products, he has to propose tariffs $T_A(.)$ and $T_B(.)$ solutions of the following program :

$$(T_A^*(.), T_B^*(.)) = \underset{(T_A(.), T_B(.))}{\arg\max}\ \left[T_A(\widetilde{q}_A) + T_B(\widetilde{q}_B)\right]$$

[3]Notice than in our case, since the marginal cost have been normalised to 0, this tariff consists in 0 wholesale prices and in a franchise fee equal to π^M.

[4]As we have already seen earlier in this paper, full-line forcing (i.e. a unique affine tariff $T(q_A, q_B) = \pi^M$), would allow the producer to recover the monopoly profit.

subject to the constraint :

$$\pi_D(\widetilde{q}_A, \widetilde{q}_B) \geq \max\left[0, \max_{q_A}\left[P\left(q_A, 0\right)q_A - T_A(q_A)\right], \max_{q_B}\left[P\left(q_B, 0\right)q_B - T_B(q_B)\right]\right] \qquad (2)$$

The manufacturer has to ensure that the retailer is willing to accept both contracts. To do this, he has to take into account that, when the retailer has already accepted a first contract and paid the corresponding franchise fee, the second product reduces the profit the retailer can make on the first product. This creates the strategic rent earned by the retailer. The retailer's bargaining power arises from the opportunity cost of stocking an additional brand. Since products are imperfect substitutes, the total sales of the two products are less than the sum of the sales of each product carried alone.

The objective is now to derive the equilibrium quantities and to compare them to the monopoly outcome. The following lemma shows that it is not necessary to consider any possible tariff, but that we can focus on direct mechanisms, $T_A = (q_A, t_A)$ and $T_B = (q_B, t_B)$.

Lemma 2 *The optimal quantities and profits can always be implemented with direct mechanisms.*

Proof. See Appendix B. ■

The manufacturer program can then be written :

$$\left(\left(q_A^{DM}, t_A^{DM}\right), \left(q_B^{DM}, t_B^{DM}\right)\right) = \underset{((q_A,t_A),(q_B,t_B))}{\arg\max}\left[t_A - c_A q_A + t_B - c_B q_B\right]$$

subject to the constraint :

$$P\left(q_A, q_B\right)q_A + P\left(q_B, q_A\right)q_B - t_A - t_B \geqslant \max\left[0, P\left(q_A, 0\right)q_A - t_A, P\left(q_B, 0\right)q_B - t_B\right]$$

Proposition 3 *With brand specific direct mechanisms:*

- *if products are too close substitutes* $\left(\alpha \geq \frac{1}{2}\right)$, *the producer prefers to sell only one product and offers the tariff* $\left(\frac{1}{2}, \frac{1}{2}\right)$. *This situation is then identical to brand specific two-part tariffs.*

- *if the products are sufficiently differentiated* $\left(\alpha < \frac{1}{2}\right)$, *then the equilibrium is symmetric. Both products are actually sold at a common retail price,* $p^{DM} = \frac{1+3\alpha}{2(1+2\alpha)}$, *strictly lower than with brand specific two-part tariffs, but still higher than the monopoly price, i.e.* $p^M < p^{DM} < p^{TPT}$. *In this case, direct mechanisms do strictly better than two-part tariffs,* $\pi^M < \pi_P^{DM} < \pi_P^{TPT}$.

In both cases, the consumers' surplus is lower than in monopoly situation,

$$CS^{TPT} \leq CS^{DM} < CS^M$$

Proof. See Appendix C. ■

With two-part tariffs, the producer sets the wholesale prices in order to monitor the quantities (or the retail prices) and the franchise fees to recover the profit and satisfy the retailer's participation constraints. In this case, the retailer never chooses the same quantities when he decides to resell both products than when he sells only one of them, as he can adjust the quantities depending on the products actually sold.

Direct mechanisms are on the contrary similar to quantity forcing. The retailer cannot modify the quantities and therefore the participation constraints are more easily satisfied. In this sense, quantity forcing reduces the opportunity cost and thereby the rent the producer has to leave. However, it does not eliminate this rent, and brand specific mechanisms, though they do at least as well than two-part tariffs, are not sufficient to fully restore monopoly profits.

5 Concluding Remarks

The objective of this note was twofold. On one hand, we showed that brand specific two-part tariffs are not the optimal choice for a multi-product monopolist dealing with a unique retailer, even when he cannot tie-in the sales of the two products. We showed indeed that, when the two products are sufficiently differentiated, brand specific non linear contracts in the form of direct mechanisms (or quantity forcing) do strictly better than two-part tariffs. The key intuition is that quantity forcing reduces the retailer's bargaining power that arises from the possibility the retailer has to select the brands present in his shelves. However, Shaffer's intuition that this increased bargaining power leads to a loss in profit for the multi-product producer remains valid, and full-line forcing is a possible way to solve this problem restoring the monopoly profit.

The second objective was to extend Shaffer's analysis to the comparison of retail prices and consumers' surplus. In both cases, brand specific two-part tariffs or direct mechanisms, the producer reduces the rent left to the retailer by decreasing the quantities sold to the final consumers. Full-line forcing has therefore a positive impact on consumers as it leads to higher quantities (or lower retail prices), though it restores the monopoly prices and profit. Full-line forcing is thereby beneficial for the industry as a whole and for the consumers as it reduces price distortions.

References

[1] Bowman, W. S. (1957), "Tying Arrangements and the Leverage Problem", *Yale Law Review,* 67, 19-36.

[2] Burstein, M. L. (1960a), "The Economics of Tie-in Sales", *Review of Economics and Statistics*, 42, 68-73.

[3] Burstein, M. L. (1960b), "A Theory of Full-line Forcing", *Northwestern University Law Review*, 55, 62-95.

[4] Shaffer, G. (1991), "Capturing Strategic Rent: Full-line Forcing, Brand Discounts, Aggregate Rebates and Maximum Resale Price Maintenance", *Journal of Industrial Economics,* 39(5), 557-575.

[5] Slade, M. (1998), "The Leverage Theory of Tying Revisited: Evidence from Newspaper Advertising", *Southern Economic Journal,* 65(2), 204-222.

[6] Whinston, M. D. (1990), "Tying, Foreclosure and Exclusion", *American Economic Review*, 80(4), 837-859.

A Proof of Proposition 1

In our linear framework we have

$$\frac{\partial \widetilde{\pi}}{\partial w_A} = 1 - w_A - 2q_A - 2\alpha q_B \text{ and } \frac{\partial \widetilde{\pi}}{\partial w_B} = 1 - w_B - 2q_B - 2\alpha q_A$$

and this leads to quantities

$$\widetilde{q}_A\left(w_A, w_B\right) = \frac{1 - \alpha - w_A + \alpha w_B}{2(1-\alpha^2)} = \widetilde{q}_B\left(w_B, w_A\right)$$

and to the retail profit

$$\widetilde{\pi}\left(w_A, w_B\right) = \frac{2(1-\alpha) + (2-\alpha)(w_A + w_B) + w_A^2 + w_B^2 - 2\alpha w_A w_B}{4(1-\alpha^2)}$$

When the retailer decides to carry only product A, his retail profit is

$$\widehat{\pi}\left(w_A\right) = \max_{q_A}\left(1 - q_A - w_A\right) q_A = \frac{\left(1 - w_A\right)^2}{4}$$

The producer objective is thus:

$$\begin{aligned}\max_{(w_A, w_B)} \pi_P &= w_A \widetilde{q}_A\left(w_A, w_B\right) + w_B \widetilde{q}_B\left(w_B, w_A\right) + 2\widetilde{\pi}\left(w_A, w_B\right) - \widehat{\pi}\left(w_A\right) - \widehat{\pi}\left(w_B\right) \\ &= \frac{2(1-\alpha) + 2\alpha\left(w_A + w_B\right) - (1+\alpha)\left(w_A^2 + w_B^2\right)}{4\left(1+\alpha\right)}\end{aligned}$$

The first-order condition with respect to w_A is:

$$\frac{\partial \pi_P}{\partial w_A} = \frac{\alpha - (1+\alpha) w_A}{1+\alpha} = 0 \Leftrightarrow w_A = \frac{\alpha}{1+\alpha}$$

By symmetry, we have $w_B = \frac{\alpha}{1+\alpha}$, and this easily leads to the quantities $q_A = q_B = \frac{1}{2(1+\alpha)^2}$ and the retail prices $p_A = p_B = \frac{1+2\alpha}{2(1+\alpha)}$. The producer's profit is thus equal to $\frac{1}{2(1+\alpha)^2} < \pi^M$ and the consumers' surplus is $CS = \frac{1}{4(1+\alpha)^3} < CS^M$.

The other possibility for the producer, is to avoid any retailer's rent and to sell only one of the two products. In this case, the producer offers a two-part tariff with a wholesale price equal to the marginal cost ($w = 0$, in order to maximize the joint profit). The quantity actually sold is thus $q = \frac{1}{2}$ and the retail price is $p = \frac{1}{2}$. The producer is now able to recover the whole profit as the retailer's outside option is 0. This profit is $\frac{1}{4}$ and the consumer's surplus $\frac{1}{8} < CS^M$.

In order to decide whether to sell both products (and leave a rent to the retailer) or only one of them, the producer's compares to two profits

$$\pi_P(A+B) > \pi_P(A) \Leftrightarrow \frac{1}{2(1+\alpha)^2} > \frac{1}{4} \Leftrightarrow \alpha < \sqrt{2} - 1$$

B Proof of Lemma 2

Assume that $T_A^*(.)$ and $T_B^*(.)$ are the optimal contracts, such that the retailer chooses the quantities q_A^* and q_B^*. The participation constraint imposes that the retailer profit must be greater than

$$\max\left[0, \max_{q_A}\left[P\left(q_A,0\right)q_A - T_A^*(q_A)\right], \max_{q_B}\left[P\left(q_B,0\right)q_B - T_B(q_B)\right]\right]$$

and we necessarily have

$$\begin{aligned}\max_{q_A}\left[P\left(q_A,0\right)q_A - T_A^*(q_A)\right] &\geq P\left(q_A^*,0\right)q_A^* - T_A^*(q_A^*)\\ \max_{q_B}\left[P\left(q_B,0\right)q_B - T_B^*(q_B)\right] &\geq P\left(q_B^*,0\right)q_B^* - T_B^*(q_B^*)\end{aligned}$$

Since $P\left(q_A^*,q_B^*\right)q_A^*, +P\left(q_B^*,q_A^*\right)q_B^* \leq P\left(q_A^*,0\right)q_A^* + P\left(q_B^*,0\right)q_B^*$, the retailer profit is necessarily positive and the manufacturer can never obtain a profit higher than

$$\Pi^* = \left(2P\left(q_A^*,q_B^*\right) - P\left(q_A^*,0\right)\right)q_A^* + \left(2P\left(q_B^*,q_A^*\right) - P\left(q_B^*,0\right)\right)q_B^*$$

If he proposes two direct mechanisms (q_A^*, t_A^*) and (q_B^*, t_B^*) such that

$$t_A^* = T_A^*(q_A^*) \text{ and } t_B^* = T_B^*(q_B^*)$$

he satisfies the participation constraint and achieve a profit equal to Π^*. This shows that direct mechanisms are optimal in this framework.

C Proof of Proposition 3

Since $\left(P\left(q_A,q_B\right) - P\left(q_A,0\right)\right)q_A + \left(P\left(q_B,q_A\right) - P\left(q_B,0\right)\right)q_B < 0$, the manufacturer's program is equivalent to :

$$\begin{cases} t_A^{DM} = P\left(q_A^{DM},q_B^{DM}\right)q_A^{DM} - \left(P\left(q_B^{DM},0\right) - P\left(q_B^{DM},q_A^{DM}\right)\right)q_B^{DM} = \left(1 - q_A^{DM} - 2\alpha q_B^{DM}\right)q_A^{DM} \\ t_B^{DM} = P\left(q_B^{DM},q_A^{DM}\right)q_B^{DM} - \left(P\left(q_A^{DM},0\right) - P\left(q_A^{DM},q_B^{DM}\right)\right)q_A^{DM} = \left(1 - q_B^{DM} - 2\alpha q_A^{DM}\right)q_B^{DM} \end{cases}$$

and $\left(q_A^{DM}, q_B^{DM}\right) = \underset{(q_A,q_B)}{\arg\max}\,\pi_D(q_A,q_B)$, where

$$\begin{aligned}\pi_D(q_A,q_B) &= \left(2P\left(q_A,q_B\right) - P\left(q_A,0\right)\right)q_A + \left(2P\left(q_B,q_A\right) - P\left(q_B,0\right)\right)q_B\\ &= 2(q_A+q_B) - q_A^2 - q_B^2 - 4\alpha q_A q_B\end{aligned}$$

The first-order conditions are therefore

$$\frac{\partial \pi_D}{\partial q_A} = 1 - 2q_A - 4\alpha q_B \text{ and } \frac{\partial \pi_D}{\partial q_B} = 1 - 2q_B - 4\alpha q_A$$

- For $\alpha < \frac{1}{2}$:

In this case, the objective function is strictly concave and the first-order conditions are therefore necessary and sufficient. The solution is symmetric and given by $q_A = q_B = q^{DM} = \frac{1}{2(1+2\alpha)}$, and this easily leads to a retail price $p^{DM} = \frac{1+3\alpha}{2(1+2\alpha)}$. It is then straightforward to check that $p^M < p^{DM} < p^{TPT}$ and $\pi^M < \pi_P^{DM} < \pi_P^{TPT}$. As the price p^{DM} is higher than the monopoly price, the consumers' surplus is strictly lower than in the monopoly situation, $CS^{DM} < CS^M$.

- For $\alpha \geq \frac{1}{2}$:

In this case, the program is not concave and we have a corner solution. The producer prefers to avoid any retailer's rent and decides to sell only one product. He sells a quantity $q^{DM} = \frac{1}{2}$ (the retail price being $p^{DM} = p^M$ for the product actually sold) with a fixed transfer $t^{DM} = \frac{1}{4} < \pi^M$. This situation is identical to the two-part tariffs case. Therefore, profit and consumers' surplus are lower than in the monopoly situation.