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Unilateral most-favored-customer pricing

A comparison with Stackelberg *

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If one firm in a price-setting duopoly adopts a most-favored-customer pricing policy, it can commit to a price which is higher than the Bertrand price. The equilibrium price, however, must be lower than the Stackelberg leader price.

1. Introduction

In the simple Bertrand price-setting duopoly model, the notion of facilitating practices has been developed with the goal of allowing credible tacit collusion so that firms can earn greater than Bertrand profits [for a discussion, see Salop (1986)]. One particular facilitating practice is the most-favored-customer (MFC) pricing policy, in which a firm guarantees its first period customers a rebate if its second period price is below its first period price. It has been noted [by Cooper (1986), Salop (1986) and Tirole (1988)] that the strength of the MFC policy as a facilitating practice is that only one firm needs to adopt the policy to allow both firms to earn greater than Bertrand profits. Actually, both Cooper and Tirole argue that when a Bertrand player unilaterally adopts an MFC policy, that player can, and should, exactly mimic a Stackelberg leader, which is the best a firm can do if its rival prices along its best response function. The unilateral MFC equilibrium, however, has never been formally characterized.

In this note, we demonstrate that the unilateral MFC equilibrium can never mimic the Stackelberg equilibrium. While the firm adopting the MFC policy can credibly commit to the Stackelberg leader price in the second period of a two-period model, it will prefer to commit to a lower price. When the firm commits to a lower price it raises its first period profits but reduces its second period profits, and at the Stackelberg price the first period gain outweighs the second period loss. Thus, an MFC policy allows a firm to credibly alter its second period best response function, but it does not discourage the firm from deviating from the Stackelberg price in the first period. In the next section, we prove this result.

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2. Unilateral MFC equilibrium

Consider a two-period, differentiated products duopoly model in which the objective of each firm is to maximize the sum of (undiscounted) profits, where each firm's demand function and costs are stable between periods. [1] For each firm, the sum of profits over both periods is

$$\sum_{t=1}^{2} \pi_{it} = \pi_{i1}(P_{i1}, P_{j1}) + \pi_{i2}(P_{i2}, P_{j2}), \tag{1}$$

where the first subscript denotes the firm, the second subscript denotes the period, and P_{it} is the price charged by firm i in period t.

Assume that firm 1 unilaterally adopts an MFC pricing policy. If firm 1's second period price is less than its first period price, i.e., $P_{12} < P_{11}$, it must rebate its first period customers the amount $(P_{11} - P_{12})Q_{11}$, where Q_{11} is firm 1's first period output. This policy allows firm 1 to credibly commit to a higher-than-Bertrand price in the second period by changing the firm's best response function in period 2 [see Cooper (1986) and Tirole (1988) for diagrammatic analysis], and, in fact, the two prices will be the same in equilibrium.

Proposition 1. If firm 1 adopts a unilateral MFC policy, then in equilibrium it must charge the same price in both periods.

Proof. First consider the possibility that $P_{11} > P_{12}$, so that firm 1 must rebate $(P_{11} - P_{12})Q_{11}$ in the second period. Two-period profit net of the rebate is $(Q_{11} + Q_{12})P_{12} - C(Q_{11}) - C(Q_{12})$. Firm 1 could increase two-period profits by charging the lower price in both periods, so that total profit is $2(P_{12}Q_{12} - C(Q_{12}))$. With $P_{11} > P_{12}$, $Q_{12} > Q_{11}$ so that revenue is higher with the lower price, and with stable costs (and noting that Q_{12} is chosen to maximize profits when the price is P_{12}) profits must be higher when the lower price is charged in both periods. This establishes that firm 1 will not reduce its price in equilibrium. It is also impossible for it to raise its price in equilibrium because such a strategy would not be credible. □

Proposition 1 shows that firm 1 can use the MFC policy to credibly commit to a high price, but does not address the question of what the equilibrium price is. One candiate is the Stackelberg leader price, which maximizes single period profits. As will be shown, however, firm 1 will *not* choose to commit to this price.

If firm 1 is a Stackelberg leader, it finds its single period profit-maximizing price by setting

$$\mathrm{d}\pi_{1t}/\mathrm{d}P_{1t} = \partial\pi_{1t}/\partial P_{1t} + (\partial\pi_{1t}/\partial P_{2t})(\partial R_{2t}/\partial P_{1t}) = 0, \tag{2}$$

where $\partial R_{2t}/\partial P_{1t}$ is the Stackelberg conjecture, i.e. firm 1 believes that firm 2 always prices along its best-response function, $R_{2t}(P_{1t})$. If P_{11}^* is the Stackelberg leader price, firm 1 believes that if it sets any price lower than P_{11}^* in the first period, firm 2 *immediately* responds by lowering P_{21}. Thus, it is unprofitable for firm 1 to set $P_{11} < P_{11}^*$ in the first, and any subsequent, period.

When firm 1 unilaterally adopts an MFC contract in the first period, it is still a Bertrand player, not a Stackelberg leader. As a Bertrand player, the MFC contract allows firm 1 to credibly alter its second period best-response function. If firm 1 sets the Stackelberg leader price in the first period, that price is a Nash equilibrium in the second period. But is the Stackelberg leader price a Nash

[1] See Cooper (1986, p. 379) for assumptions guaranteeing stability and upward sloping reaction functions.

equilibrium in the first period? Even with an MFC contract, if firm 1 sets $P'_{11} < P^*_{11}$, as a Bertrand player it believes that firm 2 does *not* immediately respond in the first period; therefore, as firm 1 lowers its price it unambiguously gains profit in the first period. In the second period, P'_{11} is a Nash equilibrium due to the MFC contract (and firm 2's response in period 2), but firm 1's second period profits are less than if it maintained the Stackelberg leader price. If the profits gained in the first period outweigh the profits lost in the second period, the Stackelberg leader price is not the unilateral MFC equilibrium price.

The correct unilateral MFC equilibrium is one that exactly balances firm 1's gains from deviation in the first period with its loss incurred in the second period. By totally differentiating expression (1) with respect to firm 1's first period price, the first-order condition for profit maximization is

$$\begin{aligned} \mathrm{d}\Sigma\pi_{1t}/\mathrm{d}P_{11} &= \partial\pi_{11}/\partial P_{11} + (\partial\pi_{11}/\partial P_{21})(\mathrm{d}P_{21}/\mathrm{d}P_{11}) \\ &\quad + (\partial\pi_{12}/\partial P_{12})(\mathrm{d}P_{12}/\mathrm{d}P_{11}) + (\partial\pi_{12}/\partial P_{22})(\mathrm{d}P_{22}/\mathrm{d}P_{11}) = 0. \end{aligned} \tag{3}$$

In (3), the term $\mathrm{d}P_{21}/\mathrm{d}P_{11}$ is firm 1's conjecture about how firm 2 responds to a change in P_{11} in the first period, and this is zero since firm 1 is a Bertrand player. The term $\mathrm{d}P_{12}/\mathrm{d}P_{11}$ is how firm 1's second period price responds to a change in its first period price, and this is 1 because in equilibrium firm 1's second period price always matches its first period price by Proposition 1. Finally, the term $\mathrm{d}P_{22}/\mathrm{d}P_{11}$ is firm 1's conjecture about how firm 2 responds to a change in P_{11} in the second period, and this is $\partial R_{22}/\partial P_{12}$ since P_{11} and P_{12} change together and firm 2 responds to a decrease in P_{12} by moving along its best-response function in the second period. Setting $P_{11} = P_{12} = P_1$, expression (3) can be rewritten as

$$\mathrm{d}\Sigma\pi_{1t}/\mathrm{d}P_1 = \partial\pi_{11}/\partial P_1 + \partial\pi_{12}/\partial P_1 + (\partial\pi_{12}/\partial P_{22})(\partial R_{22}/\partial P_{12}) = 0. \tag{4}$$

In the usual Bertrand case, the last term in (4) is zero. Accordingly, the derivative in (4) evaluated at the Bertrand equilibrium is positive, so that the Bertrand equilibrium price is lower than the utilateral MFC price. By comparing (2) to (4), it is seen that the unilateral MFC equilibrium price differs from the Stackelberg leader price. For (4) to yield the Stackelberg leader price, an additional term, $(\partial\pi_{11}/\partial P_{21})(\partial R_{21}/\partial P_{11})$, must be added. While the additional term is zero for a Bertrand player, it is positive for a Stackelberg leader. In other words, a Stackelberg leader is immediately punished in the first period if it lowers its price, whereas a Bertrand player is not punished until the second period. Thus, the derivative in (4) evaluated at the Stackelberg leader price must be negative, which proves our main result.

Proposition 2. The unilateral MFC equilibrium price lies strictly between the Bertrand price and the Stackelberg leader price.

3. Conclusion

In this note we have shown that the unilateral MFC policy generates an equilibrium which is different from the Stackelberg equilibrium. If the Stackelberg equilibrium is the best a firm can do in the unilateral case, then an 'optimal' facilitating practice would achieve Stackelberg profits. From the discussion in section 2 it can be seen that the unilateral MFC prices differ from the Stackelberg prices because firm 2 does not react to firm 1's price in the first period. Prices could be raised to the Stackelberg level if firm 1 could find a way to ensure that firm 2 will react in the first period. There are two key factors, then, in designing an optimal unilateral facilitating practice: the firm must be able to credibly commit to a high second period price, and deviations must generate responses from the other firm in the first period. The MFC policy achieves the first objective but fails with the second.

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