RAND Journal of Economics
Vol. 25, No. 1, Spring 1994

Dynamic duopoly with best-price clauses

Monika Schnitzer*

This article investigates best-price clauses as a strategic device to facilitate collusion in a dynamic duopoly game. Best-price clauses guarantee rebates on the purchase price if a customer finds a better price after his purchase. Two different price clauses are distinguished: "most favored customer" and "meet or release." I examine the collusive potential of both clauses in a finite-horizon duopoly model with homogeneous durable goods. In each period, new consumers enter the market. I show that in this context, meet-or-release clauses have a greater anticompetitive potential than most-favored-customer clauses.

1. Introduction

■ Retailers often advertise so-called best-price clauses to attract customers. The buyers are promised a rebate if they find a better price after making their purchase. The term best-price clauses comprises both "most favored customer" (MFC) clauses and "meet or release" (MOR) clauses. A MFC clause guarantees a rebate on the original price if the seller offers lower prices to other customers thereafter; a MOR clause promises a rebate (or a release from the contract) if the purchase price is undercut by competing sellers later on.

In this article I investigate to what extent best-price clauses can help oligopolists collude on prices in markets for durable consumption goods.[1] This is of particular interest since any individual buyer at least weakly prefers to be offered these clauses. They guarantee him the lowest price that will be offered in the future, so he need not wait for a lower price or go to another seller who may offer a better deal later on. However, if best-price clauses facilitate collusion, buyers as a whole might be better off if their use is restricted.

An earlier discussion of best-price clauses by Holt and Scheffman (1987) has been motivated by the Ethyl Case. In this perhaps most infamous example of the use of best-price clauses in industrial marketing in the United States, some producers of lead-based

* University of Bonn.

This article is based on Chapter 2 of my dissertation, which was written within the European Doctoral Program in Quantitative Economics at Bonn University. Financial support by Deutsche Forschungsgemeinschaft, SFB 303 at Bonn University is gratefully acknowledged. I would like to thank Helmut Bester, Georg Nöldeke, Klaus Schmidt, John Sutton, a Coeditor and two anonymous referees for helpful comments and suggestions. The usual disclaimer applies.

[1] This analysis is not restricted to goods that are "durable" in a physical sense. The term durable refers rather to whether or not consumers consider goods offered in different periods as close intertemporal substitutes. If this is the case, consumers make a strategic decision when to buy. The terminology here follows the literature on "durable-goods monopoly" and the Coase conjecture. Thus, my model applies also to, say, services, as long as consumers consider delaying their purchase.

Copyright © 1994, RAND

antiknock compounds used both MFC and MOR clauses together with a system of advance price announcements. Following this case, Holt and Scheffman study a market for a homogeneous good in which the sellers can use advance list price notifications to foster coordination on a common list price. They assume that all sellers offer both types of best-price clauses and show that as long as the initial list price does not exceed the Cournot price, no seller is tempted to revise his price afterwards. Thus, their analysis supports the Federal Trade Commission's suspicion that in the Ethyl Case the purpose of using best-price clauses was to reduce price competition.[2]

However, Holt and Scheffman assume that the sellers use all these instruments, namely MFC clauses, MOR clauses, and advance list price notifications, at the same time, and it remains unclear from their analysis what particular role each instrument plays. Since best-price clauses may be socially beneficial if they save transaction costs, one would like to know, for example, whether best-price clauses without advance price announcements are harmless, or whether both types of clauses have to be offered together, or whether they have to be offered by all oligopolists at the same time in order to sustain collusion. Furthermore, Holt and Scheffman's model is designed to capture characteristics of the producer good market of the Ethyl Case. It is important to know to what extent their results carry over to markets with different features, for example markets in which new consumers enter over time, or in which a potential buyer may be willing to wait for a better price. In many consumer markets in which best-price clauses are frequently used, these characteristics are satisfied.[3]

To answer these questions I use a game-theoretic model with two sellers who produce a homogeneous durable good with identical constant marginal costs and no capacity constraints. Each seller decides which clauses to offer and which price to charge over a finite number of periods to a finite number of overlapping generations of consumers.

My analysis shows that MFC and MOR clauses influence the sellers' strategic behavior in different ways. A MFC clause makes a price reduction less attractive because it has to be granted also to previous customers. Thus, MFC clauses can help to avoid price competition in the last period, which typically prevents collusion in finite-horizon games. However, I show that their impact is limited. In particular, they cannot sustain profits as high as monopoly profits and they cannot prevent price competition if new consumers enter the market over time. I demonstrate that in this context a MOR clause is potentially more powerful as a collusion-facilitating device. It puts a seller at the mercy of his competitor, who can retroactively undercut his price and thus force him to pay rebates to his customers. Although MOR clauses cannot avoid price competition in the end, they can be used to prevent price competition in early periods. If early generations of consumers do not want to delay their purchase for too long, the duopolists can exploit the consumers' impatience and sustain even monopoly profits in all but the very last periods.

MFC clauses have been studied mostly in relation to durable-good monopolies and the Coase conjecture (see, for example, Butz (1990)). For duopolies with differentiated nondurable goods, MFC clauses have been analyzed by Cooper (1986) and Neilson and Winter (1993). Cooper shows that the profits of all sellers may increase even if only one of them offers a MFC clause. However, as Neilson and Winter point out for some demand specifications, there may not exist an equilibrium in which both sellers adopt a MFC pricing policy. I show in a model with homogeneous durable goods that all sellers have

[2] Supporting evidence was also provided by laboratory experiments by Grether and Plott (1984).

[3] Typical examples are markets for durable consumption goods (e.g., electrical appliances) and markets for services (e.g., travel agencies or airlines). Note that if goods are consumed immediately, the "release" part of the MOR clause is redundant. But if the purchase takes place some time before the actual consumption (for example, if a flight ticket is purchased in advance), a "release" from the contract (returning the ticket) is a feasible alternative.

to offer a MFC clause if they are to have any collusive effect at all, and that there exists an equilibrium in which all sellers will do so.

Most of the other literature on price clauses has focused on one-shot games with so-called price-matching clauses.[4] These have to be distinguished carefully from MOR clauses. A price-matching clause makes the price a seller offers a function of his competitor's current price such that it matches lower prices instantaneously.[5] If each duopolist offers this clause, effective prices are always the same for both competitors. Therefore it is a weakly dominant strategy for each seller to set the monopoly price, since none of them can benefit from offering a lower price. In contrast, a MOR clause does not meet currently available prices but provides an insurance against the possibility that a better price becomes available in the future. In this article I show that the monopoly price can be sustained even if only one seller offers a MOR clause, whereas price-matching clauses facilitate collusion only if all sellers offer them.

The rest of the article is organized as follows: Section 2 describes the model and formally defines both types of best-price clause. Section 3 analyzes the potential of the two different clauses to sustain collusion. Section 4 concludes.

2. The model

■ Consider two sellers, A and B, who produce homogeneous durable goods with identical constant marginal costs c and no capacity constraints. They sell these goods over a finite number of periods. The sellers face a continuum of consumers, each of whom wants to buy one unit of the indivisible good. The buyers have different preferences for when to buy, and they are not willing to postpone their purchase for more than a limited number of periods.[6]

I model consumers in the following stylized way: There are n different generations of consumers, denoted by index $j \in \{1, 2, \ldots, n\}$. In period t, $t = 1, \ldots, n$, generation $j = t$ enters the market. In each generation there is a continuum of types $i \in [0, 1]$ of consumers. A consumer with type i of generation j is characterized by an n-tuple of reservation values v_{ij}^t, one for each period.

$$v_{ij}^t = \begin{cases} v_i & \text{if } t = j \text{ or } t = j + 1 \text{ and } t \leq n,\ v_i \in [0, V] \\ 0 & \text{otherwise.} \end{cases}$$

Thus a consumer of generation j is indifferent whether to buy in period $t = j$ or $t = j + 1$, but he is not willing to postpone his purchase any longer (if he buys at all).[7] Consumers of generation $j = n$ can buy in period n only.

Let $D_t(p)$, $t = 1, \ldots, n$, denote the measure of consumers of generation $j = t$ with $v_{ij}^t \geq p$. For expositional convenience assume that the distribution over types of consumers

[4] Price-matching clauses are studied in complete-information models by Logan and Lutter (1989) and Doyle (1988). In the context of incomplete information, Lin (1988) and Png and Hirshleifer (1987) analyze price-matching clauses as a device to price-discriminate between informed and uninformed buyers.

[5] Price-matching clauses thus capture the spirit of the "quick response" assumption.

[6] These specifications capture characteristic features of retail markets for durable consumption goods. A particular type of, say, a refrigerator is sold for a limited number of periods and is then replaced by a new type. Whether or not a buyer considers a purchase is determined to a large extent by exogenous variables that vary across consumers, for instance the need to replace an old model. Thus, not all potential buyers are present in the market at the same time, and consumers who enter the market with the intention to buy will not delay their purchase for too long.

[7] It is not necessary for my results that a buyer of generation j does not value the good at all after period $j + 1$. All I need is that the reservation price becomes smaller than marginal cost after some finite time. However, the longer consumers are willing to delay their purchase, the larger the number of "competitive" periods in Corollary 1.

is the same for all generations. However, the population size of each generation may differ. Thus we can write

$$D_t(p) = s_t D(p), \quad s_t \geq 0, t = 1, \ldots, n, \tag{1}$$

where s_t is the population size of generation $j = t$. At the end of Section 3 and in Section 4 I discuss possible generalizations of this demand structure. $D(p)$ is assumed to be a continuous, monotonically decreasing function of p, with $D(0) = 1$ and $D(V) = 0$.

In each period both sellers first simultaneously announce which best-price clauses to offer for consumers who buy in this period. Then both sellers simultaneously announce prices p_S^t, $S \in \{A, B\}$, $t = 1, \ldots, n$.[8] All buyers who are in the market in period t and who did not purchase before simultaneously decide whether to buy and if so from which seller.[9] Purchase contracts are binding, i.e., consumers who bought in previous periods cannot simply return the good if they find a better price later on. However, they can claim rebates if possible.

Whether or not rebates can be claimed in any period depends on the price clauses and prices in previous purchase contracts. To simplify the exposition I assume that price clauses are valid for only one period, i.e., rebates can be claimed only in the period immediately after the purchase.[10] The size of potential rebates depends on the difference between prices in periods t and $t - 1$ (given that clauses are valid for only one period). More precisely, suppose a buyer has made a purchase in period $t - 1$ from seller A for price p_A^{t-1}. If his purchase contract contains a MFC provision and if $p_A^t < p_A^{t-1}$, then the buyer can claim the rebate $[p_A^{t-1} - p_A^t]$. Similarly, a MOR clause guarantees that if $p_A^t < p_A^{t-1}$, the buyer is entitled to receive the rebate $[p_A^{t-1} - p_B^t]$. If the sales contract contains both clauses and if both p_A^t and p_B^t are smaller than p_A^{t-1}, then the rebate is $[p_A^{t-1} - \min\{p_A^t, p_B^t\}]$.

Note that the game has a finite horizon so that consumers who buy in the last period cannot benefit from best-price clauses. The end of the game is best thought of as the date when the good is replaced by a newer type. Since best-price clauses usually apply only to a particular type of the good, no rebates can be claimed if a new product replaces the old one.

After each period the actions of all players are perfectly observable. Thus strategies of the sellers and the buyers can be made contingent on the entire history of the game. I assume that players do not condition their strategies on nonmeasurable sets of consumers. Buyers and sellers are risk neutral. Each buyer maximizes his undiscounted utility that is additively separable in his reservation value and the price he pays for the good, taking into account potential rebates. Each seller maximizes the undiscounted sum of his profits over all periods. The appropriate solution concept for this game with complete information is subgame-perfect equilibrium (see Selten (1965)).

3. Best-price clauses and collusion

■ It will be useful to start with the analysis of a special case of the model, in which there are only two periods and no entry of new consumers in the second period, i.e.,

[8] Clauses and prices are chosen sequentially to capture the idea that typically clauses are chosen less frequently than prices. The results do not change if clauses and prices are determined in every kth period, while only prices are chosen in all other periods. (See also footnote 16.)

[9] I assume that there exists no resale market. Sobel (1991) offers several justifications for this assumption. First, the good may be consumed by each buyer in the period he buys it. Second, an individual may find it too costly to market his good. Third, there may be quality uncertainty about the good unless it is directly sold by the original producers. The last two justifications apply for many consumer durables. The first one is relevant for services.

[10] If rebates can be claimed in more than one period, the number of "competitive" periods in Corollary 1 increases accordingly.

$s_1 > 0$, $s_2 = 0$. This allows me to relate the model to the literature, in particular to Holt and Scheffman (1987), who discuss a similar setup in their analysis of the Ethyl Case.

Before establishing the first result we must make a few definitions. Let the price p_c be defined as follows:

$$p_c = \max \left\{ p \,\middle|\, \frac{1}{2} D(p)(p-c) \right.$$
$$\left. \geq \frac{1}{2} D(p)(p-\epsilon-c) + [D(p-\epsilon) - D(p)](p-\epsilon-c), \forall \epsilon > 0 \right\}. \tag{2}$$

To interpret p_c, suppose both sellers quote a price p in the first period and share demand symmetrically. Consider a seller, say A, who faces the problem whether or not to lower his price in period 2 by $\epsilon > 0$. If he did offer a MFC clause he is forced to pay rebates to his previous customers, which lowers his first-period profit to $1/2\, D(p)(p-\epsilon-c)$. Also, he cannot win any of the customers who have already bought in period 1 from seller B, since purchase contracts are binding. So his additional sales are limited to $[D(p-\epsilon) - D(p)]$. His total profit after lowering his price is

$$\left[D(p-\epsilon) - \frac{1}{2} D(p) \right] \cdot (p-\epsilon-c).$$

Thus, p_c is the highest price with the property that no seller has an incentive to deviate from this price in period 2. Note that MFC clauses and binding purchase contracts together imply that seller A's price choice in period 2 is strategically equivalent to choosing a quantity in a Cournot quantity-setting game. In fact, p_c corresponds to the Cournot price resulting from setting Cournot quantities if there is a unique Cournot equilibrium.[11]

Let $\pi_c(s_j)$ denote the profit of each seller if both sellers set price p_c and if all consumers of generation j with $v_i \geq p_c$ randomize with equal probability between the two sellers, such that each seller faces demand of measure $1/2\, s_j D(p_c)$, i.e.,

$$\pi_c(s_j) = \frac{1}{2} s_j D(p_c) \cdot (p_c - c). \tag{3}$$

This profit π_c in our price-setting game corresponds to the symmetric per-firm Cournot profit, i.e., the equilibrium profit of each firm in a one-shot quantity-setting game. In the following I shall refer to p_c as the Cournot price and to π_c as the Cournot profit.

Proposition 1. Suppose $n = 2$, $s_1 > 0$, $s_2 = 0$. Then

(i) There exists a symmetric subgame-perfect equilibrium in which each seller offers a MFC clause and obtains the symmetric, per-firm Cournot profit $\pi_c(s_1)$.

(ii) There exists no subgame-perfect equilibrium in which the sellers make asymmetric profits that add up to twice the symmetric Cournot profit or in which the joint profits of both sellers exceed twice the symmetric Cournot profit.

(iii) There exists no subgame-perfect equilibrium in which any seller makes positive profits unless each seller offers at least a MFC clause.

Proof. To prove part (i), consider the following strategies:

Strategy of seller S, $S \in \{A, B\}$: Offer MFC clause in period 1. If both sellers have offered MFC clause, set $p_S^1 = p_c$. Otherwise set $p_S^1 = c$. If no seller has deviated in period 1, set $p_S^2 > p_c$, otherwise set $p_S^2 = c$.

[11] A sufficient condition for this is that $D(p)$ is twice continuously differentiable and concave.

Strategy of buyer i, $i \in [0, 1]$, of generation $j = 1$: If no seller has deviated in period 1 and if $v^1_{il} \geq p_c$, buy from any of the two sellers (randomizing with equal probabilities). Otherwise delay your purchase (unless $\min\{p^1_A, p^1_B\} < c$ and $v^1_{i1} \geq \min\{p^1_A, p^1_B\}$, in which case buy from any seller offering the lowest price). If you did not buy in period 1 and if $v^2_{i1} \geq \min\{p^2_A, p^2_B\}$, buy from any seller offering the lowest price.

These strategies sustain the symmetric pair of Cournot profits (π_c, π_c) as the outcome of a subgame-perfect equilibrium. To prove this I have to show that the strategies given above are optimal for each player after any history not resulting from simultaneous deviations. Then the path generated by these strategies is indeed the equilibrium path of a subgame-perfect equilibrium.[12] The optimality of the strategy of an individual buyer is straightforward. If no seller has deviated in period 1, buyer i expects prices to rise in period 2, so he is better off buying in period 1. But if one of the sellers deviated in period 1, he expects a price war in period 2, so it is optimal to delay his purchase (as long as $\min\{p^1_A, p^1_B\}, \geq c$).

To prove the optimality of the sellers' strategy, note that if both sellers have offered MFC clauses they cannot price discriminate between customers in period, 1 and 2. Suppose $p^1_A = p^1_B = p_c$ and all consumers with $v^1_{i1} \geq p_c$ have bought in period 1, half from seller A and half from seller B. Then, by the definition of p_c, a seller has no interest in competing for customers with lower reservation values. This means he may just as well raise his price. However, if any of the sellers deviated in period 1 and all consumers delayed their purchase, then we have a Bertrand game in period 2, and each seller will set price equal to marginal cost. It remains to show that the first part of the seller's strategy is optimal. Since the buyers' strategies prescribe that after any deviation all buyers postpone their purchases so that a price war will take place in period 2, a deviation in period 1 from p_c cannot pay, nor does it pay not to offer the MFC clause in the first place.

The proofs of parts (ii) and (iii) are relegated to the Appendix. *Q.E.D.*

The equilibrium outcome described in Proposition 1(i) is of course not unique. The same sorts of strategies with MFC clauses can be used to sustain profits smaller than Cournot profits. But it is not possible to sustain any joint profits higher than twice the symmetric Cournot profit, no matter what clauses the sellers might offer. If higher prices are chosen in period 1, there is more residual demand left in period 2 and, by the definition of p_c, MFC clauses will no longer suffice to prevent competition for this residual demand. Proposition 1 shows also that in order to sustain collusion it is necessary that both sellers offer MFC clauses. A seller with no MFC clause would always lower his price in period 2 to capture some of the remaining consumers.

In a similar two-period/no-entry model, Holt and Scheffman (1987) showed that MFC and MOR clauses together with advance list price notifications enable the sellers to sustain Cournot profits. Proposition 1 makes clear that MFC clauses are necessary and sufficient for collusion, provided that purchase contracts are binding and buyers act strategically. In Holt and Scheffman's model MOR clauses are necessary because purchase contracts are not binding, i.e., buyers can switch sellers even after they bought the good.[13] A MOR

[12] To see this, consider a strategy profile that specifies optimal behavior for all subgames that can be reached without simultaneous deviations but that does not specify optimal behavior for some subgames that can be reached only by simultaneous deviations. Replace that part of the strategy profile in subgames that follow simultaneous deviations by arbitrary subgame-perfect equilibrium behavior. This modified strategy profile is indeed a subgame-perfect equilibrium and has the same equilibrium path as the original strategy profile. See Gul, Sonnenschein, and Wilson (1986).

[13] In Holt and Scheffman the idea is that contracts are signed in either period 1 or 2, but that consumption takes place only after period 2. Then buyers might be able to refuse delivery if they have found a better price in the meantime. This seems to be particularly relevant for producer good markets where delivery may take place only some time after a contract has been signed. However, in markets for consumer durables, on which I focus here, consumption starts as the product is bought, and returning the good is typically not feasible. I am grateful to an anonymous referee for drawing my attention to this distinction.

clause allows a seller to meet his opponent's price cuts and thus keeps the opponent from wooing away any of his first-period customers. But if contracts are binding, as I assume, this potential function of MOR clauses is not needed. Furthermore, Holt and Scheffman's sellers use advance list price notification to coordinate on a collusive price in the first period.[14] As Proposition 1 shows, this is not necessary if consumers act strategically and can postpone their purchase if they expect a price war.[15]

In the remainder of this article I analyze the extent to which the results derived in the framework of Proposition 1 carry over to a framework that explicitly allows for entry of new consumers. As argued above, in retail markets for consumer durables, sellers typically do not face all their potential customers at the same time. Proposition 2 shows that in the two-period setup of Proposition 1, collusion can no longer be sustained if there is new entry in period 2.

Proposition 2. Suppose $n = 2$, $s_1 > 0$ and $s_2 > 0$. Then there exists no subgame-perfect equilibrium in which any seller makes positive profits.

Proof. See the Appendix.

The collusive outcome of Proposition 1 relied on the fact that MFC clauses lower the incentive to compete for customers in the last period. However, they do so only to a limited extent, and in particular they cannot prevent price competition if there is entry of new consumers. Each seller will lower his price, at least by a small amount, if he hopes to win some of the new demand. Expecting this price competition, consumers prefer to delay their purchase and buy at the best price in period 2.

MOR clauses cannot prevent this price competition in the last period either. But they can be used to sustain collusive prices in early periods. If a seller offers a MOR clause and deviates from the collusive price, then his opponent can punish him in the following period with a price cut that he has to meet. As Proposition 2 shows, collusive prices in early periods do not yield collusive profits if all consumers can postpone their purchase until the very last period. But if the horizon is long enough so that consumers of early generations are not willing to wait until the end before they buy, then collusive profits can be sustained for at least some periods.

Define

$$p_m = \underset{p}{\operatorname{argmax}}\, D(p) \cdot (p - c) \tag{4}$$

as the "static" monopoly price given demand $D(p)$. Furthermore, let

$$\pi_m(s_j) = (p_m - c) \cdot s_j \cdot D(p_m) \tag{5}$$

be the joint monopoly profit in period $t = j$ if all consumers of generation j with reservation value $v_{ij}^t \geq p_m$ buy from any of the sellers. Then I can state my main result:

Proposition 3. Suppose $n \geq 2$ and $s_j \geq 0$, $\forall_j = 1, \ldots, n$. Then there exists a subgame-perfect equilibrium in which seller A offers a MOR clause in each period and both sellers offer the monopoly price in all but the last period.[16]

Proof. See the Appendix.

[14] I.e., each seller is allowed to react to his opponent's price before any consumer can buy in period 1.

[15] In Holt and Scheffman's model, consumers are assumed to buy in the first period whenever their reservation value is higher than or equal to the symmetric price offered by the sellers.

[16] If clauses and prices are chosen simultaneously in every period, at least two MOR clauses are needed to sustain collusion in a subgame-perfect equilibrium. I am grateful to a Coeditor who pointed out to me that this is an equilibrium in weakly dominated strategies. There exists, however, a collusive subgame-perfect equilibrium in undominated strategies in which both sellers offer both clauses.

Let us try to give some intuition as to why one MOR clause is enough to sustain monopoly prices. The idea is that if one of the sellers deviates from p_m he triggers a price war in the following period. Anticipating this price war, all consumers who want to buy now buy from A to guarantee themselves the future rebate. So the deviant is worse off than if he had stuck to the collusive price.

But in the very last period a price war is unavoidable. So why can collusive prices be sustained in the penultimate period? Note that all customers who buy in period $n - 1$, anticipating the price war in the last period, will buy from A to make sure they get the rebate. Therefore prices announced in period $n - 1$ do not affect profits: B does not get any customers anyway, and A is forced to repay any profits as rebates in the following period. Since the sellers are indifferent to which price to announce in period $n - 1$, they are free to use these prices to sustain collusion in the previous periods. If any of the sellers deviated from setting, say, the monopoly price in period $n - 2$, then it is a credible threat to lower prices to marginal costs in period $n - 1$ and thus to reduce profits of period $n - 2$ retroactively. On the other hand, if there has been no deviation, it is perfectly rational for both sellers to set the monopoly price in period $n - 1$ because these prices do not matter for profits anyway. Note that any sequence of price pairs other than monopoly prices could be sustained with similar strategies.[17]

Corollary 1 characterizes the profits resulting from the sequence of equilibrium prices just described.

Corollary 1. In the subgame-perfect equilibrium described in Proposition 3, the duopolists make monopoly profits in all but the last three periods of the game.

Since price clauses apply only for the period following the purchase, only customers who buy in the last two periods can benefit from the price war in period n. But at most the last three generations of consumers consider buying in the last two periods. Given that the monopoly price is the same in each period, all other generations of buyers (weakly or strongly) prefer to buy when they enter the market (if at all), and no rebates are paid to them. Thus, the sellers gain monopoly profits from all but the last three generations of consumers. In general, the length of the competitive part at the end of the game depends on the number of periods a consumer may be willing to delay his purchase and on the number of periods to which the MOR clause applies.[18] However, it is independent of the length of the game. Finally, note that even if the sellers offer additional MFC clauses, they cannot prevent the price competition in the very end, for the same reason as in the two-period setup of Proposition 2.

It is interesting to compare these results with the situation of a durable-good monopolist. The monopolist should be less tempted to lower his price if new consumers with high reservation values enter the market over time. Sobel (1991) analyzes such a game and finds that a typical price pattern involves high prices for a number of periods and occasionally low prices to serve the buyers with low reservation values that have accumulated over several periods. However, the monopolist would be better off if he could commit to a price sequence of static monopoly prices for each new generation in each period. This is exactly what the duopolists in my model can achieve with the help of MOR clauses, since any temptation to cut prices occasionally can be kept under control with the threat to punish retroactively.

---

[17] This is not a simple corollary to Benoit and Krishna's (1985) folk theorem for finitely repeated games with complete information. In contrast to Benoit and Krishna, my result does not hinge on the existence of multiple equilibria in the stage game. Furthermore, in my game the history of past prices and consumer decisions determines a "state" in each period, i.e., the fraction of consumers to whom rebates have to be paid if prices are lowered. Thus, this game is not a simple repeated but rather a stochastic game.

[18] See footnotes 7 and 10.

Proposition 3 carries over to demand specifications where different generations of consumers differ not only in size but also with respect to the distribution over types, so that the static monopoly price may vary for each generation. This is because the duopolists can sustain any sequence of price pairs with strategies like the ones described in Proposition 3 (with just one seller offering a MOR clause). But if this price sequence requires occasional price cuts, the sellers cannot realize the full static monopoly profit in each period, as in Corollary 1, since some rebates have to be paid along the equilibrium path whenever prices go down. Furthermore, since consumers want to take advantage of these rebates, in periods preceding price cuts everyone will go to a seller who offers a MOR clause. Thus, in these periods symmetric and strictly positive profits can be sustained only if each seller offers a MOR clause.

4. Conclusions

■ This analysis has shown that both MFC and MOR clauses potentially can serve as collusion-facilitating devices. With MFC clauses, the oligopolists can tackle the problem of price competition in the last period, which typically prevents collusion in finite-horizon games. But their collusive effect is limited. Not only is the range of sustainable collusive prices restricted to Cournot prices, they are also not powerful enough to prevent price competition if there is entry of new consumers. This makes them less valuable for retail markets for consumer durables.

MOR clauses allow retroactive punishment of deviations from collusive behavior. Thus the sellers can use them to sustain collusive prices in early periods, even though they cannot prevent competitive prices in the very end. This makes MOR clauses very powerful in retail markets for consumer durables.

This article has studied best-price clauses in a setting where consumers consider goods offered in different periods as (perfect or imperfect) intertemporal substitutes. My framework also allows for repeat purchases. Instead of considering n different generations of buyers, take for simplicity just two different populations, $j = 1, 2$. Buyers of population 1 have a preference to buy in odd-numbered periods, whereas those of population 2 prefer to buy in even-numbered periods. Each purchase can be delayed, but at most for one period. The results of Proposition 3 and Corollary 1 are unaffected by this different interpretation.

The article stresses the anticompetitive potential of best-price clauses. But, as indicated in the introduction, best-price clauses may also help to save transaction costs, so there is a potential tradeoff. It would be an interesting task for future research to explicitly model these transaction costs and to analyze this tradeoff in a unified framework.

Appendix

■ Proofs of Propositions 1(ii), 1(iii), 2, and 3 follow.

Proof of Proposition 1, part (ii). As will be shown in Proposition 1(iii), no seller can make a positive profit unless each seller offers at least a MFC clause. Suppose there is a subgame-perfect equilibrium in pure strategies in which the sellers offer at least a MFC clause and make joint profits higher than twice the symmetric Cournot profit. Then it must be true that $\min\{p_A^1, p_B^1, p_A^2, p_B^2\} \equiv p > p_c$. By the definition of p_c there exists a $\epsilon > 0$ such that

$$\frac{1}{2} \cdot D(p) \cdot (p - c) < \frac{1}{2} \cdot D(p) \cdot (p - \epsilon - c) + [D(p - \epsilon) - D(p)] \cdot (p - \epsilon - c). \tag{A1}$$

Consider a seller whose market share is $\alpha \leq 1/2$. The effective price he gets for his sales cannot be higher than p, otherwise consumers would have behaved irrationally. But (A1) implies he would have done better offering $p - \epsilon$ in period 2, a contradiction.

Suppose there is a subgame-perfect equilibrium in pure strategies in which the sellers offer at least a MFC clause and make asymmetric profits that add up to twice the symmetric Cournot profit. Then $\min\{p_A^1, p_B^1, p_A^2, p_B^2\} = p_c$ and one seller has a market share $\alpha < 1/2$. By (2) this seller would have done better offering $p_c - \epsilon$ in period 2, a contradiction.

The proof for mixed strategies requires lengthy case distinctions and is omitted here. The full proof is available from the author upon request. *Q.E.D.*

Proof of Proposition 1, part (iii). Suppose there is a subgame-perfect equilibrium with positive profits for at least one of the two sellers, although not both of them have a MFC clause. By the continuity and monotonicity of $D(p)$, this implies that along the equilibrium path there must be a set of consumers with reservation value $v_{i1}^2 > c$ who did not buy in period 1. I show that competition for these consumers leads to equilibrium prices $p_A^2 = p_B^2 = c$ in period 2. But then no consumer should pay more than c, a contradiction.

Suppose both sellers have no MFC clause or one seller has no MFC clause and the other seller has both clauses. Then the only equilibrium prices are $p_A^2 - p_B^2 = c$. If both prices are higher, at least one seller has an incentive to undercut his opponent, and if only one price is higher, the seller who charges c would be better off raising his price.

Suppose A has no MFC clause and B has only a MFC clause (or vice versa). In equilibrium no consumer will ever buy from seller B in period 1 and therefore the only equilibrium prices in period 2 are $p_A^2 = p_B^2 = c$. To see this, suppose there are some consumers who buy from seller B for a price $p_B^1 > c$. In any pure-strategy equilibrium in period 2, A will undercut B. If the equilibrium is in mixed strategies, then it must be that $E(\min\{p_A^2, p_B^2\}) < \min\{E(p_A^2), E(p_B^2)\}$, since $p_A^2 \geq p_B^2$ with probability one is not optimal for A, and if $p_B^2 \geq p_A^2$ with probability one, nobody should have bought from B in the first place. In any case, consumers would have been better off had they delayed their purchases instead of buying with seller B, a contradiction. *Q.E.D.*

Proof of Proposition 2. By Proposition 1(iii) we know that even without new entry in period 2 no positive profits can be sustained unless both sellers offer MFC clauses. This is because a seller without a MFC clause is tempted to compete in period 2 for the remaining consumers with $v_{i1}^2 > c$. If there is entry in period 2, there is an even larger set of consumers a seller without a MFC clause would like to compete for. Hence I can use the same arguments as in Proposition 1(iii) to prove that no positive profits can be sustained if at least one of the sellers does not offer a MFC clause. In the following I consider all cases where both have offered MFC clauses.

Suppose $\min\{p_A^1, p_B^1\} > c$. In the second period, there is a measurable set of new consumers with v_{i2}^2 higher or equal to the price(s) at which consumers bought in period 1. Hence, no matter how many sales a seller has made in period 1, there always exists $\epsilon > 0$ such that he finds it profitable to lower his price in period 2 by ϵ and pay rebates to all previous customers if at the same time he wins all the new consumers that have entered the market. I now show how this affects price competition in period 2.

Suppose both sellers have offered both clauses. Then each seller has an incentive to undercut the other, and the only equilibrium in period 2 is $p_A^2 = p_B^2 = c$.

Suppose A has offered a MFC clause and B both (or vice versa). Then A cannot make any sales in period 1 in equilibrium and so the only price equilibrium is $p_A^2 = p_B^2 = c$. To see this, suppose there are some consumers who buy from A from $p_A^1 > c$. Then there does not exist a Nash equilibrium in pure strategies in period 2. If $p_A^2 = p_B^2 > c$, at least one of the two sellers has an incentive to undercut the opponent to win all of the new consumers instead of only a fraction, and nobody would charge $p^2 = c$. If $p_A^2 > p_B^2$, B prefers to raise his price and vice versa. In an equilibrium in mixed strategies it cannot be that $p_B^2 \geq p_A^2$ with probability one because then B cannot win new consumers but has to meet A's price anyway. Furthermore, one can show that competition for new consumers implies that $p_A^2 \leq p_A^1$ with probability one. Thus consumers who bought from A in period 1 would have been better off if they had bought from B or delayed their purchase.

Suppose both A and B have offered only a MFC clause. Then there exists no subgame-perfect equilibrium in which any seller makes sales in period 1, and thus $p_A^2 = p_B^2 = c$. To see this, suppose only one seller has made sales. Then the same arguments apply as if only one had a MFC clause, a case for which no positive profits can be sustained, as I have argued above. Suppose instead that both have made a positive number of sales. Then the same reasoning as in the previous paragraph shows that there cannot exist a Nash equilibrium in pure strategies in period 2. If the equilibrium is in mixed strategies, then it must be that $E(\min\{p_A^2, p_B^2\}) < \min\{E(p_A^2), E(p_B^2)\}$, since $p_A^2 \geq p_B^2$ with probability, one is not optimal for A and vice versa. Furthermore, one can show that competition for new consumers makes sure that $p_A^2 \leq p_A^1$ with probability one and $p_B^2 \leq p_B^1$ with probability one. Thus, consumers do better if they delay their purchase, since this guarantees them (in expected terms) $E(\min\{p_A^2, p_B^2\})$ instead of $\min\{E(p_A^2), E(p_B^2)\}$.

Since in all subgame-perfect equilibria $p_A^2 = p_B^2 = c$ in period 2, no consumer pays more than c and thus no positive profits can be sustained. *Q.E.D.*

Proof of Proposition 3. Consider the following strategies.

Strategy of seller $A(B)$: Offer a MOR clause (no clause) in period t, $t = 1, \ldots, n - 1$. If no seller has deviated in any way so far, choose $p^t_{A(B)} = p_m$, otherwise choose $p^t_{A(B)} = c$, $t = 1, \ldots, n - 1$. In period n set $p^n_{A(B)} = c$.

Strategy of buyer i from generation $j = n$: Buy in period n from the seller offering the lowest price if $\min\{p^n_A, p^n_B\} \leq v^n_{i,n}$.

Strategy of buyer i from generation $j = n - 1$: If A has offered a MOR clause in period $n - 1$ and if $v^{n-1}_{i,n-1} \geq c$, buy from A in this period (unless seller S, $S \in \{A, B\}$, has offered $p^t_S < c$, in which case buy from S if $v^{n-1}_{i,n-1} \geq p^t_S$). If you did not buy in period $n - 1$, buy in period n from the seller offering the lowest price if $\min\{p^n_A, p^n_B\} \leq v^n_{i,n-1}$.

Strategy of buyer i from generation $j = n - 2$: Do not buy in period $n - 2$ (unless $\min\{p^{n-2}_A, p^{n-2}_B\} < c$ and $v^{n-2}_{i,n-2} \geq \min\{\cdot\}$, in which case buy from the seller offering the lowest price). If A has offered a MOR clause in period $n - 1$ and if $v^{n-1}_{i,n-2} \geq c$, buy from A (unless $\min\{p^{n-1}_A, p^{n-1}_B\} < c$). If A has not offered a MOR clause and if $v^{n-1}_{i,n-2} \geq \min\{p^{n-1}_A, p^{n-1}_B\}$, buy from the seller offering the lowest price.

Strategy of buyer i from generation j, $j = 1, \ldots, n - 3$: If no seller ever deviated, buy in period $t = j$, randomizing between both sellers if $v^t_{ij} \geq p_m$. If there has been a price deviation by a seller but A has offered a MOR clause in period $t = j$, buy from him in this period if $v^t_{ij} \geq c$ (unless seller S, $S \in \{A, B\}$, has offered $p^t_S < c$, in which case buy from S if $v_{ij} \geq p^t_S$). Otherwise delay purchase. If you did not buy in period $t = j$, buy in period $j + 1$ from the seller offering the best net price (if this yields nonnegative utility).

A deviation from the prices specified by the seller's strategy does not pay, given the strategies of the buyers and the opponent. If a seller expects his opponent to set a price equal to marginal cost (after a deviation or in the last period), he can do no better than setting a price equal to marginal cost himself. If the strategy prescribes to set the monopoly price, deviation does not pay either, since either nobody will buy from him or, if he has a MOR clause, he will have to pay back any profits as rebates in the following period. This is true in all periods including the second-to-last one. A will always offer the MOR clause since he expects B to set $p^t_B = c$ if he does not. Thus the seller's strategy is optimal after any history of the game not resulting from simultaneous deviations.

The buyer's strategy for generation j prescribes buying in period j if no deviation has been observed and if, given the strategies of the sellers, delaying the purchase does not pay. In case of a price deviation, the buyers expect a price war with prices equal to marginal costs in the following period. Therefore it is optimal to buy from seller A if he has a MOR clause or to delay the purchase if he has not (unless a seller has deviated with a price smaller than marginal cost, in which case it is optimal to buy, if at all, from this seller). The same holds for period $j + 1$ (if a consumer of generation j did not buy in period j), with the only difference being that delaying the purchase is not considered any more. Thus if A has not offered a MOR clause and there has been a price deviation, the buyer will buy from whoever offers the lowest net price. *Q.E.D.*

References

BENOIT, J.-P. and KRISHNA, V. "Finitely Repeated Games." *Econometrica*, Vol. 53 (1985), pp. 905–922.

BUTZ, D.A. "Durable-Good Monopoly and Best-Price Provisions." *American Economic Review*, Vol. 80 (1990), pp. 1062–1076.

COOPER, T.E. "Most-Favored-Customer Pricing and Tacit Collusion." *RAND Journal of Economics*, Vol. 17 (1986), pp. 377–388.

DOYLE, C. "Different Selling Strategies in Bertrand Oligopoly." *Economic Letters*, Vol. 28 (1988), pp. 387–390.

GRETHER, D.M. AND PLOTT, C.R. "The Effects of Market Practices in Oligopolistic Markets: An Experimental Examination of the Ethyl Case." *Economic Inquiry*, Vol. 22 (1984), pp. 479–507.

GUL, F., SONNENSCHEIN, H., AND WILSON, R. "Foundations of Dynamic Monopoly and the Coase Conjecture." *Journal of Economic Theory*, Vol. 39 (1986), pp. 155–190.

HOLT, C.A. AND SCHEFFMAN, D.T. "Facilitating Practices: The Effects of Advance Notice and Best-Price Policies." *RAND Journal of Economics*, Vol. 18 (1987), pp. 187–197.

LIN, Y.J. "Price Matching in a Model of Equilibrium Price Dispersion." *Southern Economic Journal*, Vol. 55 (1988), pp. 57–69.

LOGAN, J.W. AND LUTTER, R.W. "Guaranteed Lowest Prices: Do They Facilitate Collusion?" *Economic Letters*, Vol. 31 (1989), pp. 189–192.

NEILSON, W.S. AND WINTER, H. "Bilateral Most-Favored-Customer Pricing and Collusion." *RAND Journal of Economics*, Vol. 24 (1993), pp. 147–155.

PNG, I.P.L. AND HIRSHLEIFER, D. "Price Discrimination Through Offers to Match Price." *Journal of Business*, Vol. 60 (1987), pp. 365–383.

SELTEN, R. "Spieltheoretische Behandlung eines Oligopolmodells mit Nachfrageträgheit." *Zeitschrift für die gesamte Staatswissenschaft*, Vol. 121 (1965), pp. 301–324.

SOBEL, J. "Durable Goods Monopoly with Entry of New Consumers." *Econometrica*, Vol. 59 (1991), pp. 1455–1485.

Copyright of RAND Journal of Economics is the property of RAND Journal of Economics and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.