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Quantity precommitment and price-matching[☆]

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ABSTRACT

We study the effects of price-matching in a capacity-constrained duopoly setting. We show that no firm does worse at any pure equilibrium under price-matching relative to Bertrand, but as capacity increases, one or both firms do better relative to Bertrand. If the firms choose their capacities simultaneously before making pricing decisions, then the effect of price-matching varies with the cost of capacity. Specifically, when the cost is "high" price-matching either (i) has no effect on the market price, i.e., the market price associated with the pure SPEs is the Cournot one, or (ii) weakly decreases the market price relative to Cournot. Furthermore, when the cost is "low" price-matching leads to a set of (pure) SPE prices that includes the Cournot price in the interior. Therefore, price-matching does not necessarily benefit the firms when firms select their capacities before competing in price.

1. Introduction

Price matching is common across firms that sell a homogeneous good: if a rival offers a lower price, then the firm offers to match the rival's low price. Given its prevalence in practice, price-matching has attracted considerable interest among economists.[1]

A price-matching firm guarantees that its price will be the lowest; hence, it seems to embrace competition. However, the price-matcher warns its competitors that it will not be undersold; it thus eliminates its rivals' incentive to undercut its price (Salop, 1986). As a result, any price which is usually reached through collusion is a market price when firms have an option to price-match.[2] From this point of view, price-matching is a tool for firms to enforce collusive agreements.

Another line of research argues that price-matching is a form of price discrimination. Belton (1987), Png and Hirshleifer (1987), and Edlin (1997) show that a price-matching firm gives discounts to customers who are aware of the market prices, but it keeps the price high for other customers. As a result, economists as well as legal scholars predominantly view price-matching as an anti-competitive practice.[3] However, the literature on price-matching implicitly assumes that firms can adjust their capacities instantly. This assumption naturally leads to the question we consider in this paper: what are the effects of price-matching if the competing firms are constrained in terms of capacity? We specifically study the effects of price-matching in two well-studied models: (1) a price-setting duopoly in which each firm has limited capacity, and (2) a model in which firms select their capacity simultaneously before making pricing decisions.

We adopt the setting of Kreps and Scheinkman (1983) (KS) in which firms install their capacity in the first period and name their price in the second period. As pointed out in the original paper, the KS model can be interpreted as follows: in the first period, firms produce, and then in the second period, having observed its rival's production level, they engage in a Bertrand (price) competition. However, each firm cannot sell more than its first period production.

Formally, this paper considers a dynamic model in which firms install their capacity in the first period and choose their price and price-matching option in the second period. What we add to the KS model is that the firms can price-match in the second period. We restrict our attention to only pure price-equilibria in the analysis of capacity-constrained duopoly and to pure SPEs in the analysis of the full game.

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1 Moorthy and Winter (2006) point out that a Google search on "price-matching" returns more than two hundred thousand hits.

2 Salop (1986) shows that the equilibrium price in the presence of a price-matching option ranges from the monopolistic price to the Bertrand price. Doyle (1988) further points out that only the monopolistic price survives the process of the iterative elimination of weakly dominated strategies.

3 For a comprehensive literature review, see Arbatskaya et al. (2004).

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Our analysis is relevant in all cases in which capacity decisions are made before pricing decisions. One example is the market for goods sold through newspaper advertisements which is documented in Arbatskaya et al. (2004). The advertisements include suggested prices as well as the price-matching policies of the stores. In this context, the firms set their capacities before they make pricing decisions.

First we show that the effects of price-matching vary with the firms' capacities when the capacities of each firm are limited. Specifically, the larger the industry capacity, the stronger the effects of price-matching on the firms. This result is intuitively plausible because for price-matching to be effective, the equilibrium price (in the absence of price-matching) needs to be low enough that some price beyond it benefits each firm. But when capacity is relatively small, the equilibrium price is already very high in the absence of price-matching (Kreps and Scheinkman, 1983; Osborne and Pitchik, 1986). Thus, price-matching does not affect the firms. At the other extreme, when capacity is relatively high, the equilibrium price is sufficiently low in the absence of price-matching. Thus, price-matching affects both firms in a positive way.

Most interestingly, when industry capacity is in an intermediate range, price-matching benefits the small firm but not the large one. Without price-matching in this case, the equilibrium strategies involve randomization (Kreps and Scheinkman, 1983; Osborne and Pitchik, 1986) because whenever the two firms offer the same price that exceeds the market clearing price, the large firm has an incentive to underprice the small firm since such an action will increase its market share discontinuously. With price-matching, the small firm can eliminate the large firm's incentive to underprice. As a result, the equilibrium price increases but the firms split the equilibrium market demand so that the small firm sells its full capacity. Thus, matching has disproportionate effects on the firms.

Second, we show that if firms choose their capacities simultaneously before making pricing decisions, then the effect of price-matching depends on the cost of capacity. We prove the following two results: (1) if the cost of capacity is low,[4] then some (pure) SPE prices are higher than the Cournot price – the only SPE price in the KS setting – while some others are lower; and (2) if the cost of capacity is high, then the (pure) SPE prices are always (weakly) lower than the Cournot price. The reason is as follows: in order for price-matching to be beneficial for both firms, the firms must have a capacity exceeding a certain threshold. Furthermore, when the firms' capacity exceeds this threshold, the maximal equilibrium price is always the monopolistic price associated with the cost of production. Consequently, price-matching is potentially anti-competitive only if the Cournot price is lower than this monopolistic price, and this case occurs only if the cost of capacity is low. Therefore, price-matching can only weakly decrease the market price below the Cournot price when the cost of capacity is high. However, when the cost of capacity is low, some SPE prices exceed the Cournot price while some others do not. Therefore, the effect of price-matching on the market price is ambiguous if the cost of capacity is low.

A handful of papers have challenged the conventional wisdom that price-matching is anti-competitive. Corts (1995) studies the robustness of the anti-competitive effect of price-matching. He extends the price-matching policy to the price-beating policy and restores the Bertrand price as the unique equilibrium.[5] There is a subtle but important difference between the price-beating and price-matching policies. The former allows firms to undercut the price of others, while the latter only allows firms to tie their price to those of the others. This difference is the reason behind Corts' result. Hviid and Shaffer (1999) introduce hassle costs, i.e., the costs that consumers have to bear to convince a price-matching firm that there is a lower price in the market. In their model, a firm can steal the other's market share by underpricing because customers save the hassle costs by buying from the price cutter, thus restoring the Bertrand price.[6] In both Corts (1995) and Hviid and Shaffer (1999), the firms' incentive to undercut the others' price is restored. In this paper, we do not restore this incentive, but instead introduce capacity as a choice variable. Moorthy and Winter (2006) introduce cost heterogeneity and show that only a low-cost firm uses price-matching to signal that it is low-priced.

The paper is organized as follows: Section 2 lays out the model. Section 3 investigates the effect of price-matching in a capacity-constrained duopoly. Section 4 studies the effect of price-matching in the full game. Lastly, Section 5 concludes.

2. Model

Two identical firms offer a homogeneous good whose market demand is $P(x)$ or $D(p) = P^{-1}(p)$ where x and p are quantity and price, respectively.

The two firms compete in two stages: in the first stage, each firm installs its capacity, which is the maximal quantity that the firm can sell in the second stage. Firm i's cost of capacity $k_i \in \mathbb{R}_+$ is $c(k_i)$.

In the second period, after observing each other's capacity, each firm i chooses its *announced* price p_i and price-matching option $o_i \in \{0, 1\}$, where 1 means "match" and 0 means "does not match". We assume that the cost of production in this stage is zero. The buyers are informed about the firms' second-period actions.[7] Consequently, by choosing different price-matching options, a firm alters the actual price of its product. Specifically, firm i sells its product for the lowest price on the market if it *does* price-match, but for its announced price if *does not*. We use the term ***effective price*** of firm i to refer to the price for which the firm sells its product, i.e., $p_i^e(p_1, o_1, p_2, o_2) \equiv (1 - o_i)p_i + o_i \min\{p_1, p_2\}$. A firm can offer any effective price by properly choosing its price and price-matching option, but it cannot underprice the other if the rival price-matches. We use effective prices extensively because these prices ultimately determine the sales volume of the firms.

Now let us formulate the sales volume of firm i, which of course depends on the firms' capacities and effective prices. Let p_1^e and p_2^e be the corresponding effective prices for firms 1 and 2. Then the sales volume of firm i is specified as follows:

$$x_i(p_1^e, k_1, p_2^e, k_2) = \begin{cases} \min\left\{k_i, D(p_i^e)\right\} & \text{if } p_i^e < p_j^e; \\ \min\left\{k_i, \max\left\{D(p) - k_j, \dfrac{D(p)}{2}\right\}\right\} & \text{if } p_i^e = p_j^e = p; \\ \min\left\{k_i, \max\{0, D(p_i^e) - k_j\}\right\} & \text{if } p_i^e > p_j^e. \end{cases} \quad (1)$$

The above formulation implicitly assumes that the firms split the market when they offer the same effective price and each has a sufficient capacity. In addition, the efficient rationing rule is used,

[4] The formal condition requires that the total Cournot quantity with the combined cost of capacity installation and production exceed the monopolistic quantity with the production cost. However, for ease of presentation, the Introduction uses the condition that coincides with the formal condition in the case of linear demand and cost.

[5] Kaplan (2000) further extends the strategy set to include effective price strategies and restores the possibility of monopoly pricing.

[6] Dugar and Sorensen (2006) take the model of Hviid and Shaffer (1999) to an experimental laboratory, and they observe a price which is significantly different from the Bertrand price.

[7] Perhaps through newspaper or internet advertising.