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On the anti-competitive effects of quantity discounts☆

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ABSTRACT

We analyze the competitive effects of quantity discounts in an asymmetric duopoly. We find that for a sizeable set of parameter values, quantity discounts harm the smaller firm and reduce consumers' surplus. They can even decrease social welfare, i.e. the sum of producers' and consumers' surpluses. However, the circumstances in which quantity discounts may decrease social welfare are limited and difficult to identify in practice.

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1. Introduction

A lively policy debate is currently taking place on the competitive effects of loyalty discounts.[1] This generic term encompasses various types of conditional rebates, including quantity discounts (where the seller offers price reductions for bulk purchases),[2] bundled discounts (where price discounts are conditional upon the customer's total purchases of various products supplied by the firm),[3] and market-share discounts (i.e. discounts that are conditional upon the firm's share of the customer's total purchases).[4]

Of all loyalty discounts, quantity discounts are regarded as the most innocuous. It is generally recognized that they may simply represent a way of passing economies of scale on to buyers, or of enabling firms to better extract consumer surplus. Nevertheless, antitrust authorities are sometimes concerned that dominant firms can use quantity discounts to eliminate or soften competition. One concern is that quantity discounts may provide a cost-effective way of engaging in predatory pricing, by depriving a rival of economies of scale so as to drive it out of business.[5] Another concern, which is the subject of this paper, is that quantity discounts can have exclusionary effects even if they are not part of a predatory strategy, especially when the competing firms are highly asymmetric.[6]

To assess this latter concern, we analyze a model where two asymmetric firms supply differentiated products to consumers who are privately informed about demand for those products. The model is timeless – a static, one-shot game of price competition – so there can be no room for predatory pricing. We also rule out economies of scale. However, firms may use non-linear prices to discriminate among

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[1] See, for instance, Heimler (2005), Kobayashi (2005), Spector (2005), Faella (2008), Ordover and Shaffer (2007), and Ahlborn and Bailey (2006).

[2] See Kolay et al. (2004), Beard et al. (2007), and Martimort and Stole (2009).

[3] See Brennan (2008), Carlton et al. (2008), Klein and Lerner (2008), Greenlee et al. (2008), and Armstrong and Vickers (2010).

[4] Market-share discounts also include exclusionary discounts as a limiting case. See Bernheim and Whinston (1998), Calzolari and Denicolò (2009), Majumdar and Shaffer (2009), and Mills (2010).

[5] This theory seems to be the basis for the current policy in the U.S., where the courts are reluctant to prohibit single-product quantity discounts under the antitrust laws. In two recent decisions – *Brooke Group* and *Concord Boats* – the courts have explicitly applied the standards required in predatory pricing cases to quantity discounts.

[6] This concern seems to be implicitly or explicitly the basis of the European case law, which is harsher than the American one. In *Michelin II*, for instance, the European Court of Justice ruled that any quantity discount that does not reflect cost efficiencies, if practiced by dominant firms, is presumed to be abusive. The European Court of Justice did not require proof that marginal price falls short of unit cost (Waelbroeck, 2005).

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consumers. We analyze whether, in spite of this seemingly innocent rationale, quantity discounts may have anti-competitive effects.

Our analysis builds on Martimort and Stole (2009), who have derived the equilibrium with non-linear prices in the symmetric case. When firms are symmetric, quantity discounts are generally pro-competitive. We find, by contrast, that anti-competitive effects are possible, and in some sense even likely, in the asymmetric case. However, identifying the circumstances in which a ban on quantity discounts can improve social welfare (i.e. the sum of producers' and consumers' surpluses) may be an extremely challenging task for the antitrust authorities. After presenting our main results, we briefly discuss their implications for competition policy in the concluding section.

2. The model

Two firms, denoted by $i=A,B$, supply differentiated products to a final consumer. The consumer's utility function in monetary terms, $u(q_A,q_B,\theta)$, depends on consumption of the two goods q_A and q_B and a parameter, θ, which is the consumer's private information. In order to get explicit solutions, we assume that θ is uniformly distributed over the interval [0, 1] and we posit a quadratic function[7]

$$u(q_A,q_B,\theta)=\theta(q_A+q_B)-\frac{1-\gamma}{2}\left(q_A^2+q_B^2\right)-\gamma q_A q_B. \tag{1}$$

The parameter $\gamma\in\left[0,\frac{1}{2}\right]$ represents the degree of substitutability between the goods: the goods are independent when $\gamma=0$ and perfect substitutes when $\gamma=\frac{1}{2}$. The factor $\frac{1-\gamma}{2}$ that multiplies the middle term in Eq. (1) serves to prevent changes in γ affecting the size of the market, as suggested by Shubik and Levitan (1980).

Firms have constant marginal costs c_A and c_B, with $c_A\le c_B$. There are no fixed costs. With no loss of generality, we normalize c_A to zero and denote $c_B=c\ge 0$. Thus, the parameter c represents the degree of asymmetry among the firms.

Firms simultaneously and independently offer a price schedule. With linear prices, price schedules must take the simple form $P_i(q_i)=p_i q_i$, so that firm i's strategy is simply its price $p_i\in\Re_+$. When firms are able to offer quantity discounts, the strategy for firm i is a function $P_i(q_i):[0,\overline{q}]\to\Re_+$ where q_i is the quantity that firm i is willing to supply, $P_i\ge 0$ is the corresponding total payment requested, and $\overline{q}$ is an upper bound large enough that no consumer may ever want to consume more than $\overline{q}$.

Each firm maximizes its expected profits

$$\pi_i=E_\theta[P_i(q_i(\theta))-c_i q_i(\theta)], \tag{2}$$

and the consumer maximizes his/her net utility

$$U(q_A,q_B,\theta)=u(q_A,q_B,\theta)-P_A(q_A)-P_B(q_B). \tag{3}$$

3. The symmetric case

We start from the symmetric case where $c=0$. To calculate the linear-pricing equilibrium, we first aggregate the individual demands into the total demand functions. We then look for the Bertrand equilibrium of the ensuing pricing game. This gives the following symmetric equilibrium prices

$$p^*=\frac{1-2\gamma}{3-4\gamma}. \tag{4}$$

The equilibrium with non linear prices has been derived by Martimort and Stole (2009).[8] The symmetric equilibrium price schedules are

$$P^*(q)\equiv\alpha_1^* q-\frac{\alpha_1^*}{2}q^2, \tag{5}$$

where

$$\alpha_1^*\equiv\frac{1}{4}\left[3(1-\gamma)-\sqrt{1-2\gamma+9\gamma^2}\right]\ge 0. \tag{6}$$

With these equilibrium price schedules, it is easy to determine the effect of quantity discounts. There are two thresholds, γ_f and γ_c, where $\gamma_c<\gamma_f$, such that firms are better off with quantity discounts if the products are weak substitutes ($0\le\gamma\le\gamma_f$), while consumers are better off if the products are close substitutes ($\gamma_c\le\gamma\le\frac{1}{2}$). Social welfare is always greater in the presence of quantity discounts.

These conclusions follow from two opposing effects of quantity discounts (which will be at work also in the asymmetric case). Quantity discounts intensify competition, thus reducing profits and benefiting consumers. However, they also allow firms to better extract consumer surplus, thus increasing profits and harming consumers. The former effect prevails when the products are close substitutes, while the latter prevails when they are relatively independent. However, non-linear pricing increases social welfare regardless of the degree of product differentiation. Thus when firms are symmetric, there is little support to the view that quantity discounts are anti-competitive.

4. The asymmetric case

The asymmetric case is more interesting from a competition policy perspective, as it allows for the fact that the dominant firm may use quantity discounts to eliminate, or weaken, its competitor.

Both with linear and non-linear pricing, finding the asymmetric equilibrium is a laborious exercise. The non-linear pricing equilibrium is particularly hard to characterize. The equilibrium takes various forms, depending on the values of parameters 3bγ and c, and involves complex strategies. For example, in one equilibrium configuration the price schedule of the most efficient firm (firm A) consists of three parts: a lower part, where firm A prices as an unconstrained monopolist; an intermediate part, where firm A engages in limit pricing; and an upper part, which is chosen by high-type consumers who also purchase product B.

We refer the reader interested in the lengthy technical analysis to Calzolari and Denicolò (2010), where a full characterization of the equilibrium is provided. Here, we report only the results that concern the comparison between the two equilibria.

4.1. Exclusion

Quantity discounts increase the likelihood that the less efficient firm is excluded from the market. However, this outcome results from the inefficient participation of the less efficient firm under linear prices, not from its inefficient exclusion with quantity discounts.

In order to understand why, let us first see when exclusion is socially efficient. Product B ought not to be produced and consumed only if c is greater than the maximum marginal willingness to pay for product B, given that the efficient quantity of product A is already

[7] In an alternative interpretation of the model, A and B are manufacturers selling their products through the same retailer, and the function u is the retailer's gross profit.

[8] However, they do not compare the non-linear price equilibrium with that obtained with linear prices.

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