Reciprocally Exclusive Contracts and Endogenous Quality

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Abstract

Our paper investigates exclusive dealing and purchasing in successive duopolies. First we show that using a limited set of feasible contracts, exclusive dealing and purchasing is going to be preferred, regardless of the level of product differentiation. In the next step, we make the choice of quality endogenous and derive the equilibrium conditions for qualities under the aforementioned contractual arrangement. Our final proposition shows that in this case the choice of quality depends exclusively on the valuation of the median consumer.

JEL codes: L14, K12, D43

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1 Introduction

Papers on exclusive dealing almost exclusively (pun intended) focus on foreclosure, possibly with vertical integration and cartelization of the downstream market, e.g. in Chen and Riordan (2007). However, the choice of distribution methods is a much more complex topic. Moner-Colonques, Sempere-Monerris and Urbano (2004) give a detailed analysis of potential distribution setups and the influencing factors.

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We intend to focus on one specific arrangement: exclusive distribution and exclusive purchasing. Here the manufacturer sells the good through an independent single brand store which carries only their product line. This setup is rather typical in car dealerships, but not unknown in consumer electronics (where Apple in many countries sells only through brand stores and Sony relies heavily on brand stores as well) or even in Hungarian bakeries.

In line with the focus of our study, we limit the structure of possible contracts between manufacturers and retailers. Though it might seem too restricting, this helps us find an equilibrium in pure strategies, thus avoiding the "bumping problem" haunting models with take-it-or-leave-it offers, mentioned by Inderst (2010). Though we only show the dominance of choosing exclusive distribution and exclusive purchasing in this limited setup, other factors might steer companies towards single-brand stores. One example would be the bias in consumer judgements when brands are presented in isolation (see Posavac *et al.* (2005)). On the other hand, we try to be more general in the field of product and retailer differentiation. Our model presents vertically differentiated upstream firms and a horizontally differentiated downstream market. Besides making our model more general, it also gives a more intuitive understanding of the decisions of the firms. As in the previous literature, we used linear contracts to focus on the strategic element in the choice of contracts.

Endogenous quality choice in an oligopolistic setup was discussed by Jing (2006), although without a retail sector. Our final proposition, just like his paper, arrives to an equilibrium condition related to consumer valuations and the steepness of the cost curves with respect to quality.

Recently the issue of product quality has also gained emphasis in discussions of distribution policies, though the focus is still on foreclosure as in Yehezkel (2008) and Argenton (2010). Our paper rather want to focus on an endogenous choice of quality determined by the contractual environment, since it might serve as a starting point for a later, more detailed analysis of welfare effects. In a way, our findings reflect that of Moner-Colonques, Sempere-Monerris and Urbano (2004) who concluded that exclusive distribution and exclusive purchasing is prevalent when product differentiation and brand asymmetries are low. However, while they were interested in how the characteristics of an industry might lead to certain contractual arrangements, we want to find out how distribution contracts affect quality choice which in turn determines product differentiation and brand asymmetries.

In the next section we analyze the choice of contracts with exogenous quality. In the third section we relax the assumption of exogenous quality and focus on the quality choices of the manufacturers under the previous contractual arrangement. In the final section we conclude our findings.

2 The Model

Consider a market in which manufacturers produce differentiated products and sell through retailers. Consumers are heterogenous in two dimensions. Each

consumer has a most preferred retailer $x \in [0,1]$ and a quality valuation $y \in [0,1]$. A consumer of type (x,y) buying a product of quality q_i at the retailer j derives the following utility

$$v + q_i y - t|x - x_j| - p_{ij}$$

where v is a positive constant common to all consumers, $t > 0$ is a preference parameter and p_{ij} is the price of the ith product sold by retailer j. Consumers are uniformly distributed over the unit square $[0,1] \times [0,1]$ with a total mass of 1 (see Figure 1). A consumer who is located at the point of coordinates (x,y) has a preferred retailer that is x away from retailer A and $1-x$ away from the retailer B. We assume that v is large enough for each consumer to find a product that leaves her with a nonnegative surplus. We normalize t to 1. This amounts to a monotonic transformation of preferences.

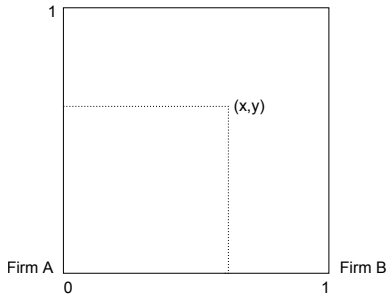

Figure 1: Location of firms and consumers on the unit square.

There are two manufacturers, 1 and 2, offering a product of quality q_1, q_2 and two retailers, A and B, located at the points of coordinates $(0,0)$ and $(1,0)$, that is, the retailers have maximum horizontal differentiation. We assume that $q_1 > q_2 > 0$. Manufacturers operate with c_i marginal costs, where $c_1 > c_2$. The retailers face no retailing costs above the costs of obtaining the products from manufacturers.

We solve the following sequential game for subgame perfect Nash equilibrium. First, the manufacturers simultaneously decide whether to offer a reciprocally exclusive contract to a retailer and set their wholesale prices, w_1 and w_2. These decisions become common knowledge after they have been made. In the second stage, the retailers – after observing the previous stage's outcome – decide whether to accept the offer and compete in prices while taking the other firm's prices as given. A retailer always accepts an offer when that yields him a non-negative profit. Consumers subsequently decide which product and at which retailer to purchase, and profits are realized.

We consider two situations. In the first case no manufacturer engages in exclusivity and therefore both products is available at each retailer shop for

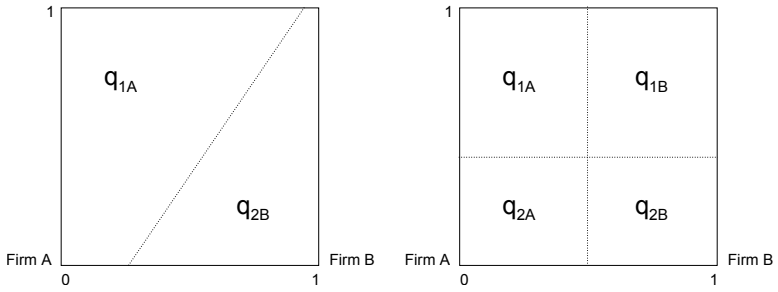

Figure 2: Market areas with and without exclusivity.

purchasing. In the second case exclusivity prevails and each manufacturer sells its product exclusively to its retailer. Note that, when a manufacturer offers an exclusive contract to a retailer implies that both manufacturers sell exclusively its products. In this setting exclusivity by both manufacturers can be achieved if at least one manufacturer choose to engage in exclusivity.

Finally, in this analysis we restrict our attention to the case when every firm makes positive profits in equilibrium. To assure this we assume that the quality difference is less then a benchmark above which all consumer would prefer to buy the high quality product, yielding zero profit for the low quality firm. Formally, we suppose the following assumption.

Assumption 1

$$\frac{c_1 - c_2}{2} < q < \frac{9 + c_1 - c_2}{5} \quad if \quad c_1 - c_2 \leq 1$$
$$\frac{c_1 - c_2}{2} < q < \frac{9 - c_1 + c_2}{4} \quad if \quad c_1 - c_2 > 1$$

where $q \equiv q_1 - q_2$

Let us first consider the case when no manufacturer commits itself to deal exclusively with a retailer. In this case both products are available for purchasing at any retailer. Figure 2 shows the division of the market between retailers when no exclusivity occurs A consumer who is located at the points of coordinates (x, y) will purchase the high quality rather then the low quality product at retailer A if $v + q_1 y - x - p_{1A} \geq v + q_2 y - x - p_{2A}$, i.e., if she is located above the line $y = \frac{p_{1A} - p_{2A}}{q}$. That is, every consumer with a quality valuation $y' > y$ strictly prefers to buy the high quality rather then the low quality product at the retailer shop A. Furthermore, this consumer prefers to buy a given quality product from retailer A rather then from retailer B, if and only if $v + q_i y - x - p_{iA} \geq v + q_i y - (1 - x) - p_{iB}$. This implies that consumers in the interval $x \in [0, \frac{1 + p_{iB} - p_{iA}}{2}]$ will purchase from retailer A , whereas those with $x \in (\frac{1 + p_{iB} - p_{iA}}{2}, 1]$ will purchase from retailer B the product in question.

Let $D_{ij}(p_{1A}, p_{1B}, p_{2A}, p_{2B})$ denote the demand function of product i at retailer j. The expressions for these functions can be given as follows

$$D_{1A}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) = \left(\frac{1 + p_{1B} - p_{1A}}{2}\right)\left(1 - \frac{p_{1A} - p_{2A}}{q}\right) \tag{1}$$

$$D_{1B}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) = \left(1 - \frac{1 + p_{1B} - p_{1A}}{2}\right)\left(1 - \frac{p_{1B} - p_{2B}}{q}\right) \tag{2}$$

$$D_{2A}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) = \left(\frac{1 + p_{2B} - p_{2A}}{2}\right)\left(\frac{p_{1A} - p_{2A}}{q}\right) \tag{3}$$

$$D_{2B}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) = \left(1 - \frac{1 + p_{2B} - p_{2A}}{2}\right)\left(\frac{p_{1B} - p_{2B}}{q}\right) \tag{4}$$

Solving the game backward, first we consider the retailers' competition. Retailers choose simultaneously (p_{1A}, p_{2A}) and (p_{1B}, p_{2B}) respectively to maximize their profits,

$$\pi_A = (p_{1A} - w_1)D_{1A}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) + (p_{2A} - w_2)D_{2A}(p_{1A}, p_{1B}, p_{2A}, p_{2B})$$

and

$$\pi_B = (p_{1B} - w_1)D_{1B}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) + (p_{2B} - w_2)D_{2B}(p_{1A}, p_{1B}, p_{2A}, p_{2B})$$

where w_i denotes the wholesale price for product i.

This yields prices equal to $p^*_{ij} = 1 + w_i$, where $i = 1, 2$ and $j = A, B$. Plugging these prices into the manufacturers profit function and maximizing them with respect to w_1 and w_2 respectively yields

Lemma 2.1 *Suppose no manufacturer offers exclusivity to retailers. The equilibrium prices and profits are as follows ($j = A, B$).*

$$p^*_{1j} = \frac{1}{3}(3 + 2q + 2c_1 + c_2), \qquad p^*_{2j} = \frac{1}{3}(3 + q + c_1 + 2c_2)$$

$$\pi^*_1 = \frac{(2q - c_1 + c_2)^2}{9q} \qquad \pi^*_2 = \frac{(q + c_1 - c_2)^2}{9q}$$

Now suppose that manufacturer i deals exclusively with one of the retailers. Without loss of generality we assume that the high quality manufacturer offers an exclusive dealing to the retailer A and commits itself not to deal with retailer B. In this case each product is available for purchasing only at one retailer. The market is shared between retailers as is shown by the Figure 2. The utilities of

type (x, y) from buying a high or a low quality product from the specific retailer can be given as $v + q_1 y - x - p_{1A}$ and $v + q_2 y - (1 - x) - p_{2B}$. Therefore, for a given y, the marginal consumer type in terms of x is

$$\hat{x}(y) = \frac{1}{2}(1 + qy + p_{2B} - p_{1A}) \tag{5}$$

For any $y \in [0, 1]$, consumers in the interval $x \in [0, \hat{x}(y)]$ will purchase the high quality product from retailer A, whereas those with $x \in (\hat{x}(y), 1]$ will purchase the low quality product from retailer B. Thus straightforward algebra implies

$$D_{1A}(p_{1A}, p_{2B}) = \frac{1}{2}\left(1 + p_{2B} - p_{1A} + \frac{q}{2}\right) \tag{6}$$

and

$$D_{2B}(p_{1A}, p_{2B}) = \frac{1}{2}\left(1 + p_{1A} - p_{2B} - \frac{q}{2}\right) \tag{7}$$

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The retailers' profit maximizing first-order conditions yield the equilibrium consumer prices $p^*_{1A} = \frac{1}{3}\left(3 + 2w_1 + w_2 + \frac{q}{2}\right)$ and $p^*_{2B} = \frac{1}{3}\left(3 + w_1 + 2w_2 - \frac{q}{2}\right)$. Having derived the equilibrium prices in the retailers' pricing subgame we can move backward and analysing the manufacturers maximization problem. Manufacturers choose wholesale prices that maximize their profits. Formally this can be summarized in the following.

Lemma 2.2 *If one or both manufacturer offers exclusivity the optimal prices and profits can be given as*

$$p^*_{1A} = \frac{1}{9}(36 + 2q + 5c_1 + 4c_2) \qquad p^*_{2B} = \frac{1}{9}(36 - 2q + 4c_1 + 5c_2)$$

$$\pi^*_1 = \frac{1}{216}(18 + q - 2c_1 + 2c_2)^2 \qquad \pi^*_2 = \frac{1}{216}(18 - q + 2c_1 - 2c_2)^2$$

This is a valid solution as long as the indifference line intersects the top and the bottom sides of the unit square, i.e., as long as $\hat{x}(0) \in (0, 1)$ and $\hat{x}(1) \in (0, 1)$. Indeed,

$$\hat{x}(0) = \frac{1}{18}(9 - 4q - c_1 + c_2) \in (0, 1) \tag{8}$$

and

$$\hat{x}(1) = \frac{1}{18}(9 + 5q - c_1 + c_2) \in (0, 1) \tag{9}$$

hold if Assumption (1) is satisfied.

In the contracting stage manufacturers simultaneously decide whether to offer exclusive contracts to retailers. From Lemma (2.1) and Lemma (2.2) it follows that

Proposition 2.1 *The subgame-perfect Nash equilibria in pure strategies are the outcomes when at least one manufacturer offers an exclusive contract to a retailer and that contract is accepted.*

It is easy to verify why a unilateral exclusivity constitute an equilibrium. Consider for example the case when the high quality manufacturer offers an exclusive contract to a retailer. In this case manufacturer 1 earns a profit given by the Lemma (2.2). Without exclusivity the profit can be given by the Lemma (2.1). Thus, the difference of profits is

$$\frac{1}{216}(18 + q - 2c_1 + 2c_2)^2 - \frac{(2q - c_1 + c_2)^2}{9q} \tag{10}$$

which is always strictly positive whenever Assumption (1) is satisfied.

Note, that the outcome when both manufacturers offer exclusivity to a retailer is always an equilibrium in this setup, while an accepted unilateral exclusivity always generates the same market structure as the outcome when both manufacturer has an exclusive retailer for its product. Furthermore, Proposition (2.1) implies that at least a manufacturer will engage in exclusivity in equilibrium.

3 Quality choices

So far we assumed that the qualities chosen by the manufacturers are fixed. As the quality difference is crucial in evaluating the equilibrium outcomes a natural question to ask is what level of quality difference will emerge in equilibrium if manufacturers choose their quality as part of the game? In this section we endogenize the manufacturers' qualities and we model this by assuming that firms simultaneously select their quality prior to the contracting choice.

Assume that manufacturers operate with $c_i(q_i)$ marginal cost functions, where $c_2(q) > c_1(q) > 0$ for every $q > 0$ and $c_i(\cdot)$ is strictly convex and increasing in quality levels for every $i = 1, 2$.

As we already know from the previous section manufacturers opt to deal exclusively with the retailers and thus gain profits given by Lemma (2.2), where the fixed marginal costs c_i $(i = 1, 2)$ are functions of the respective qualities. Maximizing these profit functions with respect to quality levels, yields the following first order conditions:

$$1 - 2c_1'(q_1) = 0 \tag{11}$$

$$1 - 2c_2'(q_2) = 0 \tag{12}$$

Proposition 3.1 *The marginal increase in average cost due to quality improvement equals the average valuation of quality in the case of both firms, ie. they optimize with respect to quality with the "median consumer" in mind.*

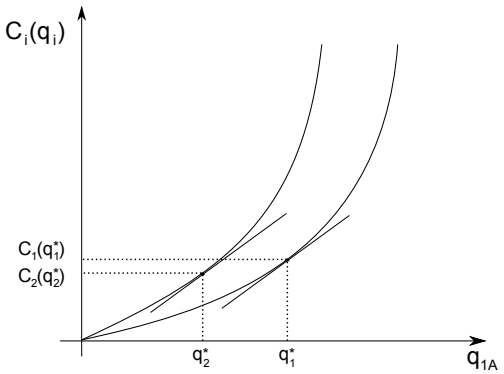

Figure 3: Equilibrium quality choices.

The next proposition summarizes the main results for the firms' equilibrium quality choices.

Proposition 3.2 *In equilibrium manufacturers choose strictly positive quality levels. The more efficient firm selects a high quality level, while the other manufacturer chooses a low quality status. Firms do not engage in maximal differentiation.*

Figure 3 helps in providing intuition for this outcome. Note that as far as firms differ in efficiency they will choose different quality levels. Furthermore, observe that the quality difference between products increases with the difference in cost functions.

4 Summary

We first proposed a non-cooperative game of successive duopolies with limited strategy choice. We have shown that exclusive purchasing and distribution is preferred to non-exclusive purchasing and distribution with any level of vertical product differentiation. Then we relaxed the assumption that quality is fixed and derived the equilibrium conditions for quality choices under exclusive purchasing and distribution. Our final conclusion here is that under this distribution arrangement, quality is going to be adjusted based only on the median consumer's valuation. This also means that vertical differentiation is going to be limited and depends on the differences in the cost function with respect to quality.

Generalizations of our results could include different distribution of consumers in the consumer space, different set of feasible contracts, or a higher number of retailers to induce richer strategic scenarios. Further steps taken in analyzing how the set of (legally) feasible contract affects product quality could greatly enhance our understanding of how antitrust policy should view certain practices (e.g. exclusive dealing).

References

Argenton C. (2010), 'Exclusive Quality', *The Journal of Industrial Economics*, 690-716.

Chen, Y. and Riordan, M. H. (2007),'Vertical integration, exclusive dealing, and ex post cartelization'. *The RAND Journal of Economics*, 1-21.

Inderst, R. (2010), 'Models of vertical market relations', *International Journal of Industrial Organization*, 341-344.

Jing, B. (2006), 'On the Profitability of Firms in a Differentiated Industry', *Marketing Science*, 248-259.

Moner-Colonques, R., Sempere-Monerris, J. J. and Urbano, A. (2004), 'The Manufacturers Choice of Distribution Policy under Successive Duopoly', *Southern Economic Journal*, 532-548.

Posavac, S. S., Sanbonmatsu, D. M., Kardes, F. R., and Fitzsimons, G. J. (2005), 'Blissful insularity: When brands are judged in isolation from competitors', *Marketing Letters*, 87-97.

Yehezkel, Y. (2008), 'Retailers' Choice of Product Variety and Exclusive Dealing under Asymmetric Information', *The RAND Journal of Economics*, 115-143.