Doctoral School of Economics

Thesis on

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Essays on Vertical Restraints

Ph.D. Dissertation

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Department of Microeconomics

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Contents

Introduction

Manufacturers in a variety of markets often impose contractual restraints on retail firms that distribute their products. Sometimes the vertical restraints sets a minimum or maximum retail price for the manufacturer's product, sometimes a manufacturer grants a retailer the exclusive right to sell in a certain territory, sometimes it requires the distributor to sell a certain minimum quantity over a given period of time, etc. Vertical restraints occur for many types of products and in markets with a wide variety of structures. they have been imposed by manufacturers of medicines, automobiles, books, electronic gadgets, and many other products. Traditionally, vertical restraints have been interpreted either as a device of market power or as an instrument of correcting failure in the market for distribution services. empirical evidences suggest that these explanations are in fact of limited applicability. As a result, recent works put forth new explanations for vertical restraints, still many important aspects of vertical restraints are poorly understood. The aim of this thesis is to shed light on a few of those aspects. Using game theoretical framework the chapters in this thesis contribute to a better understanding of vertical restraints.

Price restrictions are undoubtedly among those practices that are more severely treated by antitrust authorities than any other vertical restraint, however there is a trend towards a more flexible attitude. Yet, retail price maintenance (RPM) and price floors are often considered *per se* illegal. In the first chapter we revisit the topic of retail price maintenance (RPM). In the current literature many motives of the RPM has been analyzed, including the notion to support (either upstream or downstream) collusive arguments, to induce dealer's services or to reduce some types of dealers risk. Our analysis emphasizes an other possible explanation for the use of RPM. In the form of price floor, We show that a vertical restriction on retail price enables the manufacturer to preclude the emergence of a collusion between retailers.

Chapter 2 considers the impact of vertical restraints on foreclosure. In a simple model we show that foreclosure is not only attempted by setting high prices for the use of infrastructure, but also by the strategic behavior that is aimed at the implementation of inferior technologies in a way that restricts or hampers access to bottleneck facilities to entrant companies. Our analyses shows that regulators seeking to avoid market foreclosure might trigger technological foreclosure.

The practice of exclusive contracts has been a subject of interest in the recent literature, though most of the articles study such contracting situations suggesting triangle structures (monopolistic player on one side and duopolistic agents on the other side). While these results have generated important insights about the nature of such contracting games, it is fair to say that the analysis of exclusive contracts in bilaterally oligopolistic markets has been largely ignored in the literature and less is known about the consequences in set-ups where both the upstream and the downstream market contain more then one player. The analysis in Chapter 3 focuses on the strategic decision as whether exclusive contracts are profitable in a bilaterally duopolistic setting or not. We analyze the incentives of manufacturers to deal exclusively with retailers in bilaterally duopolistic industries with brand differentiation by manufacturers. With highly differentiated products exclusive contracts are shown to generate higher profits for manufacturers and retailers, who thus have an incentive to insist on exclusive contracting. However, if the products are close substitutes no exclusivity will emerge in equilibrium. In Chapter 4 we generalize these findings for the case of general demand curves.

In Chapter 5 In we develop a simple model to analyze the effects of exclusive contracts in vertically integrated markets where both the upstream and the downstream market are characterized as oligopolies and manufacturers produce vertically differentiated products. We find that firms prefer to deal exclusively with retailers. If the extent of consumers' heterogeneity is small, manufacturers offer exclusive contracts unilaterally. On the other hand, if consumers' valuation differ significantly both manufacturers en- gage in exclusive contracting.

The last chapter 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.

Chapter 1

The Role of Price Floor in a Differentiated Product Retail Market

Barna Bakó (2010), 'The Role of Price Floor in a Differentiated Product Retail Market', *Economic Analysis and Policy*, Vol. 40, No. 3, 363-368.

Chapter 2

Technological Foreclosure

In this chapter we consider the impact of vertical restraints on foreclosure. In a simple model we show that foreclosure is not only attempted by setting high prices for the use of infrastructure, but also by the strategic behavior that is aimed at the implementation of inferior technologies in a way that restricts or hampers access to bottleneck facilities to entrant companies. We reconsider Sadowski and Straathof (2005) model, but instead of assuming firms to compete in Cournot fashion we analyze the case when producers make their decisions in an observable and successive manner. Our analyses shows that regulators seeking to avoid market foreclosure might trigger technological foreclosure.

2.1 The Model

Consider an industry in which two firms compete in Stackelberg fashion. Suppose that firm I is a monopolist in an upstream market and as a leader firm competes with firm E in the downstream market. The cost to produce an intermediate good is k, which can be transformed without any cost to a final good.

Without intervention of the regulator, firm I refuses to supply the upstream market good to firm E, which leads to market foreclosure of the follower. In order to prevent this the regulator can impose a price celling c, such that firm E enters the downstream market and produces identical product with its competitor.

The demand for the final good is given by

$$p(q_I, q_E) = \alpha - \beta(q_I + q_E) \tag{2.1}$$

The profits can be written as:

$$\pi_I = p(q_I, q_E)q_I + cq_E - k(q_I + q_E) - m \tag{2.2}$$

$$\pi_E = p(q_I, q_E)q_E - cq_E - e \tag{2.3}$$

where m is the cost of switching to a new technology, while e denotes the entry cost.

We consider three different scenarios. In the first, firms compete in a regulated Stackelberg duopoly, in which a regulator sets a price celling for the intermediate good. In the second case we consider market foreclosure, and as a third scenario we analyze the technological foreclosure.

2.1.1 Regulated duopoly

Suppose that the regulator imposes a price celling c that allows firm E to enter to the market. Then, by maximizing the profit function given by (2.3) yields that in equilibrium $q_E = \frac{\alpha - c}{2\beta} - \frac{q_I}{2}$. Substituting this into the profit function of firm I, the first order condition yields

$$q_I^* = \frac{\alpha - k}{2\beta}, \qquad q_E^* = \frac{\alpha - 2c + k}{4\beta} \tag{2.4}$$

Hence, in equilibrium:

$$\begin{aligned} \pi_I^* \quad = \quad & \frac{(\alpha + 2c + k)(\alpha - k)}{8\beta} + \frac{(\alpha - 2c + k)c}{4\beta} - \\ & \frac{(3\alpha - 2c - k)k}{4\beta} - m \end{aligned} \tag{2.5}$$

$$\pi_E^* = \frac{(\alpha - 2c + k)^2}{16\beta} - e \tag{2.6}$$

$$p^* = \frac{\alpha + 2c + k}{4} \tag{2.7}$$

2.1.2 Market foreclosure

Without a price celling, the upstream firm can achieve market foreclosure. In this case the equilibrium values are as follows

$$q_I^* = \frac{\alpha - k}{2\beta} \tag{2.8}$$

$$\pi_M^* = \frac{(\alpha - k)^2}{4\beta} - m \tag{2.9}$$

$$p^* = \frac{\alpha + k}{2} \tag{2.10}$$

2.1.3 Technological foreclosure

Now suppose that the firm I has the possibility to choose between two upstream technologies, A and B. If firm I chooses type A, the entrant firm can start producing final goods without high up-front investment. By choosing technology B the firm E can enter the market only with high entry costs. We denote the cost of entry in the case of type A as e_A, while e_B denotes the entry cost in the case technology is type B, with $e_A < e_B$. The incumbent firm fix cost are m_i if it chooses technology of type i (where $i = A, B$). We suppose that $m_A < m_B$, otherwise firm I would always choose B. Without price celling firm I choose technology A. If the regulator interfere and imposing a price celling, than the incumbent might prefer to choose the more costly technology to prevent entry. Too see this consider the following. Firm E always enters if

$$\pi_E(T, c) = \frac{(\alpha - 2c + k)^2}{16\beta} - e_T > 0, \qquad \text{where} \quad T = A, B. \tag{2.11}$$

That is, the highest c compatible with duopoly is

$$c^E(T) = \frac{\alpha + k - 4\sqrt{\beta e_T}}{2}, \qquad T = A, B. \tag{2.12}$$

where $c^E(T)$ is the highest intermediate price for which firm E enters and firm I chooses technology T. One can easily see that $c^E(A)$ is smaller than $c^E(B)$.

If the price celling is set such that firm E enters only if firm I chooses technology A, than firm I might have the incentive to choose technology B. Although, the high cost of technology B (m_B) can offset the monopoly profit in this case.

Firm I chooses technology B if

$$\pi_M(B) - \pi_I(A, c) > 0. \tag{2.13}$$

where $\pi_I(A, c)$ denotes the profit of firm I if the market is characterized as duoply. Straightforward calculations gives that firm I chooses technology B whenever $c < c^{TF}$, where

$$c^{TF} = \frac{\alpha + k - \sqrt{8\beta(m_B - m_A)}}{2}. \tag{2.14}$$

If $c > c^{TF}$ than $\pi_I(A, c) > \pi_M(B)$, that is firm I chooses technology A and firm E enters the market.

Our main result is summarized in the following proposition.

Proposition 2.1 *With a price celling $c^{TF} < c < c^E(A)$ a regulator can prevent both market and technological foreclosure.*

2.2 Summary

In this chapter we analyzed the strategical behavior of an incumbent firm with bottleneck facilities to restrict access of potential entrant companies. We have shown that beside market foreclosure there is a threat of technological foreclosure, when the incumbent firm chooses a technology with the purpose to deter potential competitors from entering to the market. We find that there exist optimal pricing strategies for the regulator to avoid technological and market foreclosure by incumbents.

Chapter 3

Exclusive Contracts in Bilateraly Duopolistic Industries

Barna Bakó (2011), 'Exclusive contracts in bilaterally duopolistic industries', *Proceedings of the Annual International Conference on Qualitative and Quantitative Economics Research*, QQE 2011.

Chapter 4

Exclusive Contracts. A General Model[1]

In the previous chapter we have shown that the manufacturers will engage in exclusive contracting when the product differentiation is strong. In this case an exclusivity will solve the problem of contract externality. If the products are less differentiated the manufacturers experience a prisoner's dilemma, where, by having an incentive to solve the externality problem, a unilateral switch leads to a lower profit. In this case manufacturers will offer non-exclusivity to the retailers. These results, however, rely on the fact that the demand functions are linear. In this chapter we generalize our findings.

4.1 The model

We consider the following vertical structure. There are two upstream manufacturers (M_1 and M_2) and two downstream retailers (R_A and R_B). The manufacturers face constant marginal costs c_i, $(i = 1, 2)$, the retailers, in addition to the costs of obtaining the products from the manufacturers have a constant unit cost c_j $(j = A, B)$, which are normalized to zero. We assume that final goods are symmetrically differentiated, and the inverse demands for the final good i can be given by

[1] Paper presented at *'The 10th Annual International Industrial Organization Conference', March 16-18, 2012.*

$$p_i(q_i, q_{-i}, \delta) \tag{4.1}$$

where $i, -i = 1, 2$, $i \neq -i$ and $\delta \in (0, 1)$. We interpret δ as the degree of product differentiation. For δ close to 1 downstream firms supply homogenous products, while for δ close to 0 the firms supply to independent markets. We impose the following assumption on the demand curves:

Assumption 4.1 *The demand curves are strictly decreasing, continuously differentiable and intersect both axis.*

The game Γ we consider is the one given in the Chapter 3.. We solve the game by backward induction. First consider the subgame where the manufacturers don't commit themselves to sell exclusively for any of the downstream players and offer a non-exclusive contract to both of the retailers. In equilibrium q_{ij}^* must satisfy

$$q_{ij}^* = \arg\max_{q_{ij}} (p_i(q_{ij} + g_{i-j}^*, q_{-ij}^* + q_{-i-j}^*) - c_i) q_{ij} \tag{4.2}$$

for every $i, -i = 1, 2$ $(i \neq -i)$, $j, -j = A, B$ $(j \neq -j)$.

Now consider the case when manufacturer M_i, offers an exclusive contract to the retailerR_j. In this case the product of M_i is available for purchasing only at R_j, yet the other manufacturer's product is still possible to buy at any retailers. In this case the profit maximization problem boils down to

$$q_{ij}^* = \arg\max_{q_{ij}} (p_i(q_{ij} + 0, q_{-ij}^* + q_{-i-j}^*) - c_i) q_{ij} \tag{4.3}$$

where $i, -i = 1, 2$ $(i \neq -i)$, $j, -j = A, B$ $(j \neq -j)$ and $q_{ij}^* = 0$ if $ij = 1B$.

Solving for q_{ij} $(ij = 1A, 2A, 2B)$, and substituting them to the profit functions yields the equilibrium values of Π_{ij}^{e*} and Π_{-i}^*.

Then, by solving the game backward, we obtain the manufacturers' payoff in the different sub-games at stage 1 as shown in Table 4.1.

The game has several equilibria depending on the level of product differentiation. To see this consider the followings. The equilibrium profit of the manufacturer M_i depends on the number of retailers of product i, which we denote by $l = 1, 2$, the number of retailers of product $-i \neq i$, which we denote by $k = 1, 2$, the parameter δ and the level of marginal costs, considered as exogenous parameters. Following Whinston (2006) without exclusive contracts the equilibrium profits of manufacturer M_i necessarily equals $\Pi_i^* = 2\pi_i^*(2, 2, \delta, c_i, c_{-i})$. On the

Table 4.1: The payoff matrix

		M_2		
		no excl.	excl. R_A	excl. R_B
	no excl.	(Π_1^*, Π_2^*)	$(\Pi_1^{e*}, \Pi_{2A}^{e*})$	$(\Pi_1^{e*}, \Pi_{2B}^{e*})$
M_1	excl. R_A	$(\Pi_{1A}^{e*}, \Pi_2^{e*})$	$(\Pi_{1A}^{ee*}, \Pi_{2A}^{ee*})$	$(\Pi_{1A}^{ee*}, \Pi_{2B}^{ee*})$
	excl. R_B	$(\Pi_{1B}^{e*}, \Pi_2^{e*})$	$(\Pi_{1B}^{ee*}, \Pi_{2A}^{ee*})$	$(\Pi_{1B}^{ee*}, \Pi_{2B}^{ee*})$

other hand, if both manufacturers sign exclusive contracts, they both have profits $\Pi_{ij}^{ee*} = \pi_i^*(1, 1, \delta, c_i, c_{-i})$. If one of the manufacturers, say M_i, signs an exclusive contract with a retailer, but M_{-i} does not, M_i's profits are $\Pi_{ij}^{e*} = \pi_i^*(1, 2, \delta, c_i, c_{-i})$, if it is the other way round its profits are $\Pi_i^{e*} = 2\pi_i^*(2, 1, \delta, c_i, c_{-i})$.

To ensure the existence of the equilibrium, following d'Aspremont *et al.* (1979) we assume the following:

Assumption 4.2 $\pi_i^*(l, k, \delta, c_i, c_{-i})$ $(i = 1, 2)$ *is strictly decreasing and continuously differentiable in* δ.

Suppose that products are completely homogenous. In this case, following Whinston (2006) we can write

$$\pi_i^*(l, k, \delta, c_i, c_{-i}) = \pi_i^*(l + k, 0, \delta, c_i, c_{-i}) \tag{4.4}$$

From the merger paradox (see Salant *et al.* (1983)). we know that $2\pi_i^*(3, 0, \delta, c_i, c_{-i}) > \pi_i^*(2, 0, \delta, c_i, c_{-i})$ and $2\pi_i^*(4, 0, \delta, c_i, c_{-i}) > \pi_i^*(3, 0, \delta, c_i, c_{-i})$. Hence we can impose the following:

Lemma 4.1 *(merger paradox assumption): Supposing homogenous products a firm's profit is always higher if it sells its product without exclusive contracts, rather than using exclusive contracts, that is,* $\pi_i^*(1, k, 1, c_i, c_{-i}) < 2\pi_i^*(2, k, 1, c_i, c_{-i})$ *for every* $i, -i, k = 1, 2$ *and* $i \neq -i$.

With $\delta = 0$ products are completely differentiated. As monopoly profits should always be higher than duopoly profits, we can then use the following:

Lemma 4.2 *(competition assumption): If products are completely differentiated a manufacturer's profit is always higher when it sells its product exclusively, rather than using non-exclusive contracts, that is,*

$\pi_i^*(1,k,0,c_i,c_{-i}) > 2\pi_i^*(2,k,0,c_i,c_{-i})$ for every k and every $i,-i = 1,2$ and $i \neq -i$.

One key feature of the merger paradox is that for any given number of symmetric firms in the premerger equilibrium, if the merger by a specified number of firms causes gains (respectively, losses), a merger by a larger (smaller) number of firms will cause gains (losses).[2] Thus, we assume that if a merger is profitable, then it is more profitable if the other manufacturer is having less retailers.[3] This is formalized with the following

Lemma 4.3 *$\pi_i^*(1,1,\delta,c,c) - 2\pi_i^*(2,1,\delta,c,c) > \pi_i^*(1,2,\delta,c,c) - 2\pi_i^*(2,2,\delta,c,c)$ for every $i = 1,2$.*

The following propositions characterize the equilibrium outcomes of the game.

Proposition 4.1 *If δ is close enough to zero, that is when the product differentiation is strong, the only subgame perfect equilibrium is when manufacturers offer exclusive contracts to the retailers, and the retailers accept that offer.*

Proof: For exclusive contracts to be an equilibrium, we need

$$\pi_i^*(1,2,\delta,c_i,c_{-i},) > 2\pi_i^*(2,2,\delta,c_i,c_{-i}) \tag{4.5}$$

$$\pi_i^*(1,1,\delta,c_i,c_{-i}) > 2\pi_i^*(2,1,\delta,c_i,c_{-i}) \tag{4.6}$$

for every $i,-i = 1,2$ $(i \neq -i)$.

Suppose that $\delta = 1$. The Lemma 4.1 then implies that condition (4.5) is satisfied, however condition (4.6) is not. If we suppose $\delta = 0$ from Lemma 4.2 we obtain that condition (4.6) holds and condition (4.5) is violated. From Assumption 4.2 and Lemma 4.1–4.2 follows that for every reasonable c_i (c_{-i}) there is a $\underline{\delta_i}$ $(\underline{\delta_{-i}})$ for which if $\delta \leq \underline{\delta_i}$ $(\delta \leq \underline{\delta_{-i}})$ condition (4.5) is satisfied for every i. Respectively, for every c_i (c_{-i}) there is a $\underline{\underline{\delta_i}}$ $(\underline{\underline{\delta_{-i}}})$ for which if $\delta \leq \underline{\underline{\delta_i}}$ $(\delta \leq \underline{\underline{\delta_{-i}}})$ condition (4.6) holds.

Then if $\delta \leq \underline{\delta} \equiv \min\{\underline{\delta_i}, \underline{\delta_{-i}}, \underline{\underline{\delta_i}}, \underline{\underline{\delta_{-i}}}\}$ the manufacturers offer exclusive contracts to the retailers. This equilibrium is unique if Assumptions 4.1 holds. ■

[2]Salant *et al.* (1983) arrives to the conclusion that for a merger to be unprofitable it is sufficient that less than 80 percent of the firms collude.

[3]One other way to interpret this assumption is that in average the maximum profit of an industry composed either by a monopolist or by competitive firms is always higher than the average profit of an oligopolistic industry.

Proposition 4.2 *If products are close substitutes the unique perfect equilibrium when manufacturers sell their product without exclusivity and retailers accept these non-exclusive contracts.*

Proof: The existence of non-exclusive contracts equilibrium requires the following two conditions to be satisfied for every $i, -i = 1, 2$ and $i \neq -i$

$$2\pi_i^*(2, 1, \delta, c_i, c_{-i},) > \pi_i^*(1, 1, \delta, c_i, c_{-i}) \tag{4.7}$$

$$2\pi_i^*(2, 2, \delta, c_i, c_{-i}) > \pi_i^*(1, 2, \delta, c_i, c_{-i}) \tag{4.8}$$

The proof is much along the same lines as the one above. If $\delta = 0$ we know from the Lemma 4.2 that these conditions are violated, while if $\delta = 1$ from the Lemma 4.1 follows that they are satisfied. Thus, these assumptions together with the Assumption 4.2 imply that for every c_i, c_{-i} exist $\overline{\delta_i}$, $\overline{\delta_{-i}}$, $\overline{\overline{\delta_i}}$, $\overline{\overline{\delta_{-i}}}$ such that for every $\delta \geq \overline{\delta} \equiv \max\{\overline{\delta_i}, \overline{\delta_{-i}}, \overline{\overline{\delta_i}}, \overline{\overline{\delta_{-i}}}\}$ manufacturers are better off if they sell through both of the retailers rather than offering an exclusive contracts to one of them.

The Assumption 4.1 assures that this equilibrium is unique. ■

It is easy to show that supposing symmetric manufacturers there is no equilibrium in which one of the manufacturer unilaterally would offer an exclusive contract to one of the retailers. This follows directly from the Lemma 4.3, which contradicts the required conditions, namely

$$\pi_i^*(1, 2, \delta, c, c,) > 2\pi_i^*(2, 2, \delta, c, c) \tag{4.9}$$

$$2\pi_{-i}^*(2, 1, \delta, c, c) > \pi_{-i}^*(1, 1, \delta, c, c) \tag{4.10}$$

where $i \neq -i$. This result is stated in the following proposition.

Proposition 4.3 *Supposing symmetric manufacturers* ($c_i = c_j = c$) *there is no* δ *for which unilateral exclusive contract would emerge in equilibrium.*

Our findings regarding the existence of asymmetric exclusive contract equilibria crucially changes if we introduce asymmetric manufacturers. To see this consider the following.

For asymmetric exclusive contract equilibrium we need

$$\pi_i^*(1, 2, \delta, c_i, c_{-i},) > 2\pi_i^*(2, 2, \delta, c_i, c_{-i}) \tag{4.11}$$

$$2\pi_{-i}^*(2, 1, \delta, c_i, c_{-i}) > \pi_{-i}^*(1, 1, \delta, c_i, c_{-i}) \tag{4.12}$$

where $i \neq -i$. If $\delta = 0$, Lemma 4.2 implies that (4.11) holds, while (4.12) is violated. On the other hand, if $\delta = 1$, (4.12) is satisfied, while (4.11) is not, using Lemma 4.1.

For any given c_i, c_{-i}, define by $\hat{\delta}_i(c_i, c_{-i})$ the degree of product differentiation, when manufacturer M_i is indifferent between offering an exclusive contract to a retailer or selling its product non-exclusively, supposing that the other manufacturer using non-exclusive contracts, that is when $\pi_i^*(1, 2, \hat{\delta}_i, c_i, c_{-i},) = 2\pi_i^*(2, 2, \hat{\delta}_i, c_i, c_{-i})$. Similarly, we can define $\hat{\delta}_{-i}(c_i, c_{-i})$ as a degree of product differentiation when $2\pi_{-i}^*(2, 1, \hat{\delta}_{-i}, c_i, c_{-i},) = \pi_{-i}^*(1, 1, \hat{\delta}_{-i}, c_i, c_{-i})$. For an asymmetric exclusive contract equilibrium we need $\hat{\delta}_i > \hat{\delta}_{-i}$ to be hold for any given (c_i, c_{-i}) pair. To assure this, we impose the following assumption:

Assumption 4.3 *A low cost manufacturer is more likely to engage in exclusive contracting, than a high cost manufacturer. that is* $\frac{d\delta(c_i, c_{-i})}{dc_i} < 0$ *for every* $i, -i = 1, 2$.

Our main result is stated in the following proposition.

Proposition 4.4 *Let* Γ *be a game satisfying Assumptions 4.1–4.3. Supposing asymmetric manufacturers* $(c_i < c_j)$ *unilateral exclusive contract will emerge in equilibrium, if the product differentiation is moderate, and the low cost manufacturer will offer an exclusive contract to one of the retailers, while the other manufacturer will sell its product offering non-exclusive contracts to the retailers.*

Chapter 5

Exclusive Contracts with Vertically Differentiated Products

Barna Bakó (2012), 'Exclusive contracts with vertically differentiated products', *Economics Bulletin*, 1312-1319.

Chapter 6

Reciprocally Exclusive Contracts and Endogenous Quality

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 (1999). 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.

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 and Shaffer (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.

6.1 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 6.1). 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.

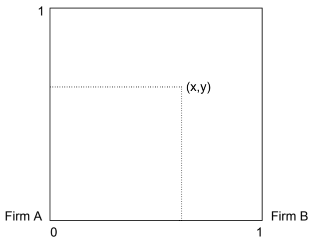

Figure 6.1: Location of firms and consumers on the unit square.

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 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 6.1

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

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 6.2 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

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

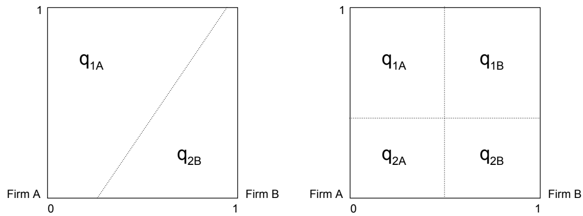

Figure 6.2: Market areas with and without exclusivity.

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

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

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

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,

$$\begin{aligned} \pi_A &= (p_{1A} - w_1)D_{1A}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) + \\ &\quad (p_{2A} - w_2)D_{2A}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) \end{aligned}$$

and

$$\begin{aligned} \pi_B &= (p_{1B} - w_1)D_{1B}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) + \\ &\quad (p_{2B} - w_2)D_{2B}(p_{1A}, p_{1B}, p_{2A}, p_{2B}) \end{aligned}$$

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 6.1 *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 6.2. 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

$$\hat{x}(y) = \frac{1}{2}(1 + qy + p_{2B} - p_{1A}) \tag{6.1}$$

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

$$D_{1A}(p_{1A}, p_{2B}) = \frac{1}{2}\left(1 + p_{2B} - p_{1A} + \frac{q}{2}\right) \tag{6.2}$$

and

$$D_{2B}(p_{1A}, p_{2B}) = \frac{1}{2}\left(1 + p_{1A} - p_{2B} - \frac{q}{2}\right) \tag{6.3}$$

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 6.2 *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,

$$\hat{x}(0) = \frac{1}{18}(9 - 4q - c_1 + c_2) \in (0,1) \tag{6.4}$$

and

$$\hat{x}(1) = \frac{1}{18}(9 + 5q - c_1 + c_2) \in (0,1) \tag{6.5}$$

hold if Assumption (6.1) is satisfied.

In the contracting stage manufacturers simultaneously decide whether to offer exclusive contracts to retailers. From Lemma (6.1) and Lemma (6.2) it follows that

Proposition 6.1 *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 (6.2). Without exclusivity the profit can be given by the Lemma (6.1). Thus, the difference of profits is

$$\frac{1}{216}(18 + q - 2c_1 + 2c_2)^2 - \frac{(2q - c_1 + c_2)^2}{9q} \tag{6.6}$$

which is always strictly positive whenever Assumption (6.1) 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 (6.1) implies that at least a manufacturer will engage in exclusivity in equilibrium.

6.2 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 (6.2), 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:

$$1 - 2c_1'(q_1) = 0 \tag{6.7}$$

$$1 - 2c_2'(q_2) = 0 \tag{6.8}$$

Proposition 6.2 *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.*

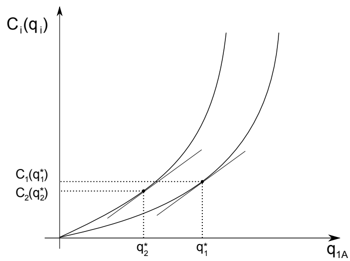

Figure 6.3: Equilibrium quality choices.

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

Proposition 6.3 *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 neither in maximum nor in minimum differentiation.*

Figure 6.3 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.

6.3 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. Our result contradicts the earlier result of product differentiation in multi-characteristics space, when firms choose to maximize differentiation in the dominant characteristic and to minimize differentiation in the others (see Irmen and Thisse (1998)).

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).

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