Deutsches Institut für Wirtschaftsforschung

DIW BERLIN

Discussion Papers

919

Pio Baake • Christian Wey

Mergers in Imperfectly Segmented Markets

Berlin, September 2009

IMPRESSUM

DIW Berlin
German Institute for Economic Research
Mohrenstr. 58
10117 Berlin
Tel. +49 (30) 897 89-0
Fax +49 (30) 897 89-200
http://www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

Mergers in Imperfectly Segmented Markets*

Pio Baake† Christian Wey‡

September 2009

Abstract

We present a model with firms selling (homogeneous) products in two imperfectly segmented markets (a "high-demand" and a "low-demand" market). Buyers are mobile but restricted by transportation costs, so that imperfect arbitrage occurs when prices differ in both markets. We show that equilibria are distorted away from Cournot outcomes to prevent consumer arbitrage. Furthermore, a merger can lead to an equilibrium in which only the "high-demand" market is served. This is more likely (i) the lower consumers' transportation costs and (ii) the higher the concentration of the industry. Therefore, merger incentives are much larger than standard analysis suggests.

JEL-Classification: D43, L13, L41

Keywords: Imperfect Market Segmentation, Oligopoly, Price Discrimination, Consumer Arbitrage, Mergers.

*We thank Ulrich Kamecke and Damien Neven for very helpful comments. The paper benefited from presentations at seminars at Ruhr University Bochum, WZB Berlin, University Cologne, University of Erlangen-Nürnberg, the CEPR/ESF Worskhop on "The Effectiveness of Competition" (Paris), and at annual conferences of EARIE, EEA, and Verein für Socialpolitik. This paper is a substantially revised and retitled version of our draft paper that circulated under the title "Spatial Price Discrimination, Buyer Mobility, and Coordinated Effects of Mergers."

†Deutsches Institut für Wirtschaftsforschung (DIW) Berlin and Technische Universität Berlin. E-mail: pbaake@diw.de.

‡Deutsches Institut für Wirtschaftsforschung (DIW) Berlin and Technische Universität Berlin. E-mail: cwey@diw.de.

1 Introduction

In this paper we analyze mergers when firms sell their (homogenous) products in geographically differentiated markets (as for example, national markets of different countries). We assume that the supply side is perfectly integrated, so that firms can serve all markets without incurring any additional costs. In contrast to standard approaches of international oligopoly theory (e.g., Brander 1995), third-degree price discrimination in oligopoly (e.g., Holmes 1989), and international merger control (e.g., Barros and Cabral 1994) which analyzed the integration of the supply side of markets, we make the possibility of demand substitution between markets explicit. This allows us to analyze how buyer mobility, or equivalently, the extent of consumer arbitrage between different markets affects firms' merger incentives and the assessment of the competitive effects of mergers.

Our analysis is motivated by the fact that markets become increasingly integrated not only from manufacturers' perspective but also from a consumer perspective. Accordingly, the phenomenon of "globalization" is often associated with the "death of distance" as transport, logistic and distribution costs have been declining and innovations in information and communications technologies have made international business as well as arbitrage much more effective (in particular, through Internet-based intermediation, as e.g., E-Bay or Amazon). At the same time (and this is particularly true for the European Union) a massive reduction of tariff and non-tariff barriers to international trade paved the way for the deepening of market integration across formerly separated regions and countries.[1]

[1] Focusing on the EU, several studies have recently analyzed the implications of increasing market integration for the definition of the relevant geographical market (Padilla 2001, Sleuwaegen, De Voldere, and Pennings 2001, and EU 2003). Interestingly, those studies focus mainly on supply-side market integration while demand-side market integration plays only a minor role. Sleuwaegen, De Voldere, and Pennings (2001) describe the competitive environment in the EU as being characterized by multi-market competition with border effects. While the supply-side tends to become more or less perfectly integrated (e.g., because of international distribution systems or distributed production facilities), border effects mirror remaining segmentations on the demand-side. However, the implications of those border effects remain unexplored.

When regional demands become more integrated (i.e., consumers find it easier to buy products in other regions), firms will find it harder to price discriminate across different regional markets. Consequently, firms have then incentives to adopt counteractive measures to restore discriminatory outcomes. Perhaps most prominently, vertical restraints (imposed by a manufacturer on regional intermediaries) and/or product differentiation strategies may be used to suppress consumer arbitrage. However, using vertical restraints to prevent resales across sales areas (or, parallel trade in an international context) may not be a feasible option because of antitrust laws.[2] Similarly, product differentiation strategies (e.g., selling "damaged goods" in low-demand regions) may not be a viable option either if the product is inherently not modifiable (as, for example, in pharmaceuticals).

In this paper we focus on horizontal mergers as a counter strategy to prevent consumer arbitrage so as to reap the benefits from price discrimination. For this purpose, we expand the standard Cournot oligopoly model by considering two markets (regions) which are connected through imperfect consumer arbitrage. We suppose a high-demand market and a low-demand market such that the market price and firms' profits are strictly larger in the high-demand market if both markets were perfectly segmented. We assume that the supply-side is perfectly integrated so that firms are indifferent from a transportation cost perspective between serving each of the markets. We suppose a mobility function which specifies for each consumer the transportation costs he has to forgo if the product is bought in the foreign region. Given the market demands and consumers' mobility costs we obtain aggregated demands where some consumers of the high-demand market buy the product in the low-demand market (where a lower price prevails if the low-demand market is served). We analyze the Cournot-Nash equilibria when firms set the quantities they supply in both markets simultaneously.

[2] For example, EC competition law embraces the objective of promotion of market integration besides the objective of economic efficiency. The objective of market integration is mirrored in the *Block Exemption Regulation* 2790/1999 and the *Guidelines on Vertical Restraints* (Commission Notice 2000/C 291/01) which state that manufacturers may restrict active resales (if a firm's market share is sufficiently small) but must not restrict passive resales, where passive resales refer exactly to the kind of consumer-driven arbitrage which is the core of our analysis.

Our main results are the following: *First*, there may exist two equilibrium constellations where either both markets are served (the "interior equilibrium") or only the high-demand market is served (the "corner equilibrium"). *Second*, the equilibrium in which only the high-demand market is served (and none of the consumers in the low demand market can afford to buy the product) becomes more likely if transportation costs decrease (or, markets become more integrated) and/or if concentration (e.g., through a merger) increases. Moreover, existence of a corner equilibrium is only guaranteed if the demands of both markets are sufficiently asymmetric. *Third*, in the interior equilibrium firms try to avoid consumer arbitrage by offering relatively large quantities in the high-demand market and relatively small quantities in the low-demand market. Hence, the equilibrium quantities offered in the high-demand (low-demand) market are larger (smaller) than the corresponding Cournot quantities that would prevail if markets were perfectly segmented.

With those results at hand, we derive our main finding that imperfect market integration (from a consumer perspective) may give rise to incentives to merge which are not discussed in the merger literature so far (see, e.g., Ivaldi et al. 2003 and Whinston 2006 for recent overviews). Those merger incentives result from firms' desire to suppress sales in a low-demand market so as to increase the profit from exclusive sales to the high-demand market. Precisely, by referring to a linear demand specification we can fully characterize the equilibrium outcomes and firms' merger incentives. We show that with more than two firms a merger is never profitable if firms remain in the interior equilibrium after the merger. However, if a merger moves the industry into the parameter region where the corner equilibrium becomes feasible, then a merger may become profitable if all firms select (the then pareto-dominant) strategies consistent with the corner equilibrium. Such a constellation becomes more likely the lower consumers' mobility costs.

We also analyze the welfare losses associated with a bilateral merger. We show that the adverse welfare effects of a merger which provokes a corner equilibrium increases whenever consumer mobility increases. The opposite is true if the industry remains in the interior equilibrium after the merger. While the latter observation mirrors the fact that increasing (demand-side) market integration should counter possible adverse merger effects, the former result shows that this optimistic view may be premature. Rather the opposite may happen: If merger incentives are driven by firms' desire to counter consumer arbitrage, then increasing (demand-side) market integration may increase the firms' incentives to merge as well as the adverse effects of a merger on social welfare.

Our paper contributes to two strands of literature: the merger literature and the literature on (third-degree) price discrimination.

With regards to merger incentives, our paper contributes to the large literature on mergers in Cournot markets. In their seminal work, Salant, Switzer, and Reynolds (1983) proved that a bilateral merger is typically not profitable when firms compete in a homogeneous product market.[3] They assumed symmetric firms, linear demand, and constant marginal costs. Those assumptions, and with that, the controversial "merger paradox," have been criticized in the subsequent literature. By that, Salant, Switzer, and Reynolds' model has been enriched by many supply-side features as, for instance, synergies (Farrell and Shapiro 1990), Bertrand behavior (Deneckere and Davidson 1985), different cost specifications (Levin 1990 and Perry and Porter 1985), Stackelberg-leadership (Daughety 1990), multi-product rivalry (Lommerud and Sörgard 1997), input market bargaining and purchasing power (Horn and Wolinsky 1988 and von Ungern-Sternberg 1996, resp.), product differentiation (Inderst and Wey 2004), and spatially differentiated suppliers (McAfee, Simons, and Williams 1992).

Interestingly, this literature has exclusively focused on supply-side aspects, while demand-side sources of adverse competitive effects of mergers have been suppressed. International aspects of mergers have been addressed in Barros and Cabral (1994) in an extension of Farrell and Shapiro's (1990) seminal paper, Horn and Levinsohn (2001), Bjorvatn (2004), Lommerud, Straume and Sörgard (2006), and Qiu and Zhou (2006). Again, this literature has focused on the effects of supply-side market integration (through imports and exports) and mergers, while disregarding the possibility of demand mobility.

Our analysis of price discrimination across regions is also related to the literature of third degree-price discrimination in oligopoly (see, e.g., Neven and Phlips 1985, Holmes 1989, and, for surveys, Varian 1989 and Stole 2003). This literature has focused largely

[3]See Selten (1973) for a similar reasoning in the context of cartel formation.

on the welfare effects of price discrimination when compared with a regime which bans price discrimination. Moreover, our analysis is related to Malueg and Schwartz (1994) and Anderson and Ginsburgh (1999) who studied a monopolist's pricing decision and the associated welfare effects in the presence of parallel trade.

In the following we first set out the general model in section 2. In section 3 we characterize the properties of the Cournot equilibria. Section 4 examines merger incentives and their effects on market outcomes by referring to a numerical example. Finally, Section 5 concludes.

2 The Model

We consider a Cournot oligopoly model with $n \geq 1$ firms offering a homogeneous product in two markets $j = h, l$, where h and l stand for the high-demand and low-demand market, respectively.[4] All firms face the same production costs which we normalize to zero. In addition, firms' costs of supplying their products in each market are the same. We also normalize those transportation and distribution costs to zero. Hence, both markets are perfectly integrated from a supply-side perspective.

In each market $j = h, l$ there is a unit mass of consumers which we refer to as j-consumers. Consumers can decide in which market they buy and how much they demand.

We first consider the demand decisions in market j. We suppose that all j-consumers have the same quasi-linear utility function

$$U_j(x, p) = u_j(x) - px, \text{ for } j = h, l, \tag{1}$$

where x is the quantity consumed and p the product price. The following assumption specifies the properties of consumers' gross utilities $u_j(x)$.

Assumption 1. *Consumers' gross utility functions $u_j(x)$, $j = h, l$, fulfill the following properties:*

i) $u_j(0) = 0$ and $u_j'(x) > 0$, $u_j''(x) < 0$, $u_j'''(x) \leq 0$, for all $x > 0$,

[4] We typically think of a market as representating a geographical region, as e.g., the national market of a country.

ii) $u_h'(x) > u_l'(x)$, $u_h''(x) \leq u_l''(x)$, *and* $u_h'''(x) \geq u_l'''(x)$, *for all* $x > 0$.

Property *i)* guarantees that demand functions are downward sloping and concave. Property *ii)* implies that marginal revenues are strictly larger in the high-demand market than in the low-demand market: Defining $X_j(p) := \arg\max_x [u_j(x) - px]$, we get $d(pX_h(p))/dp > d(pX_l(p))/dp$ for all p with $X_l(p) > 0$. Hence, the high-demand market is also the more profitable market from a firm's perspective.

Let us next turn to the consumer decision in which market to buy. If a consumer buys in the foreign market, then he incurs a constant transport cost, t, which differs among consumers. Buying in the home market does not involve similar transportation costs. Transportation costs depend on a consumer specific parameter, θ_j, and on a shift parameter, α, which measures the degree of market integration. The following assumption specifies the exact properties of consumers' transportation cost function, $t(\theta_j, \alpha)$.[5]

Assumption 2. *Consumers' transportation costs,* $t(\theta_j, \alpha)$, *for buying in the foreign market depend on a consumer specific parameter,* θ_j, $j = h, l$, *which is uniformly distributed over the interval* $[0, 1]$ *and a shift parameter,* α, *with the following properties:*

i) $t(0, \alpha) = 0$,

ii) $t_\theta(\theta_j, \alpha) > 0$ *and* $t_{\theta\theta}(\theta_j, \alpha) = 0$, *for* $\theta_j > 0$, *and*

iii) $t_\alpha(\theta_j, \alpha) < 0$, *for* $\theta_j > 0$.

Property *i)* of Assumption 2 guarantees that there exists a consumer with zero transportation costs in each market. Hence, if prices differ in both markets, then some consumers will always find it optimal to buy in the foreign market (provided demand is positive). Property *ii)* specifies that transportation costs increase linearly over the set of consumers in each market. The shift parameter α which measures the degree of market integration (from a buyer perspective) is characterized by property *iii)*. A higher value of the parameter α reduces each consumer's transportation costs. Hence, consumers become more mobile and markets more integrated with increasing values of α.

We can now specify the net utility of a j-consumer of type θ_j for given prices p_h and p_l in the high-demand and the low-demand market. Defining $V_j(p) := u_j(X_j(p)) - pX_j(p)$,

[5] Subscripts denote partial derivatives.

the net utility $\widetilde{V}_j(p_j, p_k, \theta_j, \alpha)$ of a j-consumer of type θ_j is given by

$$\widetilde{V}_j(p_j, p_k, \theta_j, \alpha) := \begin{cases} V_j(p_j) & \text{if he buys in the home market} \\ V_j(p_k) - t(\alpha, \theta_j) & \text{if he buys abroad,} \end{cases} \tag{2}$$

with $j, k = h, l$ and $k \neq j$. Using (2) and defining

$$\lambda_j(p_j, p_k, \alpha) := \min\left\{\max\left\{0, \theta \middle| V_j(p_j) = V_j(p_k) - t(\theta, \alpha)\right\}, 1\right\}, \tag{3}$$

we obtain the following aggregate demand functions $X_h^D(p_h, p_l, \alpha)$ and $X_l^D(p_h, p_l, \alpha)$ in market h and l, respectively:

$$X_h^D(p_h, p_l, \alpha) \quad : \quad = \begin{cases} (1 - \lambda_h(p_h, p_l, \alpha))X_h(p_h) & \text{for} \quad p_h \geq p_l \\ \lambda_l(p_h, p_l, \alpha)X_l(p_h) + X_h(p_h) & \text{for} \quad p_h \leq p_l, \end{cases} \tag{4}$$

$$X_l^D(p_l, p_h, \alpha) \quad : \quad = \begin{cases} \lambda_h(p_h, p_l, \alpha)X_h(p_l) + X_l(p_l) & \text{for} \quad p_h \geq p_l \\ (1 - \lambda_l(p_h, p_l, \alpha))X_l(p_l) & \text{for} \quad p_h \leq p_l. \end{cases} \tag{5}$$

The demand system (4)-(5) shows that overall demand in a market j consists of the home demand and a fraction, $\lambda_j(\cdot)$, of the demand from abroad if the market price is higher abroad. Conversely, the market with the higher price consists only of a fraction, $1 - \lambda_j(\cdot)$, of its home market demand.

Let x_j denote the total quantity supplied in market j, with $j = h, l$. The inverse demand functions $P_h(x_h, x_l, \alpha)$ and $P_l(x_h, x_l, \alpha)$ implied by the demand system (4)-(5) then satisfy[6]

$$x_h = X_h^D(P_h, P_l, \alpha) \text{ and } x_l = X_l^D(P_h, P_l, \alpha). \tag{6}$$

We assume that firms play a Cournot game where all firms choose their quantities for the high-demand and the low-demand market simultaneously. In the following we first examine the main properties of the Cournot-Nash equilibrium. In a second step we analyze firms' merger incentives and their consequences.

[6] In the following we will omit the arguments of the functions where this does not lead to any confusion.

3 General Analysis

We assume that firms simultaneously choose the quantities they supply in both markets. Let x_j^i denote the quantity which firm i ($i = 1, ..., n$) supplies in market $j = h, l$. We define the total supply of firm i's competitors in market j as

$$x_j^{-i} := \sum_{m=1,\ m \neq i}^{n} x_j^m > 0. \tag{7}$$

We can then write firm i's profit function, $\Pi_i(x_h^i, x_l^i, x_h^{-i}, x_l^{-i})$, as

$$\Pi_i(x_h^i, x_l^i, x_h^{-i}, x_l^{-i}, \alpha) = P_h(x_h, x_l, \alpha)x_h^i + P_l(x_l, x_h, \alpha)x_l^i \tag{8}$$

which is the sum of revenues generated in market h and in market l. Differentiating firm i's profit function (8) with respect to x_j^i leads to the following first-order conditions

$$\frac{\partial \Pi_i}{\partial x_j^i} = \frac{\partial P_j}{\partial x_j} x_j^i + P_j + \frac{\partial P_k}{\partial x_j} x_k^i \leq 0 \text{ and } \frac{\partial \Pi_i}{\partial x_j^i} x_j^i = 0, \tag{9}$$

for $i = 1, ..., n$ and $j, k = h, l$, with $k \neq j$, where $\partial P_j / \partial x_j$ and $\partial P_k / \partial x_j$ follow from differentiating (6) and applying the implicit function theorem.[7]

Inspection of the first-order conditions (9) shows that there may exist two types of Cournot-Nash equilibria depending on whether or not both markets are served. We will refer to an equilibrium in which both markets are served as an "interior equilibrium." There may also exist an equilibrium such that a firm's equilibrium supply is strictly positive only in the high-demand market, while supply to the low-demand market is set to zero. We will refer to this outcome as a "corner equilibrium."[8]

In the following we establish existence conditions and characterize the main properties of both equilibrium outcomes. We start with the analysis of the corner equilibrium and then turn to the interior equilibrium.

The Corner Equilibrium. In a corner equilibrium firms do not supply any quantities in the low-demand market (i.e., $x_l^* = 0$) but strictly positive quantities in the high-demand

[7] Note that the inverse demand functions are not differentiable at quantities x_h and x_l such that $P_h(x_h, x_l, \alpha) = P_l(x_h, x_l, \alpha)$ holds. The derivatives $\partial \Pi_i / \partial x_j^i$ then refer to the right-hand side derivatives.

[8] The inverse constellation with $x_h = 0$ and $x_l > 0$ cannot constitute an equilibrium outcome. This follows directly from $u_h'(x) > u_l'(x)$ for all $x > 0$ (see Assumption 1).

market (i.e., $x_h^* > 0$).[9] Then, the first-order conditions for firms' optimal quantities x_h^{i*} are given by

$$\left.\frac{\partial \Pi_i}{\partial x_h^i}\right|_{x_l=0} = \frac{\partial P_h}{\partial x_h} x_h^{i*} + P_h = 0, \text{ for } i = 1, ..., n. \tag{10}$$

Assuming the existence of a corner equilibrium, the following lemma establishes its main properties.

Lemma 1. *If a corner equilibrium with $x_h^* > 0$ and $x_l^* = 0$ exists, then it is unique. Furthermore, the equilibrium is symmetric, with $x_h^{i*}(n) = x_h^*(n)/n$ and $x_l^{i*} = 0$, for $i = 1, ..., n$. Moreover, the following properties hold:*

i) equilibrium profits $\Pi_i^*(n) := \Pi_i(x_h^{i*}, 0, x_h^{-i*}, 0, \alpha)$ are monotonically decreasing in n,

ii) $\frac{d\left[x_h^*(n)\right]}{dn} > 0 > \frac{d[x_h^{i*}(n)]}{dn}$, and

iii) $P_h(x_h^*, 0, \alpha) > \bar{p}_l := \sup\{p | \, X_l(p) > 0\}$.

Proof. See Appendix.

The properties *i)* and *ii)* of Lemma 1 establish standard comparative static results of a symmetric Cournot equilibrium. In particular, an increase in the number of firms increases total output while it decreases each firm's individual output. Property *iii)* reveals that a corner equilibrium with $x_h^* > 0$ and $x_l^* = 0$ implies the existence of a sufficiently low reservation price in the low-demand market such that $P_h(x_h^*, 0, \alpha) > \bar{p}_l$ holds. Intuitively, with $P_h(x_h^*, 0, \alpha) \leq \bar{p}_l$ the price in the high-demand market is so low that each firm has a strictly positive incentive to increase its profit by serving the residual demand in the low-demand market; i.e., those l-consumers who would not find it optimal to buy in an exclusively served high-demand market. As an immediate implication of property *iii)*, we conclude that any corner equilibrium involves a complete withdrawal of supply to the low-demand consumers.

We now examine the existence of a corner equilibrium. A corner equilibrium exists if and only if no firm finds it profitable to deviate by supplying strictly positive quantities in the low-demand market; i.e., if and only if

$$\Pi_i(x_h^i, x_l^i, x_h^{-i*}, 0, \alpha) \leq \Pi_i^*(n) \tag{11}$$

[9] Asterisks indicate equilibrium values.

holds for all $x_h^i, x_l^i > 0$. Analyzing the first-order conditions for an optimal deviation

$$\max_{x_h^i, x_l^i} \Pi_i(x_h^i, x_l^i, x_h^{-i*}, 0, \alpha),$$

the following lemma characterizes the optimal deviation behavior x_l^{id} and x_h^{id}.

Lemma 2. *Given $x_h^{-i*} > 0$ and $x_l^{-i*} = 0$, $\Pi_i(x_h^i, x_l^i, x_h^{-i*}, 0, \alpha)$ attains a (local) maximum with $x_h^{id} > 0$ and $x_l^{id} > 0$ only if the following conditions are fulfilled:*

i) $\bar{p}_l > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$ and

ii) $P_h(x_h^*, 0, \alpha) > P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$.

Moreover, $P_h X_h(P_h) > P_l X_h(P_l)$ holds.

Proof. See Appendix.

Condition *i)* of Lemma 2 mirrors the fact that a deviation can only be worthwhile if more consumers are served. Condition *ii)* shows the basic trade-off implied by offering positive quantities in the low-demand market. With $P_h > P_l$ some h-consumers buy in the low-demand market which necessarily lowers the price in the high-demand market. Hence, the lower the transportation costs, i.e., the higher α, the less attractive such a deviation should become.

Moreover, inspecting the price level in the high-demand market, we should expect that the lower the price $P_h(x_h^*(n), 0, \alpha)$ the larger the incentive to deviate. Taking into account $dx_h^*(n)/\,dn > 0$ and thus $dP_h/\,dn < 0$ the incentives to deviate should, therefore, be positively correlated with the number of firms. Analyzing the impact of α and n on a firm's incentives to deviate more carefully, we obtain the following lemma.

Lemma 3. *The maximal attainable profit from deviation, $\Pi_i^d(n, \alpha)$, fulfills the following properties.*

i) $\frac{\partial \Pi_i^d(n,\alpha)}{\partial \alpha} < 0$ and $\frac{\partial \Pi_i^d(n,\alpha)}{\partial n} < 0$, and

ii) sign $\left[\frac{\partial \Pi_i^d(n,\alpha)}{\partial n} - \frac{d\Pi_i^*(n)}{dn}\right] > 0$.

Proof. See Appendix.

Property *i)* of Lemma 3 reiterates that the optimal deviation profit decreases as competition becomes more intense both through lower transportation costs and an increase in the number of firms. More importantly, Property *ii)* states that an increase in the number of firms induces a sharper decrease of a firm's profit in the corner equilibrium when compared with the maximal deviation profit.

Combining parts *i)* and *ii)* of Lemma 3 allows us to characterize the necessary and sufficient conditions for the existence of a corner equilibrium in which only the high-demand market is served.

Proposition 1. *Suppose* $\Pi_i^d(1,\alpha) < \Pi_i^*(1)$*. Then, a corner equilibrium with* $x_h^* > 0$ *and* $x_l^* = 0$ *exists if and only if*

$$n \leq n^k(\alpha) := \left\{ n | \, \Pi_i^d(n,\alpha) = \Pi_i^*(n) \right\}.$$

Furthermore, $n^{k\prime}(\alpha) > 0$.

Proof. If $\Pi_i^d(1,\alpha) < \Pi_i^*(1)$ is true, then parts *i)* and *ii)* of Lemma 3 imply that there exists a unique $n > 1$ such that $\Pi_i^d(n,\alpha) = \Pi_i^*(n)$. Applying the implicit function theorem gives that the critical value $n^k(\alpha)$ is monotonically increasing in α. *Q.E.D.*

Proposition 1 states that the existence of a corner equilibrium critically depends on the number of firms (or, conversely, on industry concentration) and the degree of market integration. Precisely, a corner equilibrium is the more likely to exist, the smaller the number of firms (or, the higher the concentration level) and the higher the degree of market integration (or, the lower consumer transportation costs). The former effect follows from the sensitivity of firms' profits due to an increase in the number of competitors as stated in Lemma 3. The latter result follows from the positive sign of $n^{k\prime}(\alpha)$. A higher value of α (or, lower transportation cost) makes a deviation less attractive (and hence, a corner equilibrium more likely) as this induces more h-consumers to buy in the low demand market (in case of deviation).

The fact that increasing market integration (or, lower transportation cost) increases the likelihood of a corner equilibrium deserves some attention. Resale and parallel trade have become increasingly significant in markets where asymmetries in national demands prevail. Both are a particular issue in the pharmaceutical industry, where differences in national health regulations typically lead to substantial price differences. As a consequence, drug prices differ substantially across countries giving rise to strong arbitrage incentives.[10] For example, Carlton and Perloff (2005) describe the US-Canada case. While a federal law forbids US citizen from importing pharmaceuticals from Canada, they have strong incentives to do so as the prices of many popular drugs are substantially lower in Canada. Not surprisingly, major drug companies *GlaxoSmithKline* and *Pfizer* among others have been trying to reduce imports by cutting off Canadian pharmacies that resale to US consumers. According to Carlton and Perloff (2005, p. 297), "Wyeth and AstraZeneca report that they watch Canadian pharmacies and wholesale customers for spikes in sales volume that could indicate imports, and then restrict supplies."

On 16 September 2008, the European Court of Justice decided about a cut off of sales by *GlaxoSmithKline* to Greek wholesalers in 2000 (ECJ 2008).[11] Greek drug prices have long been among the lowest in Europe. Taking advantage of this price differential, Greek drug wholesalers ordered large quantities from manufacturers and re-exported them to countries where prices were higher. The cut off to wholesalers in Greece lasted for three month. The wholesalers complained that the company violated antitrust laws, while the company argued that because individual EU countries dictate different prices for their medications, they should be allowed to restrict parallel trade.[12]

Those cases illustrate that arbitrage (though imperfect) occurs and that firms have incentives to take actions to prevent the resale of their products into regions where higher prices are achievable. Those actions may lead to a complete cut off as firms find it increasingly harder to segment markets by vertical restraints or other practices. Moreover, the examples also show that the a corner equilibrium outcome becomes more likely when

[10] The effects of parallel have been examined empirically in Ganslandt and Maskus (2004). They find that parallel trade decreased drug prices by 12–19% in Sweden in 1994–1999.

[11] See for the description of this case "Court Adviser Says Glaxo Broke EU Antitrust Laws," *Wall Street Journal Europe*, 2 April 2008, p. 5.

[12] While the cut off was complete for wholesaler it was not from patients' perspective as *GlaxoSmithKline* sold directly to hospitals and pharmacies in Greece in that period. After that period the company resumed sales to the wholesalers, but filled their orders only partially, so that it was shipping only enough medication for the Greek market. Recently, the European Court of Justice decided that restricting delivery to "ordinary orders" should be judged as a "reasonable restriction" on wholesalers (see ECJ 2008).

arbitrage increases.

We now turn to the analysis of the interior equilibrium.

The Interior Equilibrium. When firms supply positive quantities in both markets, the relevant first-order conditions are given by

$$\frac{\partial \Pi_i}{\partial x_h^i} = \frac{\partial P_h}{\partial x_h} x_h^i + P_h + \frac{\partial P_l}{\partial x_l^i} x_l^i \leq 0 \text{ and } \frac{\partial \Pi_i}{\partial x_h^i} x_h^i = 0, \tag{12}$$

$$\frac{\partial \Pi_i}{\partial x_l^i} = \frac{\partial P_h}{\partial x_l} x_h^i + P_l + \frac{\partial P_l}{\partial x_l^i} x_l^i \leq 0 \text{ and } \frac{\partial \Pi_i}{\partial x_l^i} x_l^i = 0, \tag{13}$$

for $i = 1, ..., n$. Analyzing the system of first-order conditions (12) and (13), we obtain the following proposition (the superscript c marks the interior equilibrium).

Proposition 2. *If an interior equilibrium exists with $x_h^c > 0$ and $x_l^c > 0$, then it is unique and symmetric, with $x_j^{ic} = x_j^c/n$, for $i = 1, ...n$ and $j = h, l$. Furthermore, the equilibrium quantities x_h^c and x_l^c fulfill the following conditions:*

i) $P_h(x_h^*, 0, \alpha) > P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha)$ *and* $\bar{p}_l > P_l(x_l^c, x_h^c, \alpha)$,

ii) $P_h X_h(P_h) - P_l X_h(P_l) > 0$, *and*

iii) $(1 - \lambda_h) P_h X_h'(P_h) + x_h^{ic} > 0 > P_l \left(X_l'(P_l) + \lambda_l X_h'(P_l) \right) + x_l^{ic}$.

Proof. See Appendix.

The first inequality of condition *i)* of Proposition 2 states that the price in the high-demand market is lower in the interior equilibrium than in the corner equilibrium. This follows intuitively from the second inequality of condition *i)* which implies that some h-consumers buy the product in the low-demand market in the interior equilibrium. The conditions *ii)* and *iii)* together mirror the fact that firms try to avoid consumer arbitrage (i.e., prevent h-consumers from buying in the low-demand market) by offering relatively large quantities in the high-demand market and relatively small quantities in the low-demand market. More precisely, given the number of h-consumers who decide to buy in the low-demand market, the equilibrium quantities offered in the high-demand market are larger than the corresponding Cournot quantities that would prevail if markets were perfectly segmented. The opposite holds for the low-demand market such that firms' quantities are smaller than in the corresponding Cournot equilibrium. By narrowing the price differential between both markets, firms' losses from consumer arbitrage are reduced. Nevertheless, this feature also implies that firms' profits $\Pi_i^c(n,\alpha) := \Pi_i(x_h^{ic}, x_l^{ic}, x_h^{-ic}, x_l^{-ic}, n, \alpha)$ are lower than in the standard Cournot model in which consumers are perfectly immobile.

Let us next turn to the existence of the interior equilibrium. It is straightforward that the relevant deviation for the existence of the interior equilibrium is whether a firm can increase its profit by selling exclusively to the high-demand market. If firm i deviates from an interior equilibrium its deviation profit, $\widetilde{\Pi}_i(x_h^i, 0, (n-1)/n\ x_h^c, (n-1)/n\ x_l^c, \alpha)$, can be written as

$$\widetilde{\Pi}_i(\cdot) = P_h\left(x_h^i + \frac{n-1}{n}x_h^c, \frac{n-1}{n}x_l^c, \alpha\right)x_h^i. \tag{14}$$

Let $\widetilde{x}_h^{id}$ denote the quantity which maximizes the deviation profit (14) and let $\widetilde{\Pi}_i^d(\widetilde{x}_h^{id}, \cdot)$ be the corresponding maximal deviation profit. Clearly, the condition for a profitable deviation

$$\widetilde{\Pi}_i^d(\widetilde{x}_h^{id}, \cdot) > \Pi_i^c(n,\alpha),$$

is not fulfilled if

$$P_l\left(\frac{n-1}{n}x_l^c, \frac{n-1}{n}x_h^c, \alpha\right) < \overline{p}_l \tag{15}$$

holds. Hence, an interior equilibrium does exist if (given the equilibrium quantities for n firms) a reduction of the number of firms by 1 does not lead to a situation where no l-consumer actually buys. Note, however, that the inequality (15) is only a sufficient condition for the existence of an interior equilibrium.

As a more detailed comparison of $\widetilde{\Pi}_i^d(\cdot)$ and $\Pi_i^c(n,\alpha)$ depends on the functional forms in a rather complicated way, we refer in the following to an example. This example also allows us to characterize the conditions under which both corner and interior equilibria exist. Furthermore, we can perform a complete analysis of firms' merger incentives and we are able to describe the effects which mergers have on market outcomes.

4 Merger Analysis

As is well-known from the Cournot-based merger literature, merger incentives are quite small (if not absent) when firms are symmetric, products are homogenous and marginal costs are constant. While the respective literature has produced several variations since Salant, Switzer, and Reynolds' (1983) seminal paper, we follow the route of our previous analysis which gives rise to new merger incentives based on firms' incentives to counter the adverse effects of increasing market integration. As increasing buyer mobility (or, equivalently, lower transportation cost) reduces firms' profits whenever both markets are served, firms' profits may be higher when it becomes feasible to select the corner equilibrium where only the high-demand market is served. This observation together with the result that the existence of a corner equilibrium is more likely the lower the number of firms (Proposition 1) establishes the basic merger incentive on which we focus in the following.

Precisely, suppose that the number of firms before the merger is $n > 2$, and let $\Pi_i^c(n, \alpha) < \Pi_i^*(n)$. Assume also that before merger only an interior equilibrium exists, while after a two-firm merger a corner equilibrium exists as well, i.e. $n-1 < n^k(\alpha)$. Then, a merger is profitable if

$$\Pi_i^*(n-1) > 2\Pi_i^c(n, \alpha), \tag{16}$$

holds and if the industry switches after the merger to the corner equilibrium. Note, that the selection of the corner equilibrium is reasonable if the firms are better off in the corner equilibrium when compared with the corresponding interior equilibrium; i.e., if

$$\Pi_i^*(n-1) > \Pi_i^c(n-1, \alpha) \tag{17}$$

holds. Taking both properties (namely, feasibility and profitability) together, a merger can be uniquely traced back to the incentive to withdraw supplies to the low-demand market as long as conditions (16) and (17), and additionally,

$$\Pi_i^c(n-1, \alpha) < 2\Pi_i^c(n, \alpha) \tag{18}$$

hold. Note that conditions (18) and (16) imply condition (17). As the analysis of the conditions (16) and (18) involves a rather complicated comparison of firms' profit levels under different market structures, the following analysis is based on an example with linear demands. While this, of course, restricts the generality of our analysis it allows us to derive explicit results with respect to the conditions which α and n have to fulfill such that requirements (16) and (18) are satisfied.

4.1 An Example

We assume the following specification of consumers' utilities in markets $j = h, l$ and of consumers' transportation costs:

$$u_h(x) = x - \frac{1}{2}x^2,\ u_l(x) = \frac{1}{10}x - \frac{b}{2}x^2,\ t(\theta,\alpha) = \frac{1}{\alpha}\theta, \text{ and } f(\theta) = 1. \tag{19}$$

The utility functions give rise to linear demands as it has been assumed in Salant, Switzer, and Reynolds (1983). As they have shown, under perfectly segmented markets the so-called 80% rule holds, so that any bilateral merger which does not perfectly monopolize the market is never profitable. As we will show below, our profitability condition (16) significantly qualifies that result. Furthermore, comparing the results for $b = 0.2$ and $b = 0.5$ we get that mergers which induce the firms to switch from an interior to a corner equilibrium are less likely to be profitable the steeper the slope of the inverse demand function on the market with the low demand, i.e. the higher b.

Using our example (19) and considering the corner equilibrium in which only the high-demand market is served, we obtain the following equilibrium values:

$$x_h^* = \frac{n}{1+n},\ P_h(x_h^*, 0, \alpha) = \frac{1}{1+n}, \text{ and } \Pi_i^*(n) = \frac{1}{(1+n)^2}. \tag{20}$$

Inspecting (20) and applying Lemma 1, it is immediate that a corner equilibrium with $(x_h^*, 0)$ does not exist for $n \geq 9$. Turning to the deviation profit $\Pi_i^d(n,\alpha)$ and using (20) and $p_h = P_h(x_h^i + x_h^{-i*}, x_l^i, \alpha) > p_l = P_l(x_l^i, x_h^i + x_h^{-i*}, \alpha)$ we get for $\Pi_i(x_h^i, x_l^i, x_h^{-i*}, 0, \alpha)$ the expression[13]

$$\begin{aligned}\Pi_i(\cdot) \quad &= \quad \frac{(1+n)\left(\frac{1}{10} - p_l\right)p_l + bp_h\left(2-(n+1)p_h\right)}{b\,(1+n)} \\ &\quad -\frac{\alpha}{2}(p_h - p_l)^2\,(2 - p_h - p_l)\,(1 - p_h - p_l)\,,\end{aligned} \tag{21}$$

[13]In order to shorten the notation, we omit b as an argument of the respective functions.

and for the respective first-order conditions the following expressions:

$$\begin{aligned}\frac{\partial \Pi_i}{\partial x_h^i} &= 0 \Leftrightarrow \qquad (22)\\ 0 &= 4 + (1+n)\left(-4\,p_h - \alpha\,(p_h - p_l)\,(4 - 3p_l + p_h\,(-9 + 4p_h + 4p_l))\right) \text{ and}\\ \frac{\partial \Pi_i}{\partial x_l^i} &= 0 \Leftrightarrow \qquad (23)\\ 0 &= \frac{2}{10} - 4p_l + \alpha b\,(p_h - p_l)\,(4 + p_l\,(-9 + 4p_l) + p_h\,(-3 + 4p_h))\,.\end{aligned}$$

If both markets are served, we can use Proposition 2 to calculate the relevant profit functions and first-order conditions. Using symmetry and $p_h = P_h(x_h^c, x_l^c, \alpha) > p_l = P_l(x_l^c, x_h^c, \alpha)$ and $p_l < 1/\,10$, equilibrium profits $\Pi_i^c(n, \alpha)$ are given by

$$\begin{aligned}\Pi_i^c(\cdot) &= \frac{1}{2nb}\left[2b\,(1 - p_h^c)\,p_h^c + 2p_l^c\left(\frac{1}{10} - p_l^c\right)\right.\\ &\quad \left. -b(p_h^c - p_l^c)^2\,(2 - p_h^c + p_l^c)\,(1 - p_h^c - p_l^c)\,\alpha\right], \qquad (24)\end{aligned}$$

where $p_h^c = P_h(x_h^c, x_l^c, \alpha) > p_l^c = P_l(x_l^c, x_h^c, \alpha)$ are determined by the following two equations

$$\begin{aligned}0 &= -2 + 2\,(1+n)\,p_h + \alpha\,(p_h - p_l)\,[(-1 + p_h)\,(-2 + p_h + p_l) \qquad (25)\\ &\quad +n\,\,(2 - 2p_l + 3p_h\,\,(-2 + p_h + p_l))]\,, \text{ and}\\ 0 &= \frac{2}{10} - 2\,(1+n)\,p_l + \alpha b\,(p_h - p_l)\,[(-1 + p_l)\,(-2 + p_h + p_l) \qquad (26)\\ &\quad +n\,(2 + 3\,(-2 + p_l)\,p_l + p_h\,(-2 + 3p_l))]\,.\end{aligned}$$

Finally, assuming existence of an interior equilibrium, the deviation profit $\widetilde{\Pi}_i(\cdot)$ can be written as

$$\begin{aligned}\widetilde{\Pi}_i(\cdot) &= \frac{1}{2}\widetilde{p}_h\left[\frac{(1-n)(1-p_h^c)(2 + \alpha(p_h^c - p_l^c)(p_h^c + p_l^c - 2))}{n}\right.\\ &\quad \left. +(1 - \widetilde{p}_h)(2 + \alpha(\widetilde{p}_h - \widetilde{p}_l)(\widetilde{p}_h + \widetilde{p}_l - 2))\right], \qquad (27)\end{aligned}$$

with

$$\begin{aligned}\widetilde{p}_h &:= P_h(x_h^i + [(n-1)/n]\,x_h^c, [(n-1)/n]\,x_l^c, \alpha) \text{ and}\\ \widetilde{p}_l &:= P_l([(n-1)/n]\,x_l^c, x_h^i + [(n-1)/n]\,x_h^c, \alpha).\end{aligned}$$

The optimal deviation supply $\widetilde{x}_h^{id}$ is then implicitly determined by

$$\begin{aligned} \frac{\partial \widetilde{\Pi}_i^d(\cdot)}{\partial x_h^i} &= 0 \Leftrightarrow \qquad (28)\\ 0 &= \frac{1}{2}\left[-2\widetilde{p}_h - \frac{3\alpha\widetilde{p}_h(\widetilde{p}_h-\widetilde{p}_l)^2(\widetilde{p}_h+\widetilde{p}_l-2)^2}{2-\widetilde{p}_h(2-\widetilde{p}_h)+3\widetilde{p}_l(\widetilde{p}_l-2))}\right. \\ &\quad +\frac{(1-n)(1-p_h^c)(2+\alpha(p_h^c-p_l^c)(p_h^c+p_l^c-2))}{n} \\ &\quad \left. +(1-\widetilde{p}_h)(2+\alpha(\widetilde{p}_h-\widetilde{p}_l)(\widetilde{p}_h+\widetilde{p}_l-2))\right] \end{aligned}$$

We are now in a position to fully analyze the existence of the two equilibria and firms' incentives to merge.

4.2 Results

Starting with existence, using expressions (20)-(28) and comparing firms' profits, we obtain that there exists a unique critical value, $n^c(\alpha)$, such that the interior equilibrium does only exist if $n > n^c(\alpha)$ holds.[14] Furthermore, calculating $n^k(\alpha)$ we get that $n^k(\alpha) > n^c(\alpha)$ holds, for all α, with $n^k(\alpha) > 1$. Hence, there exist parameter constellations of n and α such that both a corner equilibrium and an interior equilibrium coexist (that region of parameter constellations is indicated by the shaded areas in Figure 1 and 2 below).

Turning to firms' incentives to merge and analyzing equations (24) and (26) yields that

$$2\Pi_i^c(n,\alpha) > \Pi_i^c(n-1,\alpha)$$

holds for all $n \geq 3$ and for both parameter values $b = 0.2$ and $b = 0.5$.[15] Therefore, if $n \geq 3$ a bilateral merger is never profitable as long as the interior equilibrium remains valid after the merger. This result mirrors exactly the 80% rule of Salant, Switzer, and Reynolds (1983).

However, a comparison of firms' profits in the interior equilibrium and in the corner equilibrium reveals that there exists a unique critical value, $n^f(\alpha)$, such that for all $n <$

[14] Note that $n^c(\alpha)$ as well as $n^k(\alpha)$ and $n^f(\alpha)$ (which is defined below) also depend on b. Again, to save notation we omit b as an argument of those functions.

[15] As the respective first-order conditions are highly non-linear in prices, we used numerical methods to solve the equation system.

$n^f(\alpha)$ a merger is profitable as long as it also implies that firms switch to the corner equilibrium after the merger; i.e., the condition for a profitable merger

$$n < n^f(\alpha) \Leftrightarrow \Pi_i^*(n-1) > 2\Pi_i(x_h^c, x_l^c, n, \alpha)$$

is fulfilled. Starting with $b = 0.2$ and neglecting integer constraints the graphs for $n^f(\alpha)$, $n^k(\alpha)$ and $n^c(\alpha)$ are depicted in Figure 1.

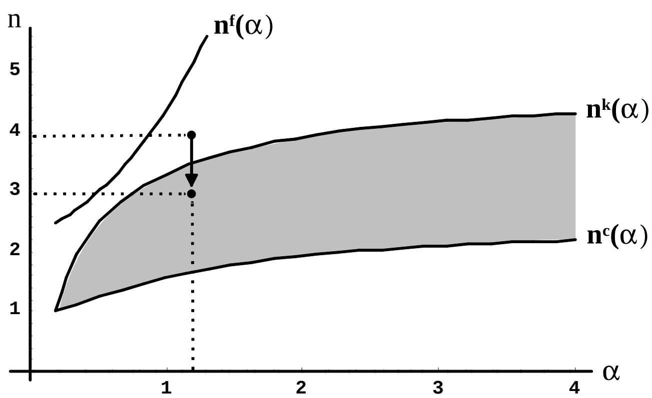

Figure 1: $n^f(\alpha)$, $n^k(\alpha)$ and $n^c(\alpha)$ for $b = 0.2$

From Figure 1 we observe that any merger which fulfills $n^c(\alpha) \leq n-1 \leq n^k(\alpha) < n$ is profitable; i.e., meets the requirement $n < n^f(\alpha)$, if all firms select the corner equilibrium after the merger. Considering the parameter values $\alpha \approx 1.2$ and $n = 4$ a merger between two firms moves the industry into the region where the corner equilibrium becomes both feasible and profitable.

Setting $b = 0.5$, we obtain the graphs depicted in Figure 2.

Comparing Figures 1 and 2 shows that an increase in b leads to an upward shift of $n^k(\alpha)$ and $n^c(\alpha)$. The higher b the steeper the inverse demand curve of l-consumers, and thus, the lower the profits from deviating. Considering relative low values of α reveals that although a merger may allow to achieve the corner equilibrium, such a merger may not be profitable due to the losses the firms would have to bear by not serving the l-consumers. This situation occurs for all α and n such that $n > n^k(\alpha) > n-1$ and $n > n^f(\alpha)$. For example, with $\alpha \approx 0.8$ and $n = 5$ a merger is not profitable.

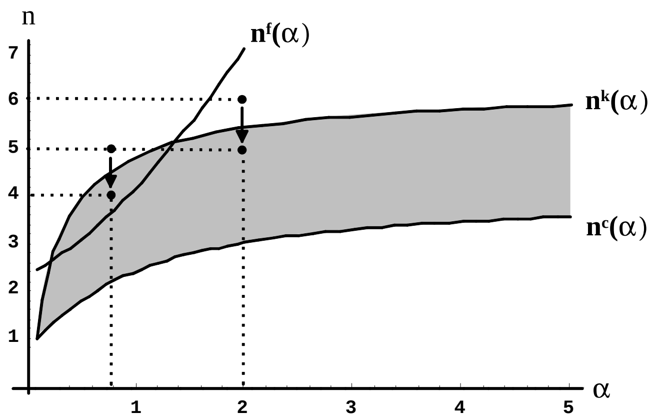

Figure 2: $n^f(\alpha)$, $n^k(\alpha)$ and $n^c(\alpha)$ for $b = 0.5$

However, as α increases merger incentives tend to increase. For example, with $\alpha = 2$ and $n = 6$ a merger of two firms is profitable, again. Quite interestingly, this example also shows that a bilateral merger may be more likely to be profitable in a less concentrated market.

Finally, we analyze the welfare consequences of a merger which induces firms' to select the corner equilibrium. We define social welfare as the sum of consumer rents and the firms' profits which gives the welfare formulas

$$
\begin{aligned}
W^*(n) \quad &: \quad = \sum_{i=1}^{n} \Pi_i^*(n) + V_h(P_h(x_h^*, 0, \alpha)) \text{ and} \\
W^c(\alpha, n) \quad &: \quad = \sum_{i=1}^{n} \Pi_i^c(n, \alpha) + (1 - \lambda_h)V_h(P_h) + \lambda_h V_h(P_l) + V_l(P_l) \\
&\qquad - \int_0^{\lambda_h(\cdot)} t(\theta, \alpha) d\theta,
\end{aligned}
$$

where $W^*(n)$ and $W^c(\alpha, n)$ stand for the social welfare in the corner equilibrium and in the interior equilibrium, respectively (P_h, P_l and λ_h are evaluated at the the respective equilibrium quantities x_h^*, x_h^c and x_l^c).

Figure 3 indicates that the welfare loss due to a merger that induces a switch from an interior equilibrium to a corner equilibrium is substantially higher than the welfare loss which would result if firms stick to the strategies consistent with the interior equilibrium. For example, consider the left graph of Figure 3 which compares the corresponding welfare losses associated with a bilateral merger in a four-firm industry (with $b = 0.2$). Inspecting the graph, the welfare loss is roughly four times higher when the merger induces the industry to switch into the corner equilibrium when compared with an "interior-equilibrium" merger.

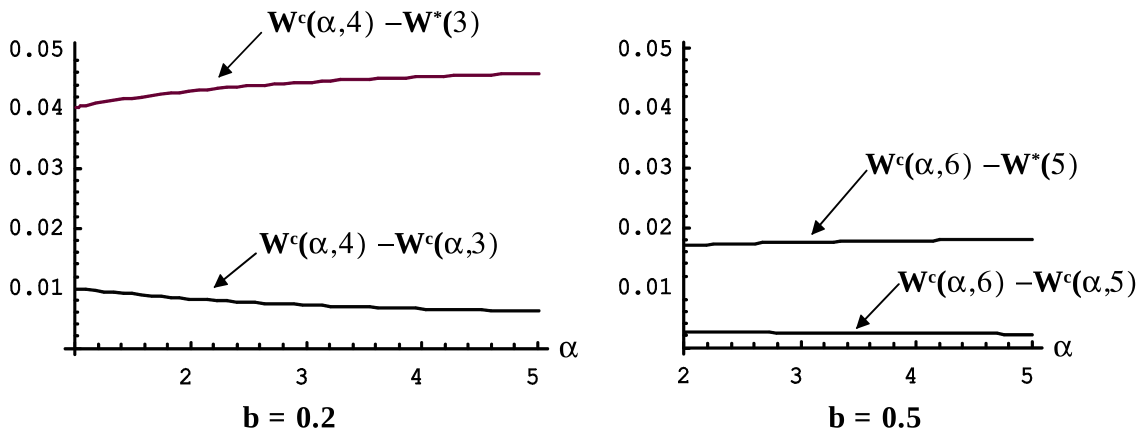

Figure 3: Welfare effects of mergers

Figure 3 also shows that the welfare loss $W^c(\alpha, n) - W^*(n-1)$ is increasing in α, so that the adverse welfare effects of a merger which provokes a corner equilibrium increases whenever consumer mobility increases. The opposite is true if the industry remains in the interior equilibrium after the merger; i.e., $W^c(\alpha, n) - W^c(\alpha, n-1)$ is decreasing in α. While the latter observation mirrors the generally agreed upon assessment that increasing (demand-side) market integration should counter possible adverse merger effects, the former result shows that this optimistic view may be premature. If merger incentives are driven by firms' desire to counter consumer arbitrage, then increasing (demand-side) market integration increases both firms' merger incentives and the adverse effects of a merger on social welfare.

5 Conclusion

We have presented a Cournot model with symmetric firms which sell their (homogeneous) products in different and asymmetric markets which are neither perfectly integrated nor perfectly segmented (from a consumer perspective). Buyers are mobile but restricted by transportation costs, so that (imperfect) arbitrage occurs when prices differ in both market regions. We showed that firms' incentives to discriminate between both markets together with buyer mobility give rise to new strategic and competitive effects of mergers. As long as both markets are served market equilibria are distorted away from Cournot outcomes. A merger reduces this distortion by widening the price differential between both market regions. Most importantly, a merger can lead to an equilibrium outcome in which only the high-demand market region is served. As profits are never lower in such a corner equilibrium when compared with the interior equilibrium (where both markets are served), we expect that firms' may have monopolizing merger incentives in order to move the industry into the corner equilibrium. This merger incentives becomes the stronger *i)* the more integrated markets become (i.e., the lower consumer transportation costs), and/or *ii)* the higher the concentration of the industry.

Our analysis has several implications for antitrust authorities' merger control. As has been argued by proponents of an "effects based approach" to competition policy, our analysis also points at the dangers of a two-step procedure, where the market is defined in the first stage and the analysis of the competitive effects of a merger remains mainly confined to the then defined relevant market in a second step.[16] While much of the critique has focused on additional supply-side sources of competition which have been alleged to be not properly taken into account by the standard market definition procedure, we argue that a too narrow market definition (which cuts out imperfect demand-side arbitrage relations between market areas) may lead to type-2 errors (i.e., approving falsely anti-competitive mergers) which can lead to substantial consumer harm (i.e., a discriminatory equilibrium outcome where low-demand regions are not served anymore and the price effects are much larger in the high-demand market than standard analysis would suggest). The anticompetitive discriminatory merger incentive of our analysis can only be detected if the geographical market is defined rather broadly so that those regions are included

[16] See, for instance, *Economic Advisory Group for Competition Policy EAGCP*: "An Economic Approach Towards Art. 82," Juli 2005.

in the analysis which are only loosely connected with the main market. As standard market definition tests (e.g., the SSNIP test) focus on the smallest relevant market worth monopolizing, those tests run into danger of defining markets too narrow.[17] In those settings, our analysis has shown that firms may want to merge in order to avoid intrabrand cannibalization (which occurs when all markets are served) by tipping the market into a discriminatory equilibrium through a merger in which only the high-demand country is served.

We finally, conjecture that our analysis is particularly relevant for the pharmaceutical industry, where significant asymmetries between countries (and hence, price differences) prevail because of institutional differences in health regulations. Several studies show that large pharmaceutical firms have strong incentives to sustain price discrimination through market segmentation strategies; if necessary by completely abstaining from selling to all wholesalers in a country as our description if the GlaxoSmithKline case has shown. While firms typically use various sorts of vertical restraints to sustain price discrimination, we suspect that horizontal mergers may serve similar purposes.

[17] Our point is related to Davidson (1983) who emphasized that segmented markets may give rise to pronounced anticompetitive effects which are not mirrored in more standard market definition tests and HHI criteria. See also Bernheim and Whinston (1990) for a model which suggests to consider multi-market contact features in merger control.

Appendix

Proof of Lemma 1. Assume $P_h(x_h^*, 0, \alpha) > \bar{p}_l$ and note that this also implies that only h-consumers buy the product in the home market. Note also that $\Pi_i(x_h^{i*}, 0, x_h^{-i*}, 0, \alpha)$ does not depend on α.[18] Inspection of firms' first-order conditions (10) implies symmetry. Employing standard arguments with respect to the slope of the firms' reaction functions establishes uniqueness. Hence, we obtain $x_h^{i*}(n)$ and $x_h^{i*}(n) = x_h^*(n)/n$. Furthermore, it is easy to show that $x_h^{i*}(n)$ and $\Pi_i^*(n)$ have the following (standard) properties

$$\frac{d[x_h^{i*}(n)]}{dn} < 0 < \frac{d[x_h^*(n)]}{dn} \text{ and} \tag{29}$$

$$\frac{d\Pi_i^*(n)}{dn} = -P_h(nx_h^*(n), 0, \alpha)\frac{d\left[(n-1)x_h^*(n)\right]}{dn} < 0, \tag{30}$$

where (30) follows from (29) and the envelope theorem. For later reference note also that we have

$$sign\left[\left.\frac{\partial \Pi_i}{\partial x_h^i}\right|_{x_l=0}\right] = sign\left[P_h(x_h^i + x_h^{-i}, 0, \alpha)X_h'(P_h(x_h^i + x_h^{-i}, 0, \alpha)) + x_h^i\right]. \tag{31}$$

To show that $P_h(x_h^*, 0, \alpha) > \bar{p}_l$ must hold assume first that $P_h(x_h^*, 0, \alpha) = \bar{p}_l$ holds. $P_h(x_h^*, 0, \alpha) = \bar{p}_l$ implies that the marginal revenue of increasing x_l^i is strictly positive while the loss from h-consumers buying in the low-demand market l is only of second order. Hence, each firm would have an incentive to deviate by choosing $x_l^i > 0$, so that $P_h(x_h^*, 0, \alpha) = \bar{p}_l$ can not hold in a corner equilibrium. Assuming $P_h(x_h^*, 0, \alpha) < \bar{p}_l$ and using w.l.o.g. $P_l(x_h^*, 0, \alpha) = \bar{p}_l$, a fraction $\lambda_l(P_h(x_h^*, 0, \alpha), \bar{p}_l, \alpha)$ of l-consumers would buy in market h. Let $\tilde{X}_l := \lambda_l(P_h(x_h^*, 0, \alpha), \bar{p}_l, \alpha)X_l(P_h(x_h^*, 0, \alpha))$ and consider the following change in firm i's supply: Instead of supplying $x_h^{i*} > 0$ and $x_l^{i*} = 0$ firm i chooses $\tilde{x}_h^i = \max\{0, x_h^{i*} - \tilde{X}_l\}$ and $\tilde{x}_l^i = \tilde{X}_l$. As this implies $\tilde{x}_h^i + \tilde{x}_l^i \geq x_h^{i*}$ and

$$P_h(\tilde{x}_h^i + x_h^{-i}, \tilde{x}_l^i, \alpha) \geq P_h(x_h^*, 0, \alpha) \text{ and } P_l(\tilde{x}_l^i, \tilde{x}_h^i + x_h^{-i}, \alpha) > P_h(x_h^*, 0, \alpha) \tag{32}$$

firm i's profit is higher when it chooses $(\tilde{x}_h^i, \tilde{x}_l^i)$ instead of $(x_h^{i*}, 0)$. Therefore, in any corner equilibrium with $x_h^* > 0$ and $x_l^* = 0$ it must hold that $P_h(x_h^*, 0, \alpha) > \bar{p}_l$. *Q.E.D.*

[18] Recall that the arguments of the profit function are written in the following order: $\Pi_i(x_h^{i*}, x_l^{i*}, x_h^{-i*}, x_l^{-i*}, \alpha)$.

Proof of Lemma 2. $P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha) < \bar{p}_l$ is implied by Lemma 1. The proof of part $ii)$ proceeds in two steps: We first show $P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$ and then turn to $P_h(x_h^*, 0, \alpha) > P_h(x_h^{id} + x_h^{-i*}, x_l^i, \alpha)$ and $P_h X_h(P_h) > P_l X_h(P_l)$.

Step 1. In order to show $P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$, assume to the contrary that $P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) < P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$. Solving

$$\frac{\partial \Pi_i}{\partial x_h^i} = \frac{\partial P_h}{\partial x_h} x_h^i + P_h + \frac{\partial P_l}{\partial x_l^i} x_l^i = 0 \text{ and } \frac{\partial \Pi_i}{\partial x_l^i} = \frac{\partial P_h}{\partial x_l} x_h^i + P_l + \frac{\partial P_l}{\partial x_l^i} x_l^i = 0 \tag{33}$$

we get that the optimal quantities x_h^{id} and x_l^{id} are implicitly defined by

$$\begin{aligned} t_\theta(\theta_l, \alpha) &= \frac{X_l(P_h)\left(P_h X_l(P_h) - P_l X_l(P_l)\right)}{P_h\left(X_h'(P_h) + \lambda_l X_l'(P_h)\right) + x_h^i} \\ &= -\frac{X_l(P_l)\left(P_h X_l(P_h) - P_l X_l(P_l)\right)}{(1-\lambda_l)(P_l X_l'(P_l) + x_l^i)} > 0, \end{aligned} \tag{34}$$

where we used $x_h^i + x_h^{-i*} \equiv X_h(P_h) + \lambda_l(P_h, P_l, \alpha) X_l(P_h)$ and $x_l^i \equiv (1 - \lambda_l(P_h, P_l, \alpha)) X_l(P_l)$ as well as $\partial \lambda_l / \partial P_h = -\, X_l(P_h)/\, t_\theta(\theta_l, \alpha)$ and $\partial \lambda_l / \partial P_l = X_l(P_l)/\, t_\theta(\theta_l, \alpha)$.

Analyzing (34) and taking into account part ii) of Assumption 1 as well as $t_\theta(\cdot) > 0$ shows that $P_h X_l(P_h) - P_l X_l(P_l) < 0$ implies $P_h\left(X_h'(P_h) + \lambda_l X_l'(P_h)\right) + x_h^{id} < 0$ and $P_l X_l'(P_l) + x_l^{id} > 0$ which contradicts $P_h < P_l$. With $P_h X_l(P_h) - P_l X_l(P_l) > 0$ we arrive at $P_h\left(X_h'(P_h) + \lambda_l) X_l'(P_h)\right) + x_h^{id} > 0$ and $P_l X_l'(P_l) + x_l^{id} < 0$. However, considering quantities $\hat{x}_h^i$ and $\hat{x}_l^i$ such that

$$\begin{aligned} P_h(\hat{x}_h^i + x_h^{-i*}, \hat{x}_l^i, \alpha) &= P_l(\hat{x}_l^i, \hat{x}_h^i + x_h^{-i*}, \alpha) = \max[P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha), p_l^m] \\ \text{with} &: \quad p_l^m := \arg\max p_l X_l(p_l) \end{aligned}$$

reveals that a deviation which leads to $P_h\left(X_h'(P_h) + \lambda_l) X_l'(P_h)\right) + x_h^{id} > 0$ and $P_l X_l'(P_l) + x_l^{id} < 0$ can not be optimal.

Considering $P_h = P_l = P$ we must have

$$\left.\frac{\partial \Pi^i}{\partial x_h^i}\right|_{x_h^i < x_h^{id}} > 0; \quad \left.\frac{\partial \Pi^i}{\partial x_h^i}\right|_{x_h^i > x_h^{id}} < 0 \text{ and } \left.\frac{\partial \Pi^i}{\partial x_l^i}\right|_{x_l^i < x_l^{id}} > 0; \quad \left.\frac{\partial \Pi^i}{\partial x_l^i}\right|_{x_l^i > x_l^{id}} < 0, \tag{35}$$

for x_h^i and x_l^i close enough to x_h^{i*} and x_l^{i*}, respectively.

Using $\partial \lambda_h / \partial P_h = X_h(P_h)/\, t_\theta(\theta_h, \alpha)$ and $\partial \lambda_h / \partial P_l = -\, X_h(P_l)/\, t_\theta(\theta_h, \alpha)$ as well as $\partial \lambda_l / \partial P_h = -\, X_l(P_h)/\, t_\theta(\theta_l, \alpha)$ and $\partial \lambda_l / \partial P_l = X_l(P_l)/\, t_\theta(\theta_h, \alpha)$ and taking limits we get

(omitting arguments)

$$\lim_{x_h^i \nearrow x_h^{id}} \frac{\partial \Pi^i}{\partial x_h^i} = P + \frac{x_h^{id}}{X_h} + \frac{X_h^2(x_h^{id}X_l' - x_l^{id}X_h')}{X_h'\left[t_\theta(\cdot)X_h'X_l' - X_h^2(X_h'+X_l')\right]}, \tag{36}$$

$$\lim_{x_h^i \searrow x_h^{id}} \frac{\partial \Pi^i}{\partial x_h^i} = P + \frac{x_h^{id}}{X_h} + \frac{X_l^2(x_h^{id}X_l' - x_l^{id}X_h')}{X_h'\left[t_\theta(\cdot)X_h'X_l' - X_l^2(X_h'+X_l')\right]}, \tag{37}$$

$$\lim_{x_l^i \nearrow x_l^{id}} \frac{\partial \Pi^i}{\partial x_l^i} = P + \frac{x_l^{id}}{X_l} + \frac{X_h^2(x_l^{id}X_h' - x_h^{id}X_l')}{X_l'\left[t_\theta(\cdot)X_h'X_l' - X_h'^2(X_h'+X_l')\right]}, \tag{38}$$

$$\lim_{x_l^i \searrow x_l^{id}} \frac{\partial \Pi^i}{\partial x_l^i} = P + \frac{x_l^{id}}{X_l} + \frac{X_l^2(x_l^{id}X_h' - x_h^{id}X_l')}{X_l'\left[t_\theta(\cdot)X_h'X_l' - X_l'^2(X_h'+X_l')\right]}. \tag{39}$$

Comparing (36) and (37) as well as (38) and (39) and taking into account $X_h(p) > X_l(p)$ shows that (35) can not hold. Thus, we must have $P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$.

Step 2. Turning to $P_h(x_h^*, 0, \alpha) > P_h(x_h^{id} + x_h^{-i*}, x_l^i, \alpha)$ and $P_h X_h(P_h) > P_l X_h(P_l)$, using $P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha) > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$ and $\bar{p}_l > P_l(x_l^{id}, x_h^{id} + x_h^{-i*}, \alpha)$, the first-order conditions (33) can be written as

$$\begin{aligned} t_\theta(\theta_h, \alpha) &= -\frac{X_h(P_l)\left(P_l X_h(P_l) - P_h X_h(P_h)\right)}{(1-\lambda_h)P_h X_h'(P_h) + x_h^i} \\ &= \frac{X_h(P_l)\left(P_l X_h(P_l) - P_h X_h(P_h)\right)}{P_l\left(X_l'(P_l) + \lambda_l X_h'(P_l)\right) + x_l^i} > 0, \end{aligned} \tag{40}$$

where we used $x_h^i + x_h^{-i} \equiv (1 - \lambda_h(P_h, P_l, \alpha))X_h(P_h)$ and $x_l^i \equiv \lambda_h(P_h, P_l, \alpha)X_h(P_l) + X_l(P_l)$ as well $\partial\lambda_h / \partial P_h = X_h(P_h) / t_\theta(\theta_h, \alpha)$ and $\partial\lambda_h / \partial P_l = -X_l(P_h) / t_\theta(\theta_h, \alpha)$.

To prove $P_h X_h(P_h) > P_l X_h(P_l)$, assume to the contrary that $P_l X_h(P_l) - P_h X_h(P_h) > 0$. Then, (40) implies $(1 - \lambda_l)P_l X_l'(P_l) + x_h^{id} < 0$ and $P_l\left(X_l'(P_l) + \lambda_l)X_h'(P_l)\right) + x_l^{id} > 0$ which can not be optimal since firm i can increase its profit by simply increasing x_h^i and decreasing x_l^i. Hence we must have $P_l X_h(P_l) - P_h X_h(P_h) < 0$ which also implies $(1 - \lambda_h)P_h X_h'(P_h) + x_h^{id} > 0$ and, therefore, $P_h(x_h^*, 0, \alpha) > P_h(x_h^{id} + x_h^{-i*}, x_l^{id}, \alpha)$ (see (31)). *Q.E.D.*

Proof of Lemma 3. Part *i)* is based on applying the envelope theorem which yields

$$\frac{\partial \Pi_i^d(n, \alpha)}{\partial \alpha} = \frac{\partial \lambda_h}{\partial \alpha}\left[P_l X_h(P_l) - P_h X_h(P_h)\right] < 0 \text{ (by Lemma 2), and} \tag{41}$$

$$\frac{\partial \Pi_i^d(n, \alpha)}{\partial n} = -P_h(x_h^{id} + (n-1)x_h^*, x_l^{id}, \alpha)\frac{d}{dn}\left[(n-1)x_h^*(n)\right] < 0. \tag{42}$$

Using (30) and (42) leads to

$$\begin{aligned} & \frac{\partial \Pi_i^d(n,\alpha)}{\partial n} - \frac{d\Pi_i^*(n)}{dn} && (43) \\ = & \left[-P_h(x_h^{id} + (n-1)x_h^{i*}, x_l^{id}, \alpha) + P_h(x_h^*, 0, \alpha)\right] \frac{d}{dn}\left[(n-1)x_h^*(n)\right] > 0, \end{aligned}$$

where the sign follows from Lemma 2. *Q.E.D.*

Proof of Proposition 2. Note first, that the proof of Lemma 2 (see (35)—(39)) implies that an equilibrium with $P_h = P_l$ does not exist. Using $P_h \neq P_l$ we proceed by proving symmetry and then turn to the qualitative properties of the interior equilibrium. Finally, we prove uniqueness.

Symmetry. Assume to the contrary that asymmetric equilibria exist, where firms supply on either different markets or at least one firm is not active on both markets. Then there would exist i and j with $i \neq j$ such that

$$\frac{\partial \Pi_i}{\partial x_h^i} = 0; \ \left.\frac{\partial \Pi_i}{\partial x_l^i}\right|_{x_l^i=0} \leq 0 \text{ and } \frac{\partial \Pi_j}{\partial x_l^j} = 0, \ \left.\frac{\partial \Pi_j}{\partial x_h^j}\right|_{x_h^j=0} \leq 0; \quad (44)$$

$$\frac{\partial \Pi_i}{\partial x_h^i} = \frac{\partial \Pi_i}{\partial x_l^i} = 0 \text{ and } \frac{\partial \Pi_j}{\partial x_h^j} = 0, \ \left.\frac{\partial \Pi_j}{\partial x_l^j}\right|_{x_l^j=0} \leq 0 \text{ or} \quad (45)$$

$$\frac{\partial \Pi_i}{\partial x_h^i} = \frac{\partial \Pi_i}{\partial x_l^i} = 0 \text{ and } \left.\frac{\partial \Pi_j}{\partial x_h^j}\right|_{x_h^j=0} \leq 0, \ \frac{\partial \Pi_j}{\partial x_l^j} = 0. \quad (46)$$

Assuming $P_h > P_l$ and solving these conditions for the respective equilibrium quantities, (44) implies that prices must satisfy

$$P_h \frac{\partial P_l / \partial x_l}{\partial P_l / \partial x_h} < P_l < P_h \frac{\partial P_h / \partial x_l}{\partial P_h / \partial x_h} \quad (47)$$

$$\Rightarrow \frac{\partial P_h}{\partial x_l}\frac{\partial P_l}{\partial x_h} - \frac{\partial P_h}{\partial x_h}\frac{\partial P_l}{\partial x_l} > 0. \quad (48)$$

Similarly, employing (45) we get

$$P_l \frac{\partial P_h}{\partial x_h} - P_h \frac{\partial P_h}{\partial x_l} > 0 \text{ and } x_l^i = \frac{P_l \, \partial P_h / \partial x_h - P_h \, \partial P_h / \partial x_l}{\partial P_h / \partial x_l \, \partial P_l / \partial x_h - \partial P_h / \partial x_h \, \partial P_l / \partial x_l}, \quad (49)$$

while (46) leads to

$$P_h \frac{\partial P_l}{\partial x_l} - P_l \frac{\partial P_l}{\partial x_h} > 0 \text{ and } x_h^i = \frac{P_h \, \partial P_l / \partial x_l - P_l \, \partial P_l / \partial x_h}{\partial P_h / \partial x_l \, \partial P_l / \partial x_h - \partial P_h / \partial x_h \, \partial P_l / \partial x_l}. \quad (50)$$

Note that both (49) and (50) imply (48). However, differentiating (6) with respect to x_h and x_l and taking into account $P_h > P_l$ and $X_h'(P), X_l'(P) < 0$ shows that

$$\begin{aligned} \frac{X_h(P_l)^2 - t_\theta\left(\lambda_h X_h'(P_l) + X_l'(P_l)\right)}{X_h(P_h)X_h(P_l)} &> \frac{X_h(P_h)X_h(P_l)}{X_h(P_h)^2 - t_\theta(1-\lambda_h)X_h'(P_h)} \Rightarrow \\ \frac{\partial P_h}{\partial x_h}\Big/\frac{\partial P_h}{\partial x_l} &> \frac{\partial P_l}{\partial x_h}\Big/\frac{\partial P_l}{\partial x_l} \end{aligned} \tag{51}$$

Thus, (48) must be violated and an asymmetric equilibrium with $P_h > P_l$ can not exists. Following the same reasoning leads to the same result if one considers $P_l > P_h$. Finally, the first-order conditions $\partial\Pi_i/\partial x_h^i = \partial\Pi_i/\partial x_l^i = 0$ imply that the firms must offer the same quantities.

Qualitative properties. The following proof is similar to the proof of Lemma 2 and proceeds in several steps: We first show that an equilibrium with $x_h^c, x_l^c > 0$ must lead to $P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha)$ and $\bar{p}_l > P_l(x_l^c, x_h^c, \alpha)$. We then turn to $P_h(x_h^*, 0, \alpha) > P_h(x_h^c, x_l^c, \alpha)$ and $P_h X_h(P_h) - P_l X_h(p_l) > 0$.

Assuming $P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha) > \bar{p}_l$ we can rewrite the first-order conditions as

$$\begin{aligned} t_\theta(\theta_h, \alpha) &= -\frac{X_h(P_h)\left(P_l X_h(P_l) - P_h X_h(P_h)\right)}{(1-\lambda_h)(P_h X_h'(P_h) + x_h^i)} \\ &= \frac{X_l(P_h)\left(P_l X_h(P_l) - P_h X_h(P_h)\right)}{\lambda_h(P_l X_h'(P_l) + x_l^i)} > 0. \end{aligned} \tag{52}$$

With $P_l X_h(P_l) - P_h X_h(P_h) < 0$, (52) leads to $P_h X_h'(P_h) + x_h^{ic} > 0 > P_l X_h'(P_l) + x_l^{ic}$ which contradicts $P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha)$. Thus, we must also have $P_l X_h(P_l) - P_h X_h(P_h) > 0$ and $P_h X_h'(P_h) + x_h^{ic} < 0 < P_l X_l'(P_l) + x_l^{ic}$ which implies that $P_h(x_h^c, x_l^c, \alpha)$ is higher and $P_l(x_l^c, x_h^c, \alpha)$ is lower than the Cournot price $P_h(x_h^*, 0, \alpha)$. Note further that every firm i serves a fraction $(1/n)\lambda_h$ of $h-$consumers in the low-demand market. Using this observation, consider now a deviation of firm i such that it offers quantities $\tilde{x}_h^i > x_h^{ic}$ and $x_l^{ic} = 0$ such that $(1/n)\lambda_h$ h-consumers would switch back and buy in the high-demand market. Taking into account that buying abroad is costly, we get $P_h(x_h^c, x_l^c, \alpha) > P_h(\tilde{x}_h^i + x_h^{-ic}, x_l^{-ic}, \alpha)$ and $P_h(\tilde{x}_h^i + x_h^{-ic}, x_l^{-ic}, \alpha)\tilde{x}_h^i > P_h(x_h^c, x_l^c, \alpha)x_h^{ic} + P_l(x_l^c, x_h^c, \alpha)x_l^{ic}$. Therefore, $P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha) > \bar{p}_l$ implies that firm i can profitably deviate by economizing on consumers' transportation costs.

Considering the case with $\bar{p}_l > P_l(x_l^c, x_h^c, \alpha) > P_h(x_h^c, x_l^c, \alpha)$ and analyzing the respective first-order conditions shows that x_h^c and x_l^c must satisfy

$$\begin{aligned} t_\theta(\theta_l, \alpha) &= \frac{X_l(P_h)\,(P_h X_l(P_h) - P_l X_l(P_l))}{P_h(X_h'(P_h) + \lambda_l X_l'(P_h)) + x_h^i} \\ &= -\frac{X_l(P_l)\,(P_h X_l(P_h) - P_l X_l(P_l))}{(1-\lambda_l)P_l X_l'(P_l) + x_l^i} > 0. \end{aligned} \tag{53}$$

Assuming $P_h X_l(P_h) - P_l X_l(P_l) < 0$ leads to $P_h(X_h'(p_h) + \lambda_l X_l'(P_h)) + x_h^{ic} < 0 < (1 - \lambda_l)P_l X_l'(P_l) + x_l^{ic}$ and thus to a contradiction since firm i can increase its profit by increasing x_h^i and decreasing x_l^i. Hence, we must have $P_h X_l(P_h) > P_l X_l(P_l)$ and thus $P_h(X_h'(P_h) + \lambda_l X_l'(P_h)) + x_h^{ic} > 0 > (1 - \lambda_l)P_l X_l'(P_l) + x_l^{ic}$. Again, considering the fact that firm i serves a fraction $(1/n)\lambda_l$ of l-consumers in the high-demand market and that $0 > (1 - \lambda_l)P_l X_l'(P_l) + x_l^{ic}$ implies that the price in the low-demand market exceeds the respective Cournot price, we can apply the same argument as above. That is, firm i can decrease the quantity it supplies in the high-demand market and increase the quantity offered in the low-demand market such that a fraction $(1/n)\lambda_l$ of l-consumers would switch back and buy in the low-demand market. This would lead to $P_l(x_l^c, x_h^c, \alpha) > P_l(\tilde{x}_h^i + x_h^{-ic}, x_l^{-ic} + \tilde{x}_l^i, \alpha)$ and to $P_l(\tilde{x}_h^i + x_h^{-ic}, x_l^{-ic} + \tilde{x}_l^i, \alpha)\tilde{x}_l^i > P_h(x_h^c, x_l^c, \alpha)x_h^{ic} + P_l(x_l^c, x_h^c, \alpha)x_l^{ic}$ and thus to higher profits.

Since $P_l(x_l^c, x_h^c, \alpha) \geq \bar{p}_l > P_h(x_h^c, x_l^c, \alpha)$ can be excluded by the same reasoning, an equilibrium with $x_h^c,\ x_l^c > 0$ must imply $P_h(x_h^c, x_l^c, \alpha) > P_l(x_l^c, x_h^c, \alpha)$ and $\bar{p}_l > P_l(x_l^c, x_h^c, \alpha)$.

The proof of $P_h(x_h^c, x_l^c, \alpha) < P_h(x_h^*, 0, \alpha)$ and $P_h X_h(P_h) - P_l X_h(P_l) > 0$ again follows the same reasoning as the proof of Lemma 2. That is, with $P_h > P_l$, $\bar{p}_l > P_l$ and (12) we have

$$\begin{aligned} t_\theta(\theta_h, \alpha) &= -\frac{X_h(P_h)\,(P_l X_h(P_l) - P_h X_h(P_h))}{(1-\lambda_h)P_h X_h'(P_h) + x_h^i} \\ &= \frac{X_h(P_l)\,(P_l X_h(P_l) - P_h X_h(P_h))}{P_l\,(X_l'(P_l) + \lambda_l X_h'(P_l)) + x_l^i} > 0. \end{aligned} \tag{54}$$

Assuming $P_l X_h(P_l) - P_h X_h(P_h) > 0$ leads to a contradiction since firm i can increase its profit by increasing x_h^i and decreasing x_l^i. Hence, we must have $P_h X_h(P_h) > P_l X_h(P_l)$ and thus $(1 - \lambda_h)P_h X_h'(P_h) + x_h^{ic} > 0$ which also leads to $P_h(x_h^*, 0, \alpha) > P_h(x_h^c, x_l^c, \alpha)$ (see (31)). Finally, $P_h X_h(P_h) > P_l X_h(P_l)$ and (54) imply $P_l(X_l'(P_l) + \lambda_l X_h'(P_l)) + x_l^{ic} < 0$.

Uniqueness. Defining

$$\Gamma_h(P_h, n) \quad : \quad = \frac{P_h X_h'(P_h) + \frac{X_h(P_h)}{n}}{X_h(P_h)}, \Gamma_l(P_l, n) := \frac{P_l X_h'(P_l) + \frac{X_h(P_l)}{n}}{X_h(P_l)}, \tag{55}$$

$$\widetilde{\Gamma}_l(P_l, n) \quad : \quad = \frac{P_l X_l'(P_l) + \frac{X_l(P_l)}{n}}{X_l(P_l)}, \tag{56}$$

and $R_h(P_h) := P_h X_h(P_h)$ and $R_l(P_l) := P_l X_h(P_l)$, equations (54) can be transformed to (omitting arguments and using symmetry)

$$(1-\lambda_h)\Gamma_h - \frac{X_h(P_h)}{t_\theta}(R_h - R_l) \quad = \quad 0, \tag{57}$$

$$(1-\lambda_h)\Gamma_h + \lambda_h \Gamma_l + \widetilde{\Gamma}_l \quad = \quad 0. \tag{58}$$

Using (57), holding n and α constant and interpreting P_h as a function Φ of P_l the implicit function theorem leads to

$$\Phi'(P_l) = \frac{R_l' + \Gamma_h X_l}{R_h' + \Gamma_h X_h + \frac{1}{t_\theta}\Gamma_{hP_h}(\lambda_h - 1)}. \tag{59}$$

Applying part i) of the proposition we get that $\Phi'(P_l) > 0$ must hold as long as (57) and (58) are satisfied (this is due to $R_h', R_l', V_h > 0$ and $X_h''(p) \leq 0 \Rightarrow V_{hP_h} < 0$).

Using (58) and interpreting P_h as a function Ψ of P_l we get

$$\Psi'(P_l) = \frac{X_l(\Gamma_h - \Gamma_l) + \frac{1}{t_\theta}(\lambda_h \Gamma_{lP_l} + \widetilde{\Gamma}_{lP_l})}{X_h(\Gamma_h - \Gamma_l) + \frac{1}{t_\theta}\Gamma_{hP_h}(\lambda_h - 1)}. \tag{60}$$

Since $P_h > P_l$ implies $\Gamma_h - \Gamma_l < 0$ and since $\Gamma_{lP_l}, \widetilde{\Gamma}_{lP_l} < 0$ (because of $X_l''(p) < 0$) we obtain

$$\begin{aligned} \Psi'(P_l) \quad < \quad & 0 \Leftrightarrow X_h(\Gamma_h - \Gamma_l) + \frac{1}{t_\theta}\Gamma_{hP_h}(\lambda_h - 1) > 0 \\ \Leftrightarrow \quad & \Gamma_{hP_h}(R_l - R_h) + X_h \Gamma_h(\Gamma_h - \Gamma_l) > 0, \end{aligned} \tag{61}$$

where the second line of (61) follows from (57) and (58). Since $R_l - R_h = \Gamma_h - \Gamma_l = 0$ for $P_h = P_l$, (61) implies $\Psi'(P_l) < 0$ if

$$\frac{\Gamma_{hP_h}}{X_h \Gamma_h} - \frac{\Gamma_{lP_l}}{U_l'} < 0. \tag{62}$$

Evaluating (62) and restricting the analysis to prices P_h such that $V_h > 0$ reveals

$$\left.\frac{\Gamma_{hP_h}}{X_h \Gamma_h} - \frac{\Gamma_{lP_l}}{R_l'}\right|_{P_h = P_l} < 0. \tag{63}$$

Furthermore, differentiating $\Gamma_{lP_l}/\, R_l'$ with respect to P_l shows that $X_h'''(p) \leq 0$ from which it follows that $\frac{d}{dP_l}\left[\Gamma_{lP_l}/\, R_l'\right] < 0$ as long as $\Gamma_l > 0$. Thus, if (57) and (58) hold we must also have $\Psi'(P_l) < 0$. Combining this finding with $\Phi'(P_l) > 0$ (as long as (57) and (58) are satisfied) implies that if an interior equilibrium exists it is unique. *Q.E.D.*

References

Anderson, S.P. and Ginsburg, V.A. (1999), International Pricing with Costly Consumer Arbitrage, Review of International Economics 7, 126–139.

Barros, P.P. and Cabral, L. (1994), Merger Policy in Open Economies, European Economic Review 38, 1041-1055.

Bernheim, B.D. and Whinston, M.D. (1990), Multimarket Contact and Collusive Behavior, Rand Journal of Economics 21, 1–26.

Bjorvatn, K. (2004), Economic Integration and the Profitability of Cross-border Mergers and Acquisitions, European Economic Review 48, 1211–1226.

Brander, J.A. (1995), Strategic Trade Policy, pp. 1395-1456, in: Grossman, G.M. and Rogoff, K. (eds.), Handbook of International Economics, Vol. 3, Elsevier, Amsterdam.

Carlton, D.W. and Perloff, J.M. (2005), Modern Industrial Organization, Fourth Edition, Addison Wesley, Boston.

Daugethy, A.F. (1990), Beneficial Concentration, American Economic Review 80, 1231-1237.

Davidson, K.M. (1983), The Competitive Significance of Segmented Markets, California Law Review 71, 445–463.

Deneckere, C. and Davidson, C. (1985), Incentives to Form Coalitions with Bertrand Competition, Rand Journal of Economics 16, 473-486.

ECJ (2008), Judgment of the Court of Justice in Cases C-486/06 to C-478/06: *Sot.Lélos kai Sia EE and Others v. GlaxoSmithKline AEVE Farmakeftikon Proïonton*, Press Release No 65/08, 16 September 2008, Luxembourg.

EU (2003), The Internal Market and the Relevant Geographic Market: The Impact of the Completion of the Single Market Programme on the Definition of the Geographic Market, Report by commissioned by DG Enterprise, Copenhagen Economics, Brussels.

Farrell, J. and Shapiro, C. (1990), Horizontal Mergers: an Equilibrium Analysis, American Economic Review 80, 107-126.

Ganslandt, M. and Maskus, K.E. (2004), Parallel Imports and the Pricing of Pharmaceutical Products: Evidence from the European Union, Journal of Health Economics 23, 1035–1057.

Holmes, T.J. (1989), The Effects of Third-Degree Price Discrimination in Oligopoly, American Economic Review 79, 244-250.

Horn, H. and Levinsohn, J. (2001), Merger Policies and Trade Liberalization, Economic Journal 111, 244–276.

Horn, H. and Wolinsky, A. (1988), Bilateral Monopolies and Incentives for Merger, Rand Journal of Economics 19, 408-419.

Inderst, R. and Wey, C. (2004), The Incentives for Takeover in Oligopoly, International Journal of Industrial Organization 22, 1067-1089.

Ivaldi, M., Jullien, B., Rey, P., Seabright, P., and Tirole, J. (2003), The Economics of Unilateral Effects, Interim Report for DG Competition, European Commission.

Levin, D. (1990), Horizontal Mergers: the 50-Percent Benchmark, American Economic Review 80, 1238-1245.

Lommerud, K.E., Straume, O.R., and Sörgard, L. (2006), National Versus International Mergers in Unionized Oligopoly, Rand Journal of Economics 37, 212-233.

Lommerud, K.E. and Sörgard, L. (1997), Merger and Product Range Rivalry, International Journal of Industrial Organization 16, 21-42.

Malueg, D.A. and Schwartz, M. (1994), Parallel Imports, Demand Dispersion, and International Price Discrimination, Journal of International Economics 37, 167–195.

McAfee, R.P., Simons, J.J., and Williams, M.A. (1992), Horizontal Mergers in Spatially Differentiated Noncooperative Markets, Journal of Industrial Economics 40, 349-358.

Neven, D. and Phlips, L. (1985), Discriminating Oligopolists and Common Markets, Journal of Industrial Economics 34, 133-149.

Padilla, A.J. (2001), The Role of Supply-side Substitution in the Definition of the Relevant Market in Merger Control, A Report for DG Enterprise by NERA, Madrid, European Commission.

Perry, M.K. and Porter, R.H. (1985), Oligopoly and Incentives for Horizontal Mergers, American Economic Review 75, 219-227.

Qiu, L.D. and Zhou, W. (2006), International Mergers: Incentives and Welfare, Journal of International Economics 68, 38–58.

Salant, S.W., Switzer, S., and Reynolds, R.J. (1983), Losses from horizontal merger: The effects of an exogenous change in industry structure on Cournot-Nash equilibrium, Quarterly Journal of Economics 98, 187-199.

Selten, R. (1973), A Simple Model of Imperfect Competition, Where 4 Are Few and Six Are Many, International Journal of Game Theory 2, 141-201.

Sleuwaegen, L., De Voldere, I., and Pennings, E. (2001), The Implications of Globalization for the Definition of the Relevant Geographic Market in Competition and Competitiveness Analysis, Report.

Stole, L.A. (2007), Price Discrimination and Competition, pp. 2221-2299, in: Armstrong, M. and Porter, R. (eds.), Handbook of Industrial Organization, Vol. 3, Elsevier, Amsterdam.

Varian, H. (1989), Price Discrimination, pp. 597-654, in: Schmalensee, R. and Willig, R.D. (eds.), Handbook of Industrial Organization, Vol. 1, Elsevier, Amsterdam.

von Ungern-Sternberg, T. (1996), Countervailing Power Revisited, International Journal of Industrial Organization 14, 507-520.

Whinston, M.D. (2006), Lectures on Antitrust Economics, MIT Press, Cambridge, Massachusetts.