INTERNATIONAL INTEGRATION OF OLIGOPOLISTIC MARKETS WITH INTERRELATED NATIONAL DEMANDS

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April 30, 1994

Abstract

(Distri36.tex)

1 Introduction

Contemporary international economic integration often involve the integration of economies that in terms of factor endowments, technology, and trade seems to be fairly similar - examples would be the EC 1992 program, or the Canadian-U.S. free trade agreement. The alleged consequences of such policies are usually ascribed to the their impact on the behavior of imperfectly competitive firms. In particular, by removing various hindrances to international trade, these policies are believed to reduce the degree to which the market is "segmented", that is, the extent to which it is costly for consumers and producers to transact in foreign markets.

The trade policy literature offers two main approaches to the study of this type of integration. In one approach integration is viewed as equivalent to reduced trading costs, for a given market structure. The latter is usually taken to be an "integrated" market structure, which is defined as a situation where prices in different markets differ exactly by transport costs, and where each firm only sets one price or quantity. The other approach, here denoted the "segmented-to-integrated market" (SIM) approach, originates in Smith and Venables (1988). It portrays the consequences of integration as a shift from one type of equilibrium to another. Markets are assumed to initially be "segmented" in the sense that there are no possibilities for consumers or arbitrageurs to take advantage of price differences between markets, regardless of their magnitude. Firms exploit the segmentation to make market-specific sales or pricing decisions, conjecturing that other firms behave in the same way. But, as a result of the policy measures, markets become "integrated" in the above sense.

The first approach does not address changes in the degree of segmentation, and hence does not capture what in the policy debate are believed to be important consequences of integration, such as changes in businessmen's perceptions of the integrated markets, or other qualititative changes in the mode of competition. The SIM approach, on the other hand, while directly addressing these issues, has serious drawbacks in our view.[1] The SIM ap-

[1] We are not the first to question aspects of this approach, of course. For instance, see the literature cited below in this section. It should also be emphasized that the SIM

proach is basically a theory of international price discrimination. According to the theory firms exercise third degree price discrimination before integration. It is hence implicitly assumed that before integration consumer costs for international transactions are "infinite" while producers' transaction costs are sufficiently low to make international sales profitable. A first question that arises is whether this is a reasonable depiction of the situation before integration. Obviously, it is a rather extreme description of, say, the EEC before the implementation of the 1992 program. But, even if this assumption is accepted, it is not clear that the possibility for individual firms to charge very different prices in different markets implies that they will find it profitable to do so in equilbrium, as shown by Ben-Zvi and Helpman (1992) and Horn and Shy (1993).

Secondly, the assumption that economic integration results in an "integrated market" equilibrium, is equivalent to assuming that integration induces firms to cease to price discriminate, and instead to set one producer price (or the same producer prices) for the whole integrated market. That is, after integration firms employ basing point pricing. Again, it is not shown that such pricing is the equilibrium outcome, and there are reasons to believe that this may not be the case: there is likely to be frictions to trade and competition caused by geographical distances, cultural difference, languages, etc., if not by disguised policy measures, also after integration. These costs are likely to be higher for consumers than for producers. Firms will therefore in general have individual incentives to charge different producer prices in different markets. Whether or not this will occur in equilibrium cannot be determined *a priori*, but will depend on the competitive situation, and must therefore be derived in each individual situation.

Thirdly, the degree to which markets are segmented is in many cases the joint outcome of government policies and measures taken by producers - i.e., the segmentation is to some extent endogenous. Then, if changes in goverment policies have the desired consequences of reducing transaction costs between different markets, one may expect them to affect also producers'

approach has merits: it attempts to capture a phenomenon - international price discrimination - which seems to be of considerable empirical importance. Furthermore, it has proved useful in quantitative studies of economic integration because of its analytical convenience. Thirdly, it attempts to capture the intuitively appealing notion that international integration may not only induce firms to make quantitative adjustments of prices or quantities, but may also, somewhat vaguely, change the mode of competition.

attempt to segment or to integrate markets.[2,3]

Finally, one can also question the "scenario" of market integration suggested by the SIM approach. Before integration firms charge different prices, or choose separate output volumes, for each market. This would typically require that firms have separate distribution outlets for the different markets, to be able to target the different customer groups. Then after integration firms only charge one producer price, or choose one output volume. If transaction costs are lower for producers than for consumers, as we believe they typically are, the "integrated market equilibrium" must be interpreted as a situation where firms only sell "at the factory gates", and leave to perfectly competitive firms with constant marginal costs (or to consumers) to bring the products to the different national markets. Intuitively, it seems to us that in many instances an important aspect of integration could be to do just the opposite, to induce firms to *penetrate* into other firms home markets.

The purpose of this paper is to suggest an alternative approach to study some aspects of integration of segmented markets that at least partly avoids the above-mentioned problems. It seems to us that if the impact of international integration for market segmentation is to be taken seriously, one cannot start from the concepts of "segmented" and "integrated" markets. In contrast to the earlier literature the paper therefore studies the impact of international integration in a world where *demands in different national product markets are interdependent*. It is assumed that a firm cannot discriminate between consumers of different origin in any one outlet. Instead, in order to charge different producer prices to consumers from two different markets, firms have to establish separate distribution systems to consumers in the two markets. Examples of such systems could be contacts and contracts with individual retail stores, service stations close to consumers' homes, systems for distribution of spare parts, pipelines for oil or gas, etc.. The direct costs of establishing these distribution systems are often quite substantial, and

[2]Horn and Shy (1993) show that the distinction between exogenously imposed segmentation, and segmentation due to firms' deliberate actions, may be important to the effects of international economic integration.

[3]Another problem is that the properties of the "segmented market equilibrium" seem sensitive to the exact specification of the mode of competition. Most studies have presumed Cournot conjectures for each separate market, but alternative modes of strategic interaction seem to give quite different results. See e.g. Ben-Zvi and Helpman (1992), Haaland and Wooton (19??), and Venables (1990a,b).

may deter firms from entering foreign markets.[4] However, when establishing such distribution systems firms must take into account not only how prices are affected in the market into which they enter, but also - and fundamental to situations of multi-market interaction - how prices in *other* markets are affected. Market prices will typically tend to fall in the entered market, and this may induce some consumers in other markets to move their purchases to this market. Firms may therefore prefer not to enter foreign markets, even if there is a surplus to be captured in these markets, in order to avoid adverse effects on other markets.

The paper utilizes simple and well-known "building blocks" from location theory and IO. It examines the incentives for firms to establish outlets in competitors' home markets, and investigates how a policy of international economic integration may affect the equilibrium distribution systems, allocation and welfare. It is shown that international economic integration, interpreted as reduced transaction costs for consumers or producers, may indeed induce firms to enter foreign markets, and in this sense change market structure. In contrast to the SIM approach, these changes in market structure are not assumed, but the result of firms' optimal responses to trade policies. It is also shown that this difference may be of critical importance to the predicted consequences of market integration.[5] However, the message of the paper is not so much the particular results that are derived, but rather that it is both necessary and possible to model how integration affects firms' ability and desire to price discriminate internationally.

The paper is in spirit related to several earlier papers in trade that examine aspects of the SIM approach. For instance, Venables (1990a,b) and Ben-Zvi and Helpman (1992) study multi-stage games where fims first decide on productive capacities, and later choose prices, or sales. Venables (1990a,b) show how this may generate equilibria that are "intermediate" between the "segmented" and the "integrated" equilibria of the SIM approach. Ben-Zvi and Helpman (1992) show how the properties of the "segmented market equilibrium" critically depends on the assumed details of the competition between firms. Smith and Venables (1991) investigate location

[4]See Horstmann and Markusen (1992) for an analysis of the impact of such costs and firms' investment behavior.

[5]Haaland and Wooton (1992) bring a similar message, by comparing a "segmented market equilibrium" to an "integrated market equilibrium" with transaction costs. They also argue that competition may be more fierce in the former than in the latter.

decisions when there are fixed costs to enter foreign markets.....[ADD] Winters (1991, 1992) discusses the SIM approach....[ADD]. Haaland and Wooton (199?) uses numerical simulations to compare "segmented" to "integrated" equilibria in situations where there are remaining barriers to trade also after integration. It is shown that the predictions by the SIM approach may qualitatively depend on the magnitude of such barriers. For instance, the "segmented" equilibrium may be feature lower prices than the "integrated" equilibrium, contrary to what is often thought. Horstmann and Markusen (1992) study the role of firm and plant-specific fixed costs for international market structure. Their methodology is similar to what is employed here, in that the market structure is endogenously derived. In both papers it is also the case that small changes in underlying parameter values may have significant effects by changing market structures. Horn and Shy (1993) examine endogenous bundling of tradables and non-tradables as means of segmenting markets. It is shown how integration under such circumstances may be ineffective.

The content of the paper is the following. Section 2 uses a simple example to demonstrate some features of oligopolistic competition that are specific to situations where there are several markets with interrelated demands. The choice of the model, layed out in section 3 and analyzed in section 4, is to a large extent governed by the findings in section 2. The main concern of the paper is the welfare consequence of international integration, which is investigated in section 4. Section 5 briefly examines the incentives for firms to impose transaction costs on their own consumers, this being an alternative way of contributing to the segmentation of markets. Finally, section 6 contains a concluding discussion.

2 Multi-market competition with interrelated demands

As a preliminary step we shall briefly examine the most straightforward extension of a single-market Bertrand model to a two-market context. This will serve to highlight several features of oligopolistic competition that are specific to situations where demands in different markets are related. To this end, assume that there are two identical markets A and B, with demand

$D(r)$ in each market, where r is the minimum consumer price offered in this market. Assume that in each market all consumers have identical per unit transaction costs t for purchases in their respective foreign markets. There are two firms, 1 and 2, located in markets A and B, respectively. Firms only sell through outlets in their home markets, where they charge, respectively, p and q. A consumer in market A thus has the choice between purchasing at home at price p or purchasing in market B at a price $q + t$. Similarly, consumers in market B can purchase at home at price q or in market A at $p+t$. Suppose, finally, that the firms have identical, constant marginal costs, normalized to zero.

Note that the structure of this model is identical to that of the second period of Klemperer's (1987) consumer switching cost model. Consumers have costs t of "switching" from their home markets to their respective foreign markets. The following observation slightly extends Klemperer's (1987) analysis. Let $p^m \equiv q^m \equiv \arg\max pD(p)$, and assume that the monopoly price exists and is unique. Define $\hat{t}$ by $(p^m - \hat{t})D(p^m - \hat{t}) = \hat{t}D(p^m)$. Then[6]:

Observation 1. *If $t \geq \hat{t}$ the unique Nash equilibrium in pure strategies is (p^m, q^m). If $t < \hat{t}$ there exists no pure strategy Nash equilibrium.*

Hence, there only exists an equilibrium in pure strategies if the transaction costs are high enough, and if an equilibrium exists it has both firms charging

[6] Assume there exists a Nash equilibrium (p, q) in pure strategies. Since both firms have the same costs, and a distribution cost advantage to the home market, neither firm will in equilibrium let the other firm into its home market. The Nash equilibrium prices therefore must satisfy

$$q = \min\{q^m, p + t\} \text{ and } p = \min\{p^m, q + t\}$$

But, since

$$q = \min\{q^m, p + t\} \geq p = \min\{p^m, q + t\}$$

it must be that $q = q^m$, and hence also that $p = p^m$. Now, let ϵ be a small positive number, and consider the profit of firm 1 if it deviates from this candidate equilibrium enough to capture both markets, that is, to the price $p^m - t - \epsilon$. For the candidate equilibrium to be a true equilibrium, the deviation must not be strictly profitable:

$$(p^m - t - \epsilon)[D(p^m - \epsilon) + D(p^m - t - \epsilon)] \leq p^m D(p^m)$$

Taking limit $\epsilon \to 0$ shows that $t \geq \hat{t}$. On the other hand, it is easily seen that (p^m, q^m) is a Nash equilibrium, given that $t \geq \hat{t}$.

the *monopoly* price in their respective home market.

There are several aspects and implications of this observation that we want to emphasize. First, the critical value of the consumer transaction cost $\hat{t}$ can be substantially smaller than the monopoly markup. For instance, Klemperer (1987) shows that with $D(p) \equiv 1 - p$, $\hat{t} \approx .31$, whereas $p^m = .5$. Hence, *when demands in different national markets are related, there may be a leverage effect of trade barriers.*

Secondly, Observation 1 does not rely on the assumption that firms compete in prices. To see how it is valid also for quantity competition, let $D(p) \equiv 1 - p$. Suppose that for any pair of quantities (x, y) chosen by firms 1 and 2, respectively, the market prices are given by

$$D(p) = x, \text{ and } D(q) = y$$

as long as $q + t > p > q - t$. If prices are such that $p + t < q$, so that B-market consumers would prefer to buy in market A, an endogenous fraction β of consumers in market B purchase in A, and the market clearing conditions are

$$D(p) + \beta D(p + t) = x, \ (1 - \beta) D(q) = y, \text{ and } p + t = q$$

Finally, there is a corresponding fraction α of A-market consumers that purchase in market B if $p > q + t$. Let x^m be the optimal quantity in market A for firm 1 if it were a monopolist in this market, and define y^m analogously. The statement in Observation 1 is then again valid, with (p^m, q^m) exchanged for (x^m, y^m). The critical value of the consumer transaction cost is now $\hat{t} \approx .086$ - the leverage effect of the trade barrier is even stronger with quantity competition. But, a non-existence problem remains.

Thirdly, the non-existence of a Nash equilibrium in pure strategies is of course a reflection of a general problem encountered in spatial product differentiation models with "transportation costs" that are not sufficiently convex.. Consumers from market A have a higher willingness to pay for firm 1's product, because of its location. The residual demand of firm 1 therefore has a convex segment around the price $q - t$. Charging a price slightly below $q - t$ increases the demanded quantity for firm 1 substantially, since all B-market consumers then prefer to buy from firm 1. As a result, the profit function has two local maxima. They correspond to the two extreme strategies available to the firms: charge a high price and serve the home market only, or charge a low price and serve both markets. Such strategies can easily dominate that of seeting some intermediate price, and then give rise to a discontinuity in the best reply functions, and to non-existence of Nash equilibria in pure strategies. In particular, note that the non-existence is due to firms' *inability to price discriminate*. If firms could establish outlets in their respective foreign markets, then in each market there would effectively be Bertrand competition. The firm with the lower delivery cost would then sell at a price equal to the other firm's transaction cost t, and the existence of the equilibrium is generally assured.[7]

Fourthly, Observation 1 have important implications for the SIM approach. The "integrated market" equilibrium of the SIM approach is potentially subject to the same type of non-existence problem as highlighted above, if some transaction costs remain also after integration. In particular, it is for "small" remaining transaction costs that the non-existence of equilibrium is most likely. When deriving the "integrated market" equilibrium it is not sufficient to verify the local concavity of the profit function. It is an inherent possibility that that the solution to the first-order conditions do not specify global profit maxima.

To conclude, there is a potential non-existence problem when international transactions are associated with higher costs than domestic transactions, and when firms cannot price discriminate perfectly between different national markets. One possibility to avoid this problem is to assume sufficiently convex transaction costs. Caplin and Nalebuff (1991) provide a general existence proof for such models [KOLLA]. However, international transaction costs, at least for firms, are more likely to be concave than convex. We therefore take the alternative route and impose enough structure on the model so that existence and uniqueness of equilibrium can be verified..

3 A simple model of partial market segmentation

Consider a world market consisting of two sets of consumers (countries), A and B, and two firms, 1 and 2. Purchasing from a firm involves transaction costs, and these costs are higher when buying abroad than at home. To avoid the non-existence problems pointed at above, we assume that consumers have

[7] This is a special case of a model investigated by Thisse and Vives (1988).

different transaction costs. In particular, we take consumers to be uniformly located along a unit interval with unit mass. The endpoints 0 and 1 represent the locations of the firms' outlets. A consumer with a location $0 < s < 1$ has a transaction cost st if purchasing from an outlet at point 0, where $t > 0$, and $(1-s)t$ if purchasing from an outlet at point 1. Each consumer buys one unit from the source that is cheapest for the consumer including the transaction cost. We assume that consumers in the interval $[0, .5]$ reside in country A, and the rest in country B.[8]

At the outset the two firms have outlets located in their respective "home market": the country A-based firm 1 at point 0 , and the country B firm 2 at point 1. But firms can also choose to open and sell through an outlet in its respective foreign market, in which case the outputs from the two outlets in the same market are considered as homogeneous by consumers. When a firm only has one outlet it must charge the same price to all customers regardless of their origin. With two outlets it can charge different prices, possibly making consumers self-select on the basis of their different individual transaction costs. But, on the other hand, the firm has to pay a per unit transaction cost τ for its shipments to its foreign outlet; we assume that firms' transaction costs don't exceed those of consumers, $t \geq \tau$.

To capture the idea that when firms establish distribution outlets, they take into account how prices are affected, we use a standard two-stage game format, along the lines of Bulow *et al.* (1985). Thus, in the first stage firms decide simultaneously whether to establish a distribution outlet in the "foreign"market, in addition to the outlet it already has in the home market. Then, in the second stage, firms compete in prices. The sequential decision-making seems to us to be a much more reasonable description than the opposite, where a firm may establish a distribution outlet in the competitor's home market without the latter being able to respond in its choice of prices.

Finally, some notation. Firms have constant marginal costs c_1 and c_2, and as a matter of labeling, $c_1 < c_2$ (we disregard the case where the marginal costs happen to be exactly equal). Let p_A (q_B) be the price charged by firm 1 (2) in its home market, and p_B (q_A) be the price charged in the foreign market by firm 1 (2), if the firm has an outlet in this market. Denote by

[8]A perhaps more natural assumption would be that consumers vary in their transaction costs for purchasing in the foreign market, but don't have transaction costs in the home market. We have experimented with such models, but have not managed to come around the non-existence problem except in very special cases.

superscript n variables or functions pertaining to the case where neither firms has entered its foreign market, and by e situations where firm 1 has entered its foreign market.

4 Integration and the equilibrium mode of distribution

In order to determine whether or not firms will enter their respective foreign markets, we must first characterize the two types of second-stage equilibria that may arise, namely that neither firm enters its foreign market, or that the low cost firm enters the home market of the high cost firm.

4.1 Neither firm enters its foreign market

Suppose, first, that neither firm has entered its foreign market. A consumer with location s then pays $p_A + st$ if purchasing the product from firm 1, and $q_B + (1-s)t$ if buying from firm 2. The marginal consumer $\overline{s}$, is given by

$$\overline{s} \equiv \frac{1}{2} + \frac{q_B - p_A}{2t}$$

and demands by $D^n_{1A} = \overline{s}$, and $D^n_{2B} = 1 - \overline{s}$. Thus,

$$\Pi^n_1 = (p_A - c_1)\overline{s} \tag{1}$$

$$\Pi^n_2 = (q_B - c_2)(1 - \overline{s}) \tag{2}$$

It is readily established that there is a unique interior Nash equilibrium in prices $c_2 - c_1 \leq 3t$. In this equilibrium,

$$p^n_A = t + \frac{1}{3}(2c_1 + c_2) \text{ and } q^n_B = t + \frac{1}{3}(2c_2 + c_1) \tag{3}$$

As can be seen, producer transaction costs does not affect the equilibrium. More interestingly, there is a leverage effect of consumer transaction costs, as in the Bertrand model above: the price level increases one-for–one in the transaction cost t, but consumers' actual transaction costs are smaller than t. For instance, with identical marginal costs, a unitary increase in consumer transaction costs increases the maximum transaction costs paid by any consumer by 1/2, but increases the price level by one unit.

The equilibrium profits are

$$\Pi_1^n = \frac{1}{18t}(c_1 - c_2 - 3t)^2$$

$$\Pi_2^n = \frac{1}{18t}(c_1 - c_2 + 3t)^2$$

4.2 The low cost firm enters the high cost firm's home market

Secondly, if the low cost producer, firm 1, has established an outlet in market B, it will sell to this market as long as $c_2 - c_1 \geq \tau$. In order to have positive sales firm 1 must undercut the lowest price firm 2 is willing to charge, i.e., it must charge

$$p_B = c_2$$

The profit of firm 1 is then

$$\Pi_1^e = (p_A - c_1)\bar{s} + (c_2 - c_1 - \tau)(1 - \bar{s}) \tag{4}$$

where

$$\bar{s} = \begin{cases} 1 \text{ if } p_A \leq c_2 - t \\ \frac{1}{2} + \frac{c_2 - p_A}{2t} \text{ if } c_2 - t < p_A < c_2 + t \\ 0 \text{ if } p_A > c_2 + t \end{cases}$$

Note, first, that the profit function is continuous in p_A, even though it is not differentiable at $\bar{s}$ equal to zero or unity. Note also that it is never optimal for firm 1 to set $p_A < c_2 - t$, nor to set $p_A \geq c_2 + t$. Consider the intermediate case. The marginal profit (4) is positive at p_A slightly larger than $c_2 - t$, it is negative at a value slightly less than $c_2 + t$, and the profit function is strictly concave in the whole interval. The continuity of the profit function then implies that the unique equilibrium when firm 1 has established an outlet in market B, and where firm 2 only has an outlet in its home market, is

$$p_A^e = c_2 + \frac{1}{2}(t - \tau) \qquad p_B^e = q_B^e = c_2 \tag{5}$$

and the resulting profits are

$$\Pi_1^e = c_2 - c_1 + \frac{t}{8} - \frac{\tau}{8t}(6t - \tau)$$
$$\Pi_2^e = 0$$

4.3 Integration and the incentive to penetrate the foreign market

The statement that markets are "integrated" denotes in the literature both a policy measure by which some friction to international trade is removed, and a particular type of equilibrium. In this paper we will take "market integration" to refer to any government policy measure that reduces the product-specific consumer or producer transaction costs that are the basic source of friction to international trade here.

When will the low cost firm penetrate the high cost firm's home market, and how are these incentives affected by international integration? Observe, first, that firm 1 will not enter if $c_2 - c_1 < \tau$. Consider therefore parameter values such that firm 1 has the possibility of undercutting firm 2 in market B if it establishes an outlet there, but where both firms have positive market shares in the case where firms only have outlets in their home markets; that is, assume that

$$\tau < c_2 - c_1 < 3t \tag{6}$$

Subtracting (1) from (4) gives the following expression for the entry incentives:

$$\begin{gathered} \Delta\Pi(c_1, c_2, t, \tau) \equiv \Pi_1^e(c_1, c_2, t, \tau) - \Pi_1^n(c_1, c_2, t) \\ = (c_2 - c_1 - \tau)(1 - \bar{s}^e) - (p_A^n - p_A^e)\bar{s}^n - (p_A^e - c_1)(\bar{s}^n - \bar{s}^e) \end{gathered} \tag{7}$$

There are two consequences of establishing an outlet in market B to take into consideration by firm 1: First, entry into market B may have the direct effect of bringing firm 1 a *foreign surplus* in this market, as captured by the first term of (7). The size of this surplus depends among other things on the relation betwen the marginal costs of the two firms. But, since demand in market A depends on prices in market B, the establishment of an outlet in market B will also have repercussions for demand in the low cost firm's home market: the lower price in market B tends to induce consumers in market A to shift their purchases to market B, which in turn may force firm 1 to lower its home market price. These effects are captured by the last two terms of (7). That is, there is a *negative spill-over* of competition in the foreign market to the home market, that must be set against the potentially positive foreign surplus effect. In general, we cannot say which effect that will dominate.

Each firm is torn between two conflicting interests. On the one hand, each firm has a desire to price discriminate according to consumers' origin, since this reduces their transaction costs, and thus willingness to pay - this provides an incentive to establish an outlet in the foreign country. On the other hand, each firm wants to increase the cost for consumers to switch from its outlets to the competitor's, and this is achieved by not entering the foreign market.

Firm 1 prefers to enter if and only if $\Delta\Pi > 0$, provided profit levels are positive in either case. Let $\Delta c \equiv c_2 - c_1$ be the cost differential between the two firms. One can then show that

$$\Delta\Pi = \frac{1}{18t}[-(\Delta c)^2 + 12t\Delta c - \frac{9}{4}(3t^2 + 6t\tau - \tau^2)] \tag{8}$$

For fixed t and τ, $\Delta\Pi(\Delta c; t, \tau)$ is a concave parabola in Δc which is strictly increasing in $[\tau, 3t]$, and

$$\Delta\Pi(\tau; t, \tau) = \frac{1}{72t}(\tau - 3t)(9t + 5\tau) < 0$$

$$\Delta\Pi(3t; t, \tau) = \frac{1}{8t}(3t - \tau)^2 > 0$$

Hence:

Lemma 1 *There is a threshold value $\Delta c^* \in (\tau, 3t)$ such that it is profitable to enter iff $\Delta c > \Delta c^*$.*

Note that the negative spill-over effects of establishing an outlet in market B may be sufficiently strong to deter the low cost firm from entering even if the firm has no transaction costs at all: with $\tau = 0$, firm 1 will not establish an outlet in country B if $\Delta c < (6 - 1.5\sqrt{13})t$.

Figure 1 depicts the entry incentives in the (t, τ) plane. As can be seen, there is a set of parameter values such that firm 1 would obtain a positive foreign surplus if it established an outlet in market B, but where the firm will nevertheless abstain from doing so, due to the negative ramifications of entry on home market demand.

(Figure 1 here)

As noted above, international price discrimination requires that firms have separate outlets in different countries. Lemma 1 therefore has immediate implications for when such discrimination will occur:

Corollary 2 *For international price discrimination to arise in equilibrium, the production cost advantage of firm 1 must be sufficiently much larger than its transaction cost disadvantage in market B.*

Let us now consider the impact of international integration. It is immediately obvious from Figure 1 that reductions in t and/or τ are conducive to entry. Implicit differentiation of (8) confirms that reduced transaction costs for producers increases the relative attractiveness for firm 1 to enter market B:

$$\frac{d(\Delta c^*)}{d\tau} = \frac{9}{4}\frac{3t-\tau}{6t-\Delta c^*} > 0$$

The impact of consumer transaction costs is slightly more complicated. Implicit differentiation of the profit differential yields

$$\frac{d(\Delta c^*)}{dt} = \frac{3}{4}\frac{9t+9\tau-8\Delta c^*}{6t-\Delta c^*} > 0$$

To see that the numerator in the last expression is positive, note that

$$\Delta\Pi(\frac{9}{8}(t+\tau),t,\tau) = \frac{1}{896t}[49(\tau-\frac{9t}{\tau})^2+192t^2] > 0$$

which implies that $\Delta c^* < \frac{9}{8}(t+\tau)$. Thus:

Proposition 3 *International integration, whether in the form of reductions in producer or consumer transaction costs, may induce the low cost producer to enter the high cost producer's home market.*

5 Integration and welfare

We now turn to the welfare consequences of international integration. As long as we consider equilibria where the whole market is covered, there is no conventional dead-weight loss due to pricing above marginal costs in our model. However, integration nevertheless affects welfare since it changes the amount of productive resources and transaction costs that are spent in equilibrium.

As an intermediary step, consider first the impact of integration on prices. In the policy debate much emphasis has been put on international integration as yielding price convergence across markets.[9] Here, the consequences are different than what is usually claimed:

Proposition 4 *If the low cost producer establishes a distribution outlet in the high cost producer's home market B, then the price will be higher in market A than in market B. The price in market A may even increase as a result of integration.*

Proof. The first part is obtained directly from (5). The second part is showed by means of an example. Assume that $t = \tau$, and $\Delta c = (6 - 3\sqrt{2})t$. Then $\Delta\Pi = 0$. Using (3) and (5) to evaluate the price difference at this value,

$$p_A^e - p_A^n = (3 - 2\sqrt{2})t > 0$$

Hence, if integration makes $t = \tau$ slightly smaller than $\Delta c/(6 - 3\sqrt{2})$ firm A gets a stricly positive incentive to enter market B, and the price in market A increases discretely. *Q.E.D.*

The absolute difference in prices is $p_A^n - p_B^n = (c_1 - c_2)/3 < 0$ before integration. Therefore, if integration does not induce firm 1 to enter market B, the price differential will be unaffected, while absolute price levels will fall with lower t. On the other hand, if entry occurs as a result of integration, then the absolute difference will be $p_A^e - p_B^e = (t - \tau)/2 > 0$ after integration. Hence, whereas before integration market A has the lower price, after integration the price will be lower in market B in this case. Intuitively, the reason is that as long as the low cost firm only serves its home market, its cost advantage will be reflected in a lower price. But, if it is to capture market B, it must undercut not the high cost firm's pre-entry price, but this firm's lowest possible post-entry price c_2. The lower price in market B will

[9] It is usually taken for granted that such convergence is welfare improving. However, the literature on price discrimination, even if it does rarely address situations where two or more firms discriminate, would seem to suggest that there is no presumption that such price convergence would be beneficial from a social point of view.

induce some country-A consumers to purchase in market B. But since they will in any event purchase from firm 1, the firm may find it profitable to increase the price in the home market, to extract more surplus from remaining consumers.

5.1 Integration and national welfare

Before integration, the market price is higher in market B, and consequently this is where the marginal consumer resides. Let v be a consumer's gross surplus from the prduct. Consumer surpluses are then

$$CS_A^n = \int_0^{.5} (v - p_A^n - st)ds$$

$$CS_B^n = \int_{.5}^{s^n} (v - p_A^n - st)ds + \int_{s^n}^{1} (v - q_B^n - (1-s)t)ds$$

When integration induces firm 1 to enter market B, the marginal consumer instead lives in country A (or at the "border"):

$$CS_A^e = \int_0^{s^e} (v - p_A^e - st)ds + \int_{s^e}^{.5} (v - p_B^e - (1-s)t)ds$$

$$CS_B^e = \int_{s^e}^{1} (v - p_B^e - (1-s)t)ds$$

Define welfare as the sum of producer and consumer surplus. We can then show the following:

Proposition 5 *When firm 1 has an outlet in market B, consumer surplus is higher in country B, but welfare is higher in country A.*

Proof. Let $\tau = \alpha t$, where $0 \leq \alpha \leq 1$. Then $CS_A^e - CS_B^e = t(\alpha^2 + 2\alpha - 3)/16 < 0$.

Now turn to the second part of the proposition. Welfare would be higher in country B if

$$W_A^e - W_B^e = \Delta c + t(3\alpha^2 - 10\alpha - 1)/16 < 0 \qquad (9)$$

But for firm 1 to enter market B it is necessary that

$$\Delta\Pi = [9\alpha^2 t^2 - 54\alpha t^2 - (4\Delta c)^2 + 3t(16\Delta c - 9t)]/72t > 0 \qquad (10)$$

These two inequalities cannot be simultaneously fulfilled, as can be seen as follows. Solve for the value of Δc that makes the welfare differential in (9) equal to zero, and evaluate (10) at this value. The resulting expression is negative for any α. Then note that both (9) and (10) increase in Δc. Hence, the inequalities cannot be simultaneously fulfilled. *Q.E.D.*

But, not only will consumer welfare be lower in country A compared to country B after integration. Consumers may actually lose from integration, and lose to such an extent that welfare falls in the low cost country:

Proposition 6 *Welfare in country A may fall if firm 1 enters market B, but welfare in country B always increases.*

Proof. The first part of the proposition is proved by means of an example. Assume that before integration $\tau = t$, and $\Delta c = (6 - 3\sqrt{2})t$. Then $\Delta\Pi = 0$. At this value $W_A^e - W_A^n = (\sqrt{2} - 3/2)t < 0$. Hence, a marginal reduction in $t = \tau$ induces firm 1 to enter market B, and thus reduces welfare in country A.

To establish the second part of the proposition, let t_0 denote the consumer transaction cost before integration, and t_1 the cost thereafter. Note that

$$W_B^n = \frac{3v - 3c_1 - 4\Delta c}{6} + \frac{2\Delta c^2 - 3t_0^2}{24t_0}$$

$$W_B^e = \frac{v - c_1 - \Delta c}{2} - \frac{t_1}{8}$$

decrease in t_0 and t_1, respectively. Hence, the only reason for country B welfare to fall as a result of integration, is the shift in market structure it may bring. To load the dice against a welfare gain for country B, assume that $t_1 = t_0 = t$. We then have

$$W_B^e - W_B^n = \frac{\Delta c(2t - \Delta c)}{12t}$$

Hence, a necessary condition for welfare to fall in country B is that $\Delta c > 2t$. However, for any such value the firm has already entered. To see this, assume that $\tau = t_0$ initially. The incentive to enter is then given by

$$\Delta\Pi = \frac{2}{3}\Delta c + t_0 - \frac{\Delta c^2}{18t_0}$$

and the firm enters for $\Delta c > (6 - 3\sqrt{2})t_0$. But, this is strictly smaller than $2t_0 = 2t$, which is the lowest value at which country B can lose from integration. Hence, B must gain. *Q.E.D*

5.2 Integration and aggregate welfare

Now turn to aggregate welfare. With each firm only established in its respective home market, the total transport cost is

$$T^n = t\int_0^{s^n} s\,ds + t\int_{s^n}^1 (1-s)\,ds$$

If firm 1 has entered market B and is selling at the marginal cost of firm 2, the total transaction costs are

$$T^e = t\int_0^{s^e} s\,ds + t\int_{s^e}^1 (1-s)\,ds + \tau(1-s^e)$$

Aggregate welfare is then, if neither firm establish an outlet in the foreign market:

$$W^n = v + (c_2 - c_1)s^n - c_2 - T^n$$

and aggregate welfare is

$$W^e = v - c_1 - T^e$$

when firm 1 has entered market B.

There are three partly conflicting interests from a social point of view. First, the larger the proportion of output that is produced in the low cost firm, the higher welfare tends to be. Secondly, to minimize consumers' transaction costs, $\overline{s}$ should be as close as possible to 1/2. Thirdly, whenever firm 1 sells in market B, firm 1 and the consumers that purchase from firm 1 in the market B outlet duplicate each other's transaction activities to some degree.

It turns out that the potential loss to country A may be sufficiently large to outweigh the welfare gain to country B from integration:

Proposition 7 *International integration whether in the form of reduced transaction costs for producers or consumers, may lower aggregate welfare when there are positive transaction costs for producers.*

Proof. Consider the case where $c_1 = 0$, $c_2 = 2$, and where before integration $t = \tau = 1.5$. It can then be verified that $\Delta\Pi = -17/54$, and hence that neither firm open an outlet in the respective foreign country. Welfare is then $W^n = v - 217/216$. Assume that integration lowers the transaction costs to $t = \tau = 1$. This implies that $\Delta\Pi = 1/9$, so firm 1 will enter market B, and the resulting welfare level is $W^e = v - 9/8$. Hence, welfare has fallen. *Q.E.D.*

Note that in this particular example, with $t = \tau$, prices are the same in both markets after integration (as is clear from (5)). Therefore, after integration $\overline{s} = .5$, and consumer transaction costs are minimized. The fall in welfare is due to a form of cross-hauling as in the Brander (1981) reciprocal dumping model. The social gain from producing everything in the low cost firm hence does not fully compensate for the social cost from the additional transaction costs. Note that the welfare loss associated with this type of cross-hauling is here obtained with price competition rather than quantity competition. But, absent producer transaction costs, a reduction in consumer transaction costs increases aggregate welfare:

Proposition 8 *Integration increases aggregate welfare if* $\tau = 0$ *after integration.*

Proof. Note first that a reduction in t increases both W^n and W^e. Hence, any welfare loss must come from the change in market structure, the entry of firm 1 into market B. Therefore, consider the smallest decrease in t which would induce entry. It can be shown that for $t = (8 + 2\sqrt{13})\Delta c/9$, firm 1 is indifferent between entry and no entry. At this point $W^e - W^n \approx .31\Delta c$. Entry would therefore yield a discrete increase in aggregate welfare. *Q.E.D.*

It should be emphasized that it is the *entry* rather than the reduction in transaction costs that brings about a fall in welfare. To see this, assume that the economy is initially in a position where firm 1 is just indifferent to entering market B and stays out as a consequence. A marginal reduction in e.g. the producer transaction cost τ would then have a marginal effect on welfare at unchanged market structure. But, if it suffices to make firm 1 enter market B there may be a discrete fall in aggregate welfare.

6 A comparison to the SIM approach

The simple model here features *both* types of effects from integration that are typically considered in the literature on international integration. Consider a situation where transaction costs are sufficiently high so that both firms strictly prefer not to enter their foreign markets. A small reduction in (consumer) transaction costs will increase competition between the firms, and will reduce prices - this is the typical finding in the first approach mentioned in the introduction. But, for a sufficiently pronounced reduction, there is a qualitative change in market structure, as suggested by the SIM approach. But, in contrast to the latter approach, in our model the change in market structure is the result of firms' optimizing behavior.

Focusing on the choice of distribution systems as a mean of affecting the degree of international price discrimination, gives a rather different perspective on the workings of international integration than that suggested by the SIM approach. In the SIM approach integration reduces the number of decision variables of each firm to one, and must therefore be interpreted as inducing firms to *leave* their export markets, at least if consumer transaction costs are higher than producer transaction costs. Here, international integration, in particular in the form of lower transaction costs for firms, provides incentives for firms to *penetrate* other firms' home markets. That is, whereas before integration, the equilibrium is similar to an "integrated equilibrium" in the terminology of the SIM approach, with each firm choosing just one "world-wide" price, integration leads to a "segmented market equilibrium" in that each firm is after integration making market-specific price decisions! It seems to us that the depiction given here is in many cases a more natural description of the consequences of integration.

The two approaches may also yield different predictions. For instance, in the SIM approach integration leads almost by definition to a convergence in absolute price levels in different markets. Here, on the other hand, things are more involved. If integration is to be worthwhile, a firm must obtain a sufficiently large market share in the foreign country, which in turn requires a sufficiently low price *ex post* entry. There is thus a natural tendency for the price level to be low in markets that experience entry because of integration.

The two modelling approaches may also yield different predictions regarding the consequences of integration for absolute price levels. Assume for simplicity that costs are the same for both producers, $\Delta c = 0$, and consider the effect of reduced transaction costs for consumers. The SIM approach would assume that initially the firms set market specific prices - this would correspond to the case where both firms have outlets in the respective foreign country. Thus, it is as if there were Bertrand competition in each market with the respective foreign supplier having a cost disadvantage, and the equilibrium prices are $p^s = q^s = c + \tau$. Then after integration firms would sell at their factory gates. This would correspond to the equilibrium derived above where firms only have outlets in their home markets, and equilibrium prices would then be $p^i = q^i = c + t$. Hence, the SIM approach predicts that the price level will *increase* as a result of integration (be unaffected if $\tau = t$), despite there being no asymmetries at all between the two markets. Integration is thus anti-competitive, a possibility which is also pointed out by Haaland and Wooton (1992). Here, on the other hand, the price would fall by the same amount as the transaction costs falls.

7 Endogenous transaction costs for consumers

We have so far considered the incentives for firms to affect the degree of international price discrimination through their choice of the number of sales outlets. In this section we will briefly point to another mechanism that allow producers to affect the degree to which markets are interrelated. Assume that each producer can influence consumers' transaction costs, and that this is done prior to the price competition stage. For instance, the firms can at an earlier stage design their respective products to make it more or less costly to consumers to purchase their own product instead of the competitor's. Do firms have incentives to increase the difficulty for consumers to purchase their respective products, i.e., in this sense to segment the markets?

Consider again the model above, but where consumer s faces a transaction costs $t_1 s$ if purchasing from firm 1, and the transaction cost $t_2(1-s)$ if buying firm 2's product. Firm 1 (2) only has an outlet in market A (B). Firms first simultaneously choose the transaction costs, and then compete in prices.

It is straightforward to show that the second stage equilibrium yields a reduced form profit function

$$\Pi_i = \frac{(t_1 + t_2 + t_j - c_i + c_j)^2}{9(t_1 + t_2)}, \ \ i \neq j = 1, 2$$

The following is then immediately seen, by differentiating this expression, and taking into account the condition for $0 < s < 1$ in equilibrium:

Proposition 9 *If both firms have strictly positive market shares, and $c_i + t_i > c_j$, firm i's profit increases in the transaction costs t_i customers face when buying from the firm.*

By increasing the transaction cost, a firm reduces its *own* demand, as usual. But this is outweighed by the dampening effect on the intensity of competition. Note that while this result is similar to the maximal differentiation results in location theory, it arises under somewhat different circumstances. In location theory maximal differentiation is usually obtained with convex transport costs. With linear costs, as is assumed here, the tendency is rather the opposite.

This example suggests that international integration that does not directly lower consumer transaction costs, but that mainly makes it *possible* for firms to reduce these costs, may be ineffective - the firms here don't have any individual incentives to utilize this possibility. Instead, integration needs to attack the *basis* for the segmentation.

8 Concluding remarks

We believe that the standard the treatment of multi-market oligopoly in the recent literature on international integration is inadequate. It is either assumed that demands in national markets are completely unrelated, or that an international "law of one producer price" prevails. Instead, we think that it is necessary to model more explicitly the way in which international price discrimination is maintained, in order to understand how it is affected by integration.

The purpose of this paper is to suggest one tractable way in which integration in the presence of interrelated demands can be modeled. The paper builds on two basic assumptions. First, consumers are not totally locked into separate markets, but can at some cost switch their demand from domestic to foreign markets. Secondly, in order to charge different prices to consumers in different countries, firms have to establish distribution systems to the different markets, and this will affect equilibrium prices in all markets.

The paper employs an analytically very simple model. Nevertheless, some observations emerge that seem to be of more general validity, and that may have important implications for the analysis of international integration:
(1) With interrelated demands, there is a leverage effect of trade barriers - they tend to raise equilibrium prices more than one-to-one.
(2) With interrelated demands and non-convex transaction costs there is an inherent possibility that there does not exist an equilibrium in pure strategies.
(3) International integration, whether in the form of reduced transaction costs for consumers or producers, can affect firms' incentives to establish outlets in foreign markets, and can hence influence the degree to which firms can price discriminate. However, the incentive to establish a foreign outlet depends on the difference between two (reduced form) profit levels. Typically, integration in the form of reduced transaction costs for consumers will affect both these profit levels. One should not in general expect this form of integration to affect the entry incentives in any particular direction.
(4) Explicit modeling of the mechanism through which firms are able to price discriminate may yield very different predictions of the effects of integration from those of the SIM approach.
(5) Firms may benefit from imposing transaction costs on their own consumers.

Finally, the model we employ is based on far too restrictive assumptions to be used as a basis for policy recommendations. It would be much more satisfactory if the model did not rely on e.g. such special functional forms for demand. Some of the results above can no doubt be shown to hold in more general settings, but as mentioned under point (3) above, one should not hope for too much in this respect. Part of the problem stems from the lack of tractable models of multi-market oligopoly, and of price discrimination under competition. This deficiency is disturbing also from the more general point of view that during the last 15 years, international trade and trade policy has largely been an application of oligopoly theory to situations where there are more than a single market.

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10 SCRAP

PARTS OF THE PREVIOUS VERSION HAVE BEEN DELETED. THE FOLLOWING MATERIAL IS "LEFT-OVERS":

There are then two situations to consider, depending on the relationship between marginal costs and the producer transaction cost. If $c_1 + \tau > c_2 \geq c_1$, a possible cost advantage of firm 1 does not suffice to compensate for the transaction cost disadvantage. Firm 2 can always undercut firm 1 and capture its home market. But, when $c_1 + \tau < c_2$, firm 1 has the possibility to capture both markets, if it so wishes. We consider each in turn. (Since firm 2 does not have a cost advantage, it will never enter market A.)

As long as $c_1 + \tau > c_2 > c_1$ neither firm can profitably take over the whole market. If a firm nevertheless enters its foreign market, it will force prices down in this market, without making any profit at all from it, and will in addition reduce demand in the home market. Hence, the firm is strictly better off not entering the foreign market:

Lemma 10 *With $c_1 + \tau > c_2 > c_1$, it is a strictly dominant strategy to sell only through home market outlets.*

The equilibrium prices (p_A^{nn}, q_B^{nn}) are then given by the simultaneous solution to

$$\max_{p_A} \; (p_A - c_1) D_{1A}(p_A, q_B, t) \tag{11}$$

$$\max_{q_B} \; (q_B - c_2) D_{2B}(p_A, q_B, t) \tag{12}$$

The following is immediate from the lemma, (11), and (12):

Proposition 11 *A reduction in producers' transaction costs has no impact on the equilibrium as long as $c_1 + \tau > c_2 \geq c_1$.*

We can also infer the following, if we assume that (11) and (12) specify a unique Nash equilibrium (p_A^{nn}, q_B^{nn}), and that the resulting profit profit functions are twice continuously differentiable in the three arguments around the equilibrium:

Proposition 12 *With $c_1 + \tau > c_2 \geq c_1$, a reduction in consumers' transaction costs reduces prices in both markets if (1) the prices are strategic complements, (2) each firm's marginal profit increases in t, and (3) conventional stability holds.*

To verify the proposition, let

$$\Pi^1(p_A, q_B, t) \equiv (p_A - c_1)D_{1A}^{nn}(p_A, q_B, t)$$

with an analogous definition of $\Pi^2(p_A, q_B, t)$. Implicit differentiation of the FOCs to (11) and (12) yields

$$\frac{dp_A^{nn}}{dt} = \frac{\Pi_{pq}^1 \Pi_{qt}^2 - \Pi_{pt}^1 \Pi_{qq}^2}{\Pi_{pp}^1 \Pi_{qq}^2 - \Pi_{pq}^1 \Pi_{qp}^2} > 0$$

where subscripts temporarily index partial derivatives. The sign of the differential follows from the assumptions stated in the proposition: $\Pi_{pq}^1 > 0$ by (1), Π_{pt}^1, $\Pi_{qt}^2 > 0$ by (2), and the denominator is positive by (3). These assumptions are standard in the traditional one-market case, except for assumption (2). An example fulfilling these assumptions is provided below.

Now turn to the situation where $c_1 + \tau < c_2$, where firm 1 may find it profitable to enter market B. It then has to undercut the lowest price firm 2 would be willing to charge in market B in order to make any sales there; that is, firm 1 must set $p_B = c_2$ (or slightly less). This entry is profitable if

$$\max_{p_A} (p_A - c_1)D_{1A}(p_A, c_2, t) + (c_2 - c_1 - \tau)D_{2B}(p_A, c_2, t) > (p_A^{nn} - c_1)D_{1A}(p_A^{nn}, q_B^{nn}, t) \tag{13}$$

where the second term owes to the fact that if firm 1 enters market B, it takes over the same demand conditions as firm 2 would have, should firm 1 not enter this market.

As can be seen, the direct effect of a reduction in producer transaction costs that reverses the inequality $c_1 + \tau > c_2$, or that makes it more pronounced, is to make entry into the foreign market more attractive. However, the overall effect cannot be determined in general, since all prices will change once an outlet is established in a foreign market. Even less clear are the consequence of lower transaction costs for consumers. Intuitively, one may expect a lower t to make entry less profitable, since the competition spill-over effect should be stronger, the more easy it is for consumers to switch their purchases between markets. But, this is only part of the story, since profits both with and without entry into the competitor's market are affected by a lower t. In order to obtain more clear-cut results, we have to impose more structure on the model.

11 International Integration with Quantity Competition

A typical feature of two-stage games is their sensitivity to the type of second-stage competition, for instance, whether it is price or quantity competition. One might therefore suspect that the results above are yet an example of the value of reducing the intensity of competition in price competition games, by committing in stage one to be less aggressive in stage two, in this case by abstaining from entering the competitor's home market. There is indeed such an effect at work. But, also with quantity competition it may be unprofitable for a firm to establish an outlet in a foreign market, despite the fact that at given prices it would make a profit from sales abroad. To demonstrate this, we start with a more general formulation of quantity competition with Cournot conjectures, and then consider a particular example.

Let the inverse demand in market k be

$$P_k(x_A + y_A, x_B + y_B, t)$$

where x_k (y_k) is firm 1's (2's) deliveries to market k. The profit of firm 1 is then

$$\Pi_1 = [P_A(x_A + y_A, x_B + y_B, t) - c_1]x_A + [P_B(x_A + y_A, x_B + y_B, t) - c_1 - \tau]x_B$$

When x_B is restricted to zero, the equilibrium where firm 1 has two outlets coincides with that where the firm has one outlet. Hence, there is no reason to establish an outlet in market B if firm 1 does not intend to sell there. Let us therefore consider the impact on firm 1's profit of an exogenous change in x_B. To this end, let $y_k^*(x_B)$ be the reduced form best reply function(s) of firm 2 (obtained by using the first-order conditions for maximization of Π_1 w.r.t. x_A, and that for maximization of Π_2 w.r.t. y_B (and possibly y_A)):

$$\frac{d\Pi_1}{dx_B} = P_B - c_1 - \tau$$

$$+[x_A \frac{\partial P_A}{\partial(x_B+y_B)} + x_B \frac{\partial P_B}{\partial(x_B+y_B)}](1+\frac{dy_B^*}{dx_B})$$
$$+[x_A \frac{\partial P_A}{\partial(x_A+y_A)} + x_B \frac{\partial P_B}{\partial(x_A+y_A)}]\frac{dy_A^*}{dx_B}$$

The term $P_B - c_1 - \tau$ is the direct gain from selling a marginal unit in market B. The second line captures the effect on firm 1's profit that stems from changes in the aggregate output in market B, while the third line gives the effect from an induced change in firm 2's volume in market A.

A natural assumption in this case of quantity competition would be that products are "strategic substitutes" in the sense that if firm 1 supplies more to market B, firm 2 reduces its output in those markets where it has an outlet, (i.e., $y_k^*/dx_B < 0$), but not more than that the total volume supplied to market B increases (i.e., $d(x_B + y_B^*(x_B))/dx_B > 0$). To see firm 1's incentives to enter market B, assume these properties hold, and assume also that firm 2 does not have an outlet in market A. Then, the profit of the first unit sold in market B would be

$$\frac{d\Pi_1}{dx_B} = P_B - c_1 - \tau + x_A \frac{\partial P_A}{\partial(x_B+y_B)}(1+\frac{dy_B^*}{dx_B})$$

There is then a potentially positive direct effect to be compared with the adverse effect an expansion of output, and the consequently lower price, in market B has on firm 1's profit in its home market. That is, just as in the case of price competition, there is a *negative spill-over effect* from the foreign to the home market that may prevent the firm from entering the foreign market, even though sales *per se* are profitable.

11.1 Model III: A multi-market Cournot model [better title?]

It is tempting to draw the conclusion that the problems illustrated through this example are specific to price competition. To see that this is not the case, consider the following Cournot version of Model I, where firm 1 (2) produces the volume x (y). Let $P(x)$ be the inverse of the demand function $D(p)$, and let for simplicity $t_A = t_B = t > 0$. Define $x^m = \arg\max xP(x)$, with an analogous definition of $y^m = x^m$, and assume the maximum is unique. For the moment we leave unspecified the precise specification of the market clearing mechanism - a matter which does not have an obvious solution. Instead we make a couple of natural assumptions about its properties:

- for a sufficiently high t each producer can reap its monopoly profit in the respective home market.
- there exists a $\hat{t}$ such that for $t < \hat{t}$ it is optimal for firm to set x such $P(x) + t < P(y^m)$, and correspondingly for firm 2.

The latter assumption would obviously generally be fulfilled if $t = 0$ where permitted, since then the Nash equilibrium quantities would be larger in a larger market.

Observation 3. *Under the two assumptions above, there exists a symmetric Nash equilibrium in pure strategies if and only if $t > \hat{t}$, in which case the equilibrium is (x^m, y^m).*

Proof. Consider the decision problem facing firm 1, say. It is clear that for t sufficiently high, the optimal output response to y^m is x^m. Hence, this is a Nash equilibrium. Now suppose that $t < \hat{t}$. Then a symmetric Nash equilibrium (x^c, y^c), if it exists, must be such that $x^c = y^c < x^m = y^m$. The profit of firm 1 is then $x^c P(x^c)$. But this cannot be an optimal response by firm 1 since in such an equilibrium $P(y^c) + t > P(x^c) > P(y^c) - t$, and it is possible and profitable for firm 1 to increase x at least marginally. This reasoning applies to any symmetric equilibrium as long as $t < \hat{t}$. *Q.E.D.*

Hence, there does not exist an equilibrium in pure strategies where the existence of a competitor, and another market induces firms to behave more competitively than if they were monopolists in their home respective markets.

To get a feeling for the magnitude of $\hat{t}$, consider the following two-market Cournot model. It can also be verified that for $t < 1/6 \approx .167$ the deviation results in a price consistent with the inequality ...

[CHECK: does there exist $t > \hat{t}$, such that $\Pi^{en} > \Pi^{nn}$? Also, with asymmetric costs could have equilibrium where α or β are poisitive? If so, possible with losses from entry, despite absence of transaction costs for producers.]

If so, would get welfare loss from entry in foreign market if k]To summarize this example, with $D(p) \equiv 1 - p$, and the demand specification given above, there does not exist a symmetric Nash equilibrium in pure strategies for

$t < .086$, and the unique equilibrium with $t > .086$ is that both firm produce their domestic monopoly output volumes 1/2. While this model is suggestive, in that it clearly shows how also transaction costs that are relativly small may have significant effects, it is not very compelling to use for analyses of international integration, largely because of the existence problems. We therefore turn to another model, which is a hybrid of this model and Model II, an which has "nicer" properties.

11.2 Model IV: Quantity competition with point masses and transaction costs uniformly distributed on the unit interval

With quantity competition, market clearing occurs through some process by which prices adjust to a level where demand adjusts to supply. Therefore, we cannot use the model employed in the previous section that had a given mass of consumers with inelastic individual demands. The most obvious remedy would be to assume that each consumer's demand is elastic, and depending on the consumer price (i.e., inclusive of transaction costs). The drawback of such a specification is that it gives rise to cubic profit functions, which are less convenient to work with. Here we instead utilize an alternative approach: we assume that all consumers located on the unit interval have inelastic demands as before. But, in addition to these consumers, each firm faces demand from a separate group of that under no practical circumstances would purchase from the other firm. This group of consumers has an elastic aggregate demand, because of e.g. varying domestic transaction costs, with $D(p) \equiv 1 - p$.

The demand system is thus:

$$1 - p + \overline{s} = z_A$$

$$1 - q + 1 - \overline{s} = z_B$$

where p (q) is the market price in market A (B), z_A (z_B) is the total volume delivered to market A (B), and $\overline{s}$ is the marginal consumer as before.

Assume that production costs are zero for both firms. Then...[TO BE CONTINUED]

Lemma 13 *In Example 3, firms are indifferent with respect to entry if*

$$\frac{3t}{4t+3} < \tau < t$$

and it is a strictly dominant strategy to enter if

$$\tau < \frac{3t}{4t+3}$$

Proposition 14 *International integration in the form of reduced* t *and* τ *increases the relative attractiveness for firms to enter the other firm's home market.*

Proposition 15 *A reduction in transaction costs for producers or consumers has no consequence as long as*

$$\tau > \frac{3t}{4t+3}$$

and reduces prices for lower values of τ*.*

Proposition 16 *Prices are lower when penetration into foreign markets is permitted, compared to when it is not, when*

$$\tau < \frac{3t}{4t+3}$$

In contrast to the case with price competition, this observation suggests that the gains from integration may be underestimated if the consequences of penetration of foreign markets are not taken into consideration.

[TO BE ADDED SOMEWHERE: discussion of relevant literature such as Roberts and Sonnenschein (1977), Salop (1979), Aspremont (?) and Thisse (198?) (Handbook of Game Theory), Shilony (1977). More on market segmentation in trade, such as Gib... and Neven (198?), Neven and.(1985)....(ADD)