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Trade liberalization in vertically related markets[*]

Rafael Moner-Colonques, José J. Sempere-Monerris and Amparo Urbano[**]

Abstract

This paper looks into the desirability of trade liberalization for manufacturers, retailers and consumers. The analysis compares the move from the autarky situation to either one of free trade that entails a change in the distribution system or not. We also examine whether the interests of manufacturers and retailers about the preferred distribution system coincide, provided trade opens. We find that market integration is beneficial to all agents only under certain conditions on the degree of market asymmetry and the degree of product differentiation. Interestingly, if integration entails a change in the distribution system, the conflict between manufacturers and retailers strengthens since only retailers prefer free trade when markets are not too asymmetric and when interbrand competition is sufficiently strong. Furthermore, consumers can be harmed by trade and, in a setting without exclusivities, one country may experience a welfare decrease. Finally, the analysis of the strategic choice concerning exclusivity clauses uncovers that retailers and manufacturers never agree about their preference for endogenous distribution systems.

Keywords: international competition, vertical relationships.
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1 Introduction

Among other things, the so called "new trade theory", which dispenses with the perfect competition assumption, has provided theoretical support to the existence of intraindustry trade and can also explain why a large share of international trade takes place between similar countries. These studies acknowledge increasing returns and product differentiation as important determinants of trade. Thus an important literature, beginning in the 80s, has analyzed the welfare gains from trade under noncompetitive conditions (Krugman, 1980, Markusen, 1981, Shaked and Sutton, 1984). But whether the opening of trade is profitable to oligopolistic firms has not received much attention. This paper takes the analysis one step further and provides some normative implications about who wins and who loses from free trade. We examine the gains from trade in an imperfect competition model with demand asymmetric countries and product differentiation where vertical relationships are considered. Once these are at place, different market structures that result in different distribution systems become relevant to the analysis.

In particular, we present a model with two countries (a large and a small one) in which there is a multiproduct successive monopoly to look into the desirability of integrating two economies for manufacturers, retailers and consumers. A move to free trade entails a market expansion effect and a competition effect. The assumed market structure under autarky is made for the sake of the analysis. Since the latter effect in the current setting also depends on whether retailers are multiproduct sellers, multiproduction is assumed from scratch to better understand how the competition effect works. Two distinct questions are addressed. We first examine the incentives that manufacturers and retailers have to support trade liberalization processes. Since a move from autarky to free trade may entail a change in the distribution system or not, and each alternative distribution system implies changes on the agents' incentives to free trade as well as on welfare, we study their incentives for two alternative distribution systems: one with exclusivity in distribution and another one without it. In addition, the welfare changes originated by the opening of trade are also analyzed. Secondly, and once trade occurs, we study whether exclusivity arrangements are beneficial to the different agents involved; that is, we analyze whether the interests of manufacturers and retailers about the preferred distribution system coincide, provided trade opens. This is undertaken to further clarify the likely conflicts between agents in the production process that may arise in moves to free trade. One may wonder about the endogeneity of the exclusivity decision. It will be argued below that the introduction of exclusivity arrangements in equilibrium is sensitive to which agents hold the power to impose them. Consequently, both alternative distribution systems have to be analyzed.

The consideration of which agents in a vertical chain gain and lose from trade is particularly interesting when evaluating programmes of integration between countries that are asymmetric in size and for sectors where distribution is a relevant feature. Although the decision about free trade are taken by governments, e. g. making use of a given welfare measure, it is relevant to know which type of agent in an industry sector might benefit from trade because some welfare improving agreements are not sanctioned due to lobbying activities by those who lose. Our analysis may shed some light as to the implications of ongoing liberalization processes or agreements. As shall shortly be seen, the possible benefits that accrue to manufacturers and retailers depend on the degree of substitutability of products (or how differentiated products are perceived by consumers), on whether the firms are in a large or a small country, and also on whether there are exclusivity arrangements between manufacturers and retailers.[1]

We are interested in first examining the incentives that manufacturers and retailers have concerning a move from autarky to free trade. Two alternative distribution networks, once trade liberalization is achieved, are distinguished depending on whether intrabrand competition is introduced, i.e. there is competition in the same product as it is sold by both retailers. Then we examine whether consumers gain with trade as well as whether the existence of social benefits associated with trade

[1] As pointed out in Motta et al. (1997), trade liberalization processes between countries with very different characteristics are the rule rather than the exception. These authors emphasize how important are the initial conditions in determining the persistence of, say, historical advantages after trade. Another reason suggesting the policy problems that our analysis can help understand is exemplified by the number of preferential trade agreements - some 250 had been notified to the WTO by the year 2002. There is a widespread view that such agreements create obstacles to multilateral trade liberalization. A recent paper by Saggi (2006) examines these questions and his work indeed emphasizes the relevance of countries that are symmetric in establishing incentives to multilateral trade liberalization under different preferential trade agreements.

liberalization. Secondly, we also analyze the distribution networks that would endogenously arise in case that manufacturers or retailers were given the opportunity to introduce exclusivity relationships. Results are characterized both by the degree of market asymmetry and the degree of product differentiation. Our main findings can be summarized as follows. Firstly, the opening of trade *without* a change in the distribution system results in that both the manufacturer and retailer of the small country are *always* better off. Only if market sizes are not too asymmetric will all manufacturers and retailers gain with free trade. These findings are in contrast with earlier analyses where vertical relationships have been ignored. Secondly, trade liberalization *with* a change in the distribution system results in that *only* the retailer of the small country is better off. It is possible that both manufacturers and retailers gain with free trade only under certain conditions, i.e. for sufficiently small market asymmetry and low enough interbrand competition. Interestingly, the conflict between manufacturers and retailers strengthens since only retailers prefer free trade when markets are not too asymmetric and when interbrand competition is sufficiently strong. Thirdly, consumers in the small country can be harmed by trade when demand asymmetries are sufficiently marked. Besides, in a setting without exclusivity, producer losses can offset consumer gains so that the opening of trade results in a welfare decrease for the large country. Finally, the analysis of the strategic choice concerning exclusivity clauses uncovers that retailers and manufacturers *never agree* about their preference for endogenous distribution systems, in the sense that if manufacturers are better off under exclusivity then retailers had better not and viceversa.

As is well known, in oligopoly models of trade, in contrast with monopolistic competition and traditional general equilibrium models, it is unclear whether trade is beneficial in private and social terms. With product homogeneity, Donsimoni and Gabszewicz (1989), for a class of examples, and Anderson et al. (1989), in a more general model, have shown that trade liberalization under oligopoly is harmful for firms in at least one of the countries.[2] On the other hand, Cordella (1993)

[2] The finding that firms may lose with the opening of trade can be contradicted by resorting to product differentiation, as in Donsimoni and Gabszewicz (1989), to private cost information, as in Moner-Colonques (1998), or to endogenous product choice in a dynamic setting, as in Cabrales and Motta (2001).

undertakes a welfare analysis to show that the gains to consumers can outweigh the losses to producers and hence both countries would gain from intraindustry trade liberalization. Ambiguities in welfare remain in address models of product differentiation as the integration of two separate countries typically entails the exit of firms. This happens for the horizontal differentiation case (as proposed by Eaton and Kierzkowski, 1984), and for the vertical differentiation case with income disparities (as in Gabszewicz et al., 1981, and Shaked and Sutton, 1984). Furthermore, with a representative consumer approach and quantity competition, Motta (1992) has shown that if firms have not sunk their quality costs then there are welfare losses for the small country when the quality gap is not too large. Our paper can be seen as complementary to the above line of research and it is our purpose to examine whether firms, consisting of manufacturers and retailers, and consumers find trade liberalization profitable, modelled here as a move from an autarky to a free trade situation. Although there exist some references that study vertical relationships in open economies an analysis like the one herein developed seems not to have been undertaken.[3]

The paper is organized as follows. The next section sets out the model. Different subsections characterize the autarky equilibrium, and the free trade equilibrium with and without exclusivity relationships. Sections three and four analyze the gains agents may obtain in a move from autarky to free trade. Section five examines the endogenous distribution systems that arises once trade liberalization has taken place. Some concluding remarks close the paper.

2 The Model

Consider two countries where in each country k, $k = A$, B demand is obtained from the maximization of a representative consumer's utility function given by:

$$U^k(.) = a^k \sum_{i=1}^{n^k} q_i^k - \frac{1}{2} \sum_{i=1}^{n^k} (q_i^k)^2 - d \sum_{i \neq j}^{n^k} q_i^k q_j^k \tag{1}$$

[3] Spencer and Jones (1991, 1992) have analyzed the implications of vertical agreements for strategic trade policy. Some relevant papers on this topic are those by Spencer and Qiu (2001), Grossman and Helpman (2002) and Head et al. (2004). Recent contributions by Richardson (2004) and Raff and Schmitt (2005) study the use of some vertical restraints in international markets.

subject to the budget constraint $m^k = I^k + \sum_{i=1}^{n^k} p_i^k q_i^k$, where q_i^k denotes the amount of product i consumed at country k, p_i^k denotes the price in country k of product i, m^k is the income of the representative consumer at country k, and I^k is the income spent in the numeraire good in country k. Also, a^k are positive constants, n^k are the total number of products available for consumption in country k and $d \in (0,1)$ is the degree of product differentiation between products and measures interbrand competition.

In each country k, there is a manufacturer and a retailer. Both are needed to sell the products to consumers. Denote by M^k the manufacturer which produces two differentiated products at a constant per unit cost, c and by R^k, the retailer who then sells products to consumers.

Retailer k selling product i pays a per unit of output rate of w_{ik} to the manufacturer. We limit our analysis to linear contracts. One might be tempted to think that the results that will follow very much depend on the inefficiency caused by the double marginalization effect. We wish to briefly comment on this assumption. Firstly, although the superiority of two-part tariff contracts over linear contracts is usually established given that manufacturers have two instruments at hand, the latter may become appropriate when there are observability or renegotiation problems (see Tirole, 1988). Secondly, Shaffer (1991), who analyzes a two-product monopolist who sells to one retailer has shown that the most that can be extracted via the fixed fee is the corresponding product's marginal contribution to the retailer's payoffs and that the wholesale price exceeds marginal cost. It can also be shown that his finding also applies to a successive duopoly setting with intrabrand competition. Therefore, the common understanding that a two-part tariff eliminates the double marginalization is no longer true when retailers are multiproduct sellers; it is mitigated but not removed and the consideration of two-part tariff contracts would not significantly change the analysis below given that both under autarky and free trade we assume that retailers are multiproduct sellers.

We will consider different market configurations. i) The initial situation, *the autarky case*, where both markets are isolated. In that case each retailer sells only the two products of the corresponding domestic manufacturer; then $n^k = 2$ for $k = A, B$. The opening of trade creates a common market in which there is only one industry with two manufacturers and two retailers facing demands consisting of the sum of demands in each country. Two alternative situations under free trade will be distinguished. Firstly, ii) *the free trade with exclusivity case,* where consumers can buy products from any retailer and each retailer sells exclusively the two products of the corresponding domestic manufacturer; then $n^k = 4$ for $k = A, B$. Secondly, iii) *the free trade with non-exclusivity case,* where consumers can buy products from any retailer and each retailer sells the products of *both* the domestic and the foreign manufacturer, $n^k = 4$ for $k = A, B$, and it supposes the presence of intrabrand competition in the four products. As noted above, we are interested in analyzing whether manufacturers and retailers find international competition profitable. Such process may imply, among other things, a change in retail distribution systems from single product sellers (before trade occurs) to multiproduct sellers (once trade opens). It is for the sake of the analysis and to isolate from this effect that multiproduction is assumed.

2.1 The Autarky Equilibrium

Before trade liberalizes, each country's home industry is separated from the other's. This can be explained by e.g. the existence of a prohibitive tariff. Let product 1 and product 2 be the two products produced by M^A, while those produced by M^B are product 3 and product 4. The inverse demand system under the autarky case for country A is given by,

$$p_1^A = a^A - q_1^A - dq_2^A, \quad p_2^A = a^A - q_2^A - dq_1^A, \tag{2}$$

while for country B, the inverse demand system under autarky reads,

$$p_3^B = a^B - q_3^B - dq_4^B, \quad p_4^B = a^B - q_4^B - dq_3^B. \tag{3}$$

Under autarky all the production of manufacturers is sold in their country of origin, and there is a multiproduct successive monopoly in each country. To compute the autarky equilibrium we solve for the subgame perfect equilibrium of the following two stage game. In the first stage the manufacturer sets each product's transfer price; in the second stage the retailer chooses the amount of output for each product to be sold to consumers. Finally, consumers make their purchase decisions. Solving backwards for country A we have that, given the transfer prices (w_{1A}, w_{2A}) set by M^A in the first stage, R^A maximizes the following profits:

$$\max_{(q_1^A, q_2^A)} R^A = (p_1^A - w_{1A})q_1^A + (p_2^A - w_{2A})q_2^A$$

where the solution is $q_1^A(w_{1A}, w_{2A}) = \frac{a^A(1-d)-w_{1A}+dw_{2A}}{2(1-d^2)}$ and $q_2^A(w_{1A}, w_{2A}) = \frac{a^A(1-d)-w_{2A}+dw_{1A}}{2(1-d^2)}$. Then M^A maximizes the following profits:

$$\max_{(w_{1A},w_{2A})} M^A = (w_{1A} - c)q_1^A(w_{1A}, w_{2A}) + (w_{2A} - c)q_2^A(w_{1A}, w_{2A})$$

where the equilibrium transfer prices are $w_{1A}^* = w_{2A}^* = \frac{a^A+c}{2}$ and therefore $q_1^{*A} = q_2^{*A} = \frac{a^A-c}{4(1+d)}$. Given those equilibrium values, it is easy to find that equilibrium margins are $p_1^{*A} - w_{1A}^* = p_2^{*A} - w_{2A}^* = \frac{a^A-c}{4}$; $w_{1A}^* - c = w_{2A}^* - c = \frac{a^A-c}{2}$, where the manufacturer obtains a higher margin than the retailer and both margins are independent of the degree of product differentiation. Equilibrium profits are $M^{A*} = \frac{(a^A-c)^2}{4(1+d)}$ and $R^{A*} = \frac{(a^A-c)^2}{8(1+d)}$ while equilibrium consumer surplus is $CS^{A*} = \frac{(a^A-c)^2}{16(1+d)^2}$. Finally, social welfare is given by, $SW^{A*} = M^{A*} + R^{A*} + CS^{A*} = \frac{(a^A-c)^2(7+6d)}{16(1+d)^2}$. Similarly for the other country. The star superscript denotes the equilibrium variables under autarky. The multiproduct manufacturer sets up transfer prices that fully internalize market competition, as the equilibrium transfer price corresponds with that of monopoly. The multiproduct retailer chooses quantities that internalize competition so that the market prices are those corresponding to a multiproduct monopolist with constant marginal costs equal to the equilibrium transfer price.

2.2 The Free Trade Equilibrium with Exclusivity

Now the two countries A and B, are integrated, that is, retailers sell the products to the two representative consumers and they cannot price discriminate across consumers of different countries. Also and since retailers are exclusive, each one sells only the products of the respective manufacturer. The four equation inverse demand system for the integrated economy has to be computed. Note that it is just the sum of the demand of each country k. Then the utility maximization problem for country $k's$ consumer results in four linear inverse demands. This four equation demand system is inverted to obtain $q_i^k(p_1, p_2, p_3, p_4)$, with $i = 1, 2, 3, 4$. Total demand of product i is then defined by $Q_i(p_1, p_2, p_3, p_4) = q_i^A(p_1, p_2, p_3, p_4) + q_i^B(p_1, p_2, p_3, p_4)$, for $i = 1, 2, 3, 4$. Thus the inverse demand system in the enlarged market is,[4]

[4]Since demands are linear with a different intercept, the sum has to take into account that asymmetry, and therefore, it has two branches (see the Appendix). However and for the sake of the exposition, we only consider in the sequel the branch where consumers of both countries have positive demand. Once we have solved the model under this assumption, we ensure that the equilibrium is precisely on that branch by imposing the condition that the equilibrium price is

$$
\begin{aligned}
p_1 &= \frac{1}{2}(a^A + a^B - Q_1 - d(Q_2 + Q_3 + Q_4)) & (4)\\
p_2 &= \frac{1}{2}(a^A + a^B - Q_2 - d(Q_1 + Q_3 + Q_4)) & (5)\\
p_3 &= \frac{1}{2}(a^A + a^B - Q_3 - d(Q_1 + Q_2 + Q_4)) & (6)\\
p_4 &= \frac{1}{2}(a^A + a^B - Q_4 - d(Q_1 + Q_2 + Q_3)) & (7)
\end{aligned}
$$

In this case, there is only one market whose market structure consists of a multiproduct successive duopoly. To compute the free trade equilibrium with exclusive domestic retailers we solve for the subgame perfect equilibrium of the following two stage game. In the first stage both manufacturers set simultaneously and independently the transfer prices. In the second stage both retailers choose simultaneously and independently the amount of output for each product to be sold to consumers. Finally, consumers make their purchase decisions. Solving backwards we have that, given the transfer prices $(w_{1A}, w_{2A}, w_{3B}, w_{4B})$ set by manufacturers in the first stage, retailers R^A and R^B maximize the following profits:

$$
\begin{aligned}
\max_{(Q_1,Q_2)} R^A &= (p_1 - w_{1A})Q_1 + (p_2 - w_{2A})Q_2\\
\max_{(Q_3,Q_4)} R^B &= (p_3 - w_{3B})Q_3 + (p_4 - w_{4B})Q_4
\end{aligned}
$$

which yields the following equilibrium quantities:

$$
\begin{aligned}
Q_1(w_{1A}, w_{2A}, w_{3B}, w_{4B}) &= \frac{(a^A+a^B)(1-d)-(2+2d-d^2)w_{1A}+d(2+d)w_{2A}+d(1-d)(w_{3B}+w_{4B})}{2(1-d)(1+2d)}\\
Q_2(w_{1A}, w_{2A}, w_{3B}, w_{4B}) &= \frac{(a^A+a^B)(1-d)-(2+2d-d^2)w_{2A}+d(2+d)w_{1A}+d(1-d)(w_{3B}+w_{4B})}{2(1-d)(1+2d)}\\
Q_3(w_{1A}, w_{2A}, w_{3B}, w_{4B}) &= \frac{(a^A+a^B)(1-d)-(2+2d-d^2)w_{3B}+d(2+d)w_{4B}+d(1-d)(w_{1A}+w_{2A})}{2(1-d)(1+2d)}\\
Q_4(w_{1A}, w_{2A}, w_{3B}, w_{4B}) &= \frac{(a^A+a^B)(1-d)-(2+2d-d^2)w_{4B}+d(2+d)w_{3B}+d(1-d)(w_{1A}+w_{2B})}{2(1-d)(1+2d)}
\end{aligned}
$$

As expected, each quantity is decreasing with its own transfer price and increasing with the others. However, it must be noted that the increase due to the transfer price of the other product sold by the retailer is greater than the increase due to

below the smallest inverse demand intercept . This will be referred to as the technical threshold on $a = \frac{a^A}{a^B}$ in the sequel. In fact we are just focusing on the case where the sizes of both markets are not too different such that firms find it optimal to sell in both countries.

transfer prices of products sold by the rival retailer. This is explained by the internalization of competition by a multiproduct retailer. Then, manufacturers M^A and M^B maximize the following profits:

$$\max_{(w_{1A},w_{2A})} M^A = (w_{1A}-c)Q_1(w_{1A},w_{2A},w_{3B},w_{4B}) + (w_{2A}-c)Q_2(w_{1A},w_{2A},w_{3B},w_{4B})$$
$$\max_{(w_{3B},w_{4B})} M^B = (w_{3B}-c)Q_3(w_{1A},w_{2A},w_{3B},w_{4B}) + (w_{4B}-c)Q_4(w_{1A},w_{2A},w_{3B},w_{4B})$$

where the equilibrium transfer prices and outputs are, $w_{ik}^{FTE} = \frac{a^A+a^B+2(1+d)c}{2(2+d)}$ and $Q_i^{FTE} = \frac{(a^A+a^B-2c)(1+d)}{2(2+d)(1+2d)}$, for $i = 1,2,3,4$, and $k = A,B$, respectively. Superscript FTE stands for free trade with exclusivity. The corresponding equilibrium margins are given by,

$$p_i^{FTE} - w_{ik}^{FTE} = \frac{(a^A+a^B-2c)(1+d)^2}{4(2+d)(1+2d)} \quad w_{ik}^{FTE} - c = \frac{(a^A+a^B-2c)}{2(2+d)} \quad \text{for } i = 1,2,3,4 \text{ and } k = A,B.$$

It is worth noting that both margins are decreasing with d and, in absolute terms, the manufacturers' margins vary at a higher rate than the retailers' margins. Finally, equilibrium profits and consumer surplus[5] at equilibrium are,

$$(M^A)^{FTE} = (M^B)^{FTE} = \frac{(a^A+a^B-2c)^2(1+d)}{2(2+d)^2(1+2d)},$$
$$(R^A)^{FTE} = (R^A)^{FTE} = \frac{(a^A+a^B-2c)^2(1+d)^3}{2(2+d)^2(1+2d)^2},$$
$$(CS^A)^{FTE} = \frac{(2+3d)((a^A-c)(5+14d+7d^2)-(a^B-c)(3+6d+d^2))^2}{16(2+d)^2(1+2d)^2(1+3d)^2},$$
$$(CS^B)^{FTE} = \frac{(2+3d)(-(a^A-c)(3+6d+d^2)+(a^B-c)(5+14d+7d^2))^2}{16(2+d)^2(1+2d)^2(1+3d)^2}$$

Note that each country's social welfare is defined as the sum of firms' profits and consumer surplus and denoted by $(SW^k)^{FTE}$ $k = A,B$. Finally, aggregate social welfare is the sum of both countries' welfare $SW^{FTE} = (SW^A)^{FTE} + (SW^B)^{FTE}$.

[5]In order to compute the consumer surplus for market i, note that the equillibrium market price, p_i^{FTE}, determines which is the output consumed in each country. In particular, $(q_i^A)^{FTE}$ is the quantity that solves $p_i^{FTE} = a^A - (1+3d)(q_i^A)^{FTE}$, and similarly for $(q_i^B)^{FTE}$, where $Q_i^{FTE} = (q_i^A)^{FTE} + (q_i^B)^{FTE}$ and we have made use of the equality $(q_i^A)^{FTE} = (q_j^A)^{FTE}$ for all $i,j = 1,2,3,4$. Once $(q_i^A)^{FTE}$ and $(q_i^B)^{FTE}$ are obtained, the consumer surplus is computed in the usual manner.

2.3 The Free Trade Equilibrium with Non-Exclusivity

We now consider that the two countries are integrated as in the above scenario but assume that there is a new distribution scheme. Retailers are no longer exclusive; now both retailers sell the four products, two from the domestic manufacturer plus two from the foreign one. Demand in the integrated economy is computed as before, but now we must take into account that each product is sold by two retailers, which means that there is *intrabrand* competition. Thus the inverse demand system is given by (4)-(7), where now $Q_i = q_{iA} + q_{iB}$, $i = 1, 2, 3, 4$, where q_{ik} is the amount of product i sold by retailer k, for $i = 1, 2, 3, 4$, and $k = A, B$.[6] As above, there is only one market whose market structure consists of a multiproduct successive duopoly. To compute the free trade equilibrium with non-exclusivity we solve for the subgame perfect equilibrium of the following two stage game. In the first stage both manufacturers set simultaneously and independently the transfer prices, where each manufacturer sets two transfer prices for its two products sold at two different outlets. In the second stage both retailers choose simultaneously and independently the amount of output for each product to be sold to consumers, where now retailers choose four quantities. Finally consumers make their purchase decisions. Solving backwards we have that, given the transfer prices (w_1, w_2, w_3, w_4) set by manufacturers in the first stage,[7] retailers R^A and R^B maximize the following profits:

$$\max_{(q_{1A},q_{2A},q_{3A},q_{4A})} R^A = \sum_{i=1}^{4}(p_i - w_i)q_{iA}$$

$$\max_{(q_{1B},q_{2B},q_{3B},q_{4B})} R^B = \sum_{i=1}^{4}(p_i - w_i)q_{iB}$$

where the solution is given by:

$$q_{ik}(w_1, w_2, w_3, w_4) = \frac{(a^A + a^B)(1-d) - 2(1+2d)w_i + 2d\sum_{j\neq i} w_j}{3(1-d)(1+3d)}, \; i, j = 1, 2, 3, 4; \; k = A, \; B.$$

[6]Note that under free trade with exclusivity Q_1 was sold solely by retailer A. Thus q_{1B} was nil. Similarly for Q_2. The present setting requires further notation to identify the amount of *each* product sold by *each* retailer.

[7]We can save on notation given that manufacturers do not set different transfer prices to symmetric retailers.

Then, manufacturers M^A and M^B maximize the following profits:

$$\begin{aligned}
\max_{(w_1,w_2)} M^A &= (w_1-c)(q_{1A}(w_1,w_2,w_3,w_4)+q_{1B}(w_1,w_2,w_3,w_4)) \\
&\quad +(w_2-c)(q_{2A}(w_1,w_2,w_3,w_4)+q_{2B}(w_1,w_2,w_3,w_4)) \\
\max_{(w_3,w_4)} M^B &= (w_3-c)(q_{3A}(w_1,w_2,w_3,w_4)+q_{3B}(w_1,w_2,w_3,w_4)) \\
&\quad +(w_4-c)(q_{4A}(w_1,w_2,w_3,w_4)+q_{4B}(w_1,w_2,w_3,w_4))
\end{aligned}$$

where the equilibrium transfer prices are $w_i^{FTN} = \frac{(a^A+a^B)(1-d)+2(1+d)c}{4}$, $i=1,2,3,4$ and therefore, $q_{ik}^{FTN} = \frac{(a^A+a^B-2c)(1+d)}{6(1+3d)}$, for $i=1,2,3,4$, and $k=A,B$. Superscript FTN stands for free trade with non-exclusivity. Given these equilibrium values, it is easy to find that equilibrium margins are:

$$p_i^{FTN} - w_i^{FTN} = \frac{(a^A+a^B-2c)(1+d)}{12} \quad w_i^{FTN} - c = \frac{(a^A+a^B-2c)(1-d)}{4}; \quad \text{for } i=1,2,3,4.$$

Contrary to what happens in the absence of intrabrand competition, the retailers' margins can exceed those of the manufacturers when competition is strong (i.e. for $d > \frac{1}{2}$). In this case, the retailers' margins are increasing with d while those for manufacturers are decreasing with d. This is explained by the different way in which p_i^{FTN} and w_i^{FTN} decrease as d varies. It must be noted that prices decrease less than transfer prices and then the retailers' margins increase with d. Retailers are capable of better internalizing the competition between the four products as compared with manufacturers, who can only internalize competition between their own two products. Further note that the presence of intrabrand competition pushes both the manufacturers' and the retailers' margins down as compared with the equilibrium under free trade with exclusivity. Equilibrium profits, consumer surplus and social welfare at equilibrium are

$$\begin{aligned}
(M^A)^{FTN} &= (M^B)^{FTN} = \frac{(a^A+a^B-2c)^2(1-d^2)}{6(1+3d)} \\
(R^A)^{FTN} &= (R^A)^{FTN} = \frac{(a^A+a^B-2c)^2(1+d)^2}{18(1+3d)} \\
(CS^A)^{FTN} &= \frac{((4+d)(a^A-c)-(2-d)(a^B-c))^2}{18(1+3d)^2}, \\
(CS^B)^{FTN} &= \frac{(-(2-d)(a^A-c)+(4+d)(a^B-c))^2}{18(1+3d)^2}
\end{aligned}$$

As before, each country's social welfare is defined as the sum of firms' profits and consumer surplus in each country and denoted by $(SW^k)^{FTN}$ $k=A,B$.

3 Private Incentives to Free Trade

3.1 The Case with Exclusivity

In this section we analyze the conditions under which the agents gain in the move from autarky to free trade provided that the distribution system is exclusive. In other words we analyze the agents' incentives for trade liberalization.

Manufacturers' gains from free trade.

Both manufacturers will prefer free trade rather than autarky as long as $(M^A)^{FTE} > M^{A*}$ and $(M^B)^{FTE} > M^{B*}$. The first inequality, for $c = 0$, yields

$$\frac{4a^A a^B(1+d)^2 - (a^A)^2(2+d(8+d(7+2d))) + (a^B)^2 2(1+d)^2}{4(1+d)(2+d)^2(1+2d)} > 0$$

The denominator is positive. For the sake of the exposition and without loss of generality assume that $a_B \geq a_A$. That is, the inverse demand intercept for country B is not lower than that of country A; put differently, country B consumer's maximum willingness to pay is not lower than that of country A one's. Throughout the paper we will refer to country A as the small country and to country B as the large country. Let us define the ratio $a^A/a^B \equiv a$ as the relative market size ratio, where $a \in (0,1]$. In case of $a = 1$ we will refer to the symmetric markets case. As a approaches zero the market asymmetry across countries increases. We now divide the numerator by $(a^B)^2$ to obtain the following concave polynomial in $a : 4a(1+d)^2 - a^2(2+d(8+d(7+2d))) + 2(1+d)^2$. The coefficient of the square term is negative. Hence, $(M^A)^{FTE} > M^{A*}$ if $a \in (f_A^-(d), f_A^+(d))$, where $f_A^-(d)$ and $f_A^+(d)$ are the roots of the above concave polynomial. It can be checked that $f_A^-(d)$ always takes on negative values and that $f_A^+(d)$ is always greater than one for $d \in (0,1)$. See Appendix 2 for the precise expressions of these roots. Then we can conclude that the manufacturer of the small country always gains with free trade. Proceeding in the same manner, $(M^B)^{FTE} > M^{B*}$ holds if $a \notin (f_B^-(d), f_B^+(d))$, where $f_B^-(d)$ and $f_B^+(d)$ are the roots of the following convex polynomial, $2(1+d)^2a^2 + 4(1+d)^2a - (2+d(8+d(7+2d)))$. It can be checked that $f_B^-(d)$ always takes on negative values and that $f_B^+(d)$ lies between zero and one for $d \in (0,1)$. Thus, $0 < f_B^+(d) < 1 < f_A^+(d)$, and we conclude that as long as $a \in (f_B^+(d), 1)$ both manufacturers are better off with free trade. Put differently, both manufacturers gain in the move to free trade for sufficiently low market asymmetry, regardless of the degree of interbrand competition. Also and since $f_B^+(d)$ is increasing with d, *the higher the interbrand competition the lower the degree of market asymmetry compatible with both manufacturers benefiting from free trade.*

Retailers' gains from free trade.

By the same token, both retailers will prefer free trade rather than autarky as long as $(R^A)^{FTE} > R^{A*}$ and $(R^B)^{FTE} > R^{B*}$. These will hold for $a \in (g_B^+(d), g_A^+(d))$, where it happens that $0 < g_B^+(d) < 1 < g_A^+(d)$, for all $d \in (0, 1)$. Then, we conclude that the retailer of the small country always gains with free trade, while the one from the large country only gains for sufficiently low market asymmetry, regardless of the degree of interbrand competition. The root $g_B^+(d)$ is increasing with d and the same conclusion as for manufacturers is reached.

Combining the manufacturers and retailers' points of view, first note that the following ranking holds $0 < g_B^+(d) < f_B^+(d) < 1 < f_A^+(d) < g_A^+(d)$, for $d \in (0, 1)$. This ranking shows that the agents in the small country always gain with free trade, and that the retailer in the large country will benefit from free trade for a wider range of market asymmetry than that corresponding to the manufacturer. The next proposition summarizes the results (see Appendix 2 for the complete characterization of the agents' incentives to trade liberalization).

Proposition 1 *The manufacturer and retailer of the small country are always better off with free trade. Besides, if market sizes are not too asymmetric then all manufacturers and retailers are better off with free trade.*

Depending on the agents' incentives to trade liberalization, three different regions above the dashed line[8] may be identified in Figure 1: *region a*, where both manufacturers and both retailers benefit from free trade; *region b*, where all agents except the large country manufacturer benefit, and *region c*, where only the manufacturer and retailer from the small country benefit from trade liberalization.

Note that the case where both countries are identical corresponds with the upper side of the square and that a sufficient condition for all agents to benefit from the opening of trade is precisely market symmetry. Alternatively, for a given level of

[8]Note that as explained in the Appendix, there is a technical bound on the level of market size asymmetry that ensures that equilibrium price is on the lower branch of the inverse demand. The bound amounts to $a > \Phi^E(d) = \frac{3+6d+d^2}{5+14d+7d^2}$, the dashed line in Figure 1.

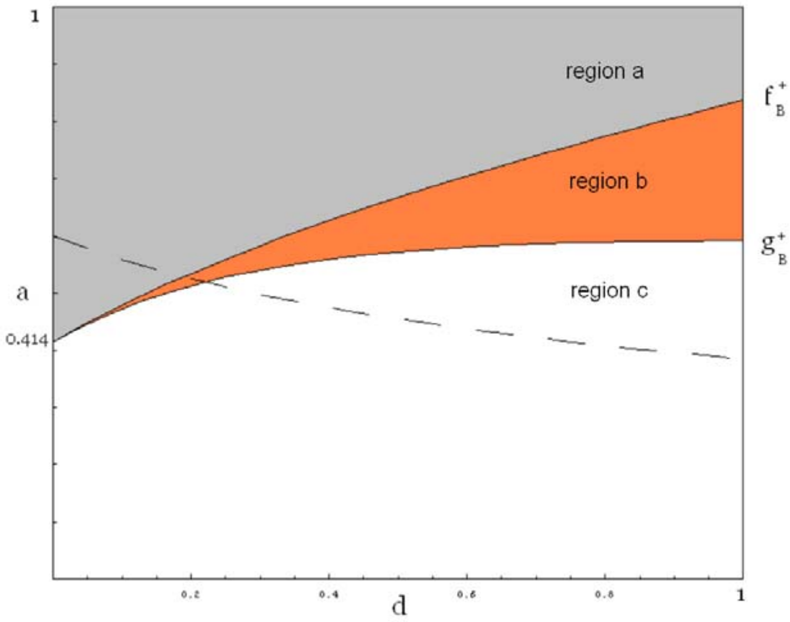

Figure 1: Autarky vs. Free Trade with Exclusivity.

product differentiation, as long as market asymmetry increases, first the manufacturer and next the retailer of the large country does not benefit from free trade. The results obtained in a setting with vertical relationships are in sharp contrast with previous work by Donsimoni and Gabszewicz (1989) and Anderson et al. (1989), who show that, for the case of complete symmetry, all firms must lose.

In fact, were the market served by manufacturers who sell directly to consumers, our model would yield that it is not always the case that, with market symmetry, both manufacturers end up better off. In particular, we find that both manufacturers are better off with international free trade competition only when products are sufficiently differentiated ($d < 0.707$); otherwise both are worse off . When markets sizes are not equal, we find that both manufacturers gain with free trade if product differentiation is sufficiently high and markets are not too asymmetric. If $d < 0.707$ and as markets become too asymmetric then the large country manufacturer will be worse off with a move to free trade.

Therefore, the comparison of a setting with and without retailers unveils the relevance of vertical separation with exclusive retailers: *trade liberalization benefits all the firms in situations (i.e. for little product differentiation) that are not beneficial to manufacturers in both countries when retailers are not employed. The presence* *of vertical relationships makes it more likely that free trade be favourable to all firms involved.*

To illustrate the intuition behind the foregoing analysis note that a move from autarky to free trade entails, in general, two opposite effects. On the one hand, there is a market expansion effect provided that manufacturers and retailers operate in a larger market. On the other hand, they face competition from agents in the other country. The former effect depends on the relative market sizes; one expects that agents in the small country will prefer the opening of trade. However, the latter effect is determined by market structure, by features such as the degree of product differentiation, the vertical distribution structure and the existence of intrabrand and in-store competition.

As it turns out, the market expansion effect always dominates the competition effect for the manufacturer and the retailer in the small country. On the one hand, it happens that equilibrium output always increases in the move from autarky to free trade with exclusivity. On the other, both the retailer's and the manufacturer's margins may increase or decrease depending on how important is market asymmetry.[9] However, the overall effect is that the agents in the small country always prefer free trade. Concerning the large country, the market expansion effect is greater the closer a is to unity; the competition effect is greater the less differentiated products are, that is, the closer d is to unity. As to the change in equilibrium margins and output, it must be noted that both margins are always higher under free trade whereas the variation in equilibrium output depends on market asymmetry.[10] Broadly speaking, the market expansion effect offsets the competition effect when markets are not too asymmetric for any given degree of product differentiation; the range of market asymmetry for which this happens is wider the softer the competition intensity. Further note that the competition effect affects in a different way the manufacturer's and the retailer's incentives to free trade. Specifically, the retailer's incentives are greater than the manufacturer's, for any given pair a and d. As equilibrium outputs are the same for manufacturer and retailer, the different incentives are explained by the difference in their respective margins. The retailer's margin decreases by less than the manufacturer's margin with more competition.

[9] Specifically, the manufacturer's margin is smaller under free trade if $a > \frac{1}{1+d}$; while that of the retailer is smaller if $a > \frac{(1+d)^2}{(1+3d+d^2)}$.

[10] Specifically, equilibrium output under free trade exceeds that under autarky if $a > \frac{d}{2(1+d)^2}$.

3.2 The Case with Non-Exclusivity

Manufacturers' gains from free trade.

Proceeding in the same way as above, both manufacturers will prefer free trade rather than autarky as long as $(M^A)^{FTN} > M^{A*}$ and $(M^B)^{FTN} > M^{B*}$. This holds for $a \in (s_B^+(d), s_A^+(d))$. Note that: i) both $s_B^+(d)$ and $s_A^+(d)$ are positive, ii) $s_A^+(d\ ) < 1$ for $d > 0.589$, iii) $s_B^+(d) < 1$ for $d < 0.589$ and iv) the functions $s_B^+(d)$ and $s_A^+(d)$ intersect at $d = 0.589$. Then the following result can be stated: *Both manufacturers are worse off iff* $d > 0.589$ and $a \in (s_A^+(d), 1)$. This *never* happens when trade liberalization does not entail any changes in the distribution system.

Retailers' gains from free trade.

It will be the case that both retailers prefer free trade rather than autarky as long as $(R^A)^{FTN} > R^{A*}$ and $(R^B)^{FTN} > R^{B*}$; this holds for $a \in (t_B^+(d), t_A^+(d))$. It can be checked that $0 < t_B^+(d) < 1 < t_A^+(d)$, for all $d \in (0, 1)$. Then, we conclude that the retailer of the small country always gains with free trade, while the one in the large country only gains for sufficiently low market asymmetry, regardless of the degree of interbrand competition.

In order to analyze the interests of the four agents, note that the ranking for the four thresholds is a function of d as follows:

a) for $d \in (0, 0.2]$, then $s_B^+(d) \leq t_B^+(d) < 1 < t_A^+(d) \leq s_A^+(d)$;

b) for $d \in (0.2, 0.589]$ then $t_B^+(d) < s_B^+(d) \leq 1 \leq s_A^+(d) < t_A^+(d)$;

c) for $d \in (0.589, 1)$ then $t_B^+(d) < s_A^+(d) < 1 < s_B^+(d) < t_A^+(d)$.

The next proposition summarizes the results, which are in sharp contrast with the analysis when trade liberalization does not suppose a change in the distribution system.

Proposition 2 *Only the retailer of the small country is always better off with free trade. Besides, the four agents are better off with free trade when market sizes are not too asymmetric and when interbrand competition is not too intense. There are free trade gains only to retailers when markets are not too asymmetric and when interbrand competition is sufficiently strong.*

The complete characterization for the four firms' incentives to trade liberalization with non-exclusivity is in the Appendix and are displayed in Figure 2. Apart from

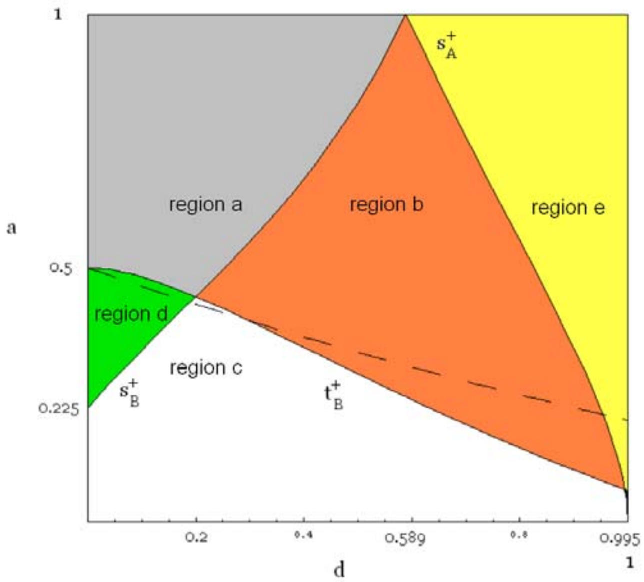

Figure 2: Autarky vs. Free Trade with Non-Exclusivity.

differences in the size of regions, there are now two additional regions above the dashed line:[11]

region a, where both manufacturers and both retailers benefit from free trade;

region b, where the firms of the small country together with the retailer of the large country are better off with trade liberalization;

region c, where only the firms of the small country benefit from trade liberalization.

region d, where the firms of the small country together with the manufacturer of the large country benefit from free trade; and

region e, where only both retailers benefit from the opening of trade.

Suppose market symmetry, $a = 1$. The introduction of intrabrand competition in a move to free trade imposes an upper bound on the degree of product differentiation such that, for $d > 0.589$ it is only the retailers who benefit from trade despite the fact that each manufacturer's products are now sold through two retailers. This finding is particularly relevant because the desirability of free trade is not necessarily linked to a country's interests but rather to the position the agents have in a distribution channel. Therefore, a change in the distribution system allows us to recover the

[11]The expresion for the dashed line is $\Phi^N(d) = \frac{2-d}{4+d}$.

result when retailers are not employed, i.e. the possibility that both manufacturers do not find free trade profitable (yellow region). Putting together the comparison in the last two sections, we conclude that vertical relations by themselves do not necessarily make trade liberalization more likely to be favourable to everybody. As the intensity of competition weakens all the agents' incentives are aligned in favour of the opening of trade. Figure 2 discloses that these are possible even for market asymmetry (grey region). Note now that, for intermediate levels of product differentiation, it is the manufacturer from the large country the one who is better off under autarky. Indeed one can find values of market asymmetry - $a < 0.443$ and above the dashed line - where it is *impossible* that all the agents simultaneously benefit from a move to free trade, regardless of the degree of product differentiation.

Finally, and in contrast with the comparison in the previous section, the retailer's incentives are greater than the manufacturer's in the large country only if d exceeds 0.2. Consequently, there appears an additional region, the green one, where it is the retailer in the large country the sole agent who finds free trade unprofitable.

A closer look at the variation in equilibrium quantities discloses that these are greater than under autarky. Furthermore, the equilibrium margin for the retailer in the small country is higher than under autarky only under some circumstances.[12] Altogether we have that the latter agent always improves with trade liberalization this meaning that the market expansion effect always compensates for the competition effect. Regarding the equilibrium margin for the manufacturer in the large country, it can be shown that it is smaller than under autarky. Whether the (positive) variation in output exceeds the (negative) variation in the margin determines whether the market expansion effect offsets the competition effect. Whatever happens to the remaining equilibrium margins is unclear. A similar but more elaborate argument applies to the possible gains enjoyed by the manufacturer in the small country and to the retailer in the large country.[13] It is the reassignment of the different equilibrium margins that gives rise to all the situations illustrated by Figure 2.

[12] The equilibrium margin is higher under free trade for $a < \frac{1-d}{2-d}$.

[13] To be more precise, the equilibrium margin for the manufacturer in the small country is higher under autarky for $a > \frac{1-d}{1+d}$. On the other hand, the equilibrium margin for the retailer in the large country is higher under autarky for $a < \frac{2-d}{1+d}$.

4 Welfare Analysis

It is common in theoretical work to find support to the existence of gains from free trade. On aggregate, it can be shown that, in the current setting, free trade improves upon autarky regardless of the distribution system. However, and given the relevance of the resulting distribution system when trade opens, it also happens that the welfare comparison under free trade with and without exclusivity gives rise to an ambiguous ranking and, on aggregate terms, the integrated economy might gain with the existence of exclusivities.[14] This happens for a sufficiently low degree of product differentiation and for any level of demand asymmetry. In the light of these results it is apparent that a deeper analysis that looks at welfare on a country basis as well as the impact of trade on consumers is required.

Countries' policy choices can be justified in terms of a social welfare analysis or be driven by their interests in consumers. We begin first with examining the gains from trade liberalization that consumers in each country obtain depending on which distribution system materializes (See Figure 3). The following proposition summarizes the main conclusions. See Appendix sections A.2.2 and A.3.2 for the proof.

Proposition 3 *Consumers in the two countries prefer free trade rather than autarky regardless of the distribution system if the degree of market asymmetry is not too important (region a). However, as the degree of market asymmetry increases then consumers in one country will be worse off if the actual distribution system is the one with exclusivity (region b). Finally when it is sufficiently large then consumers in one country will be worse off regardless of the distribution system (region c).*

With homogeneous products, it is the case that consumers are always better off when trade opens (see Cordella, 1993). With product differentiation though, trade can reduce the variety of products in the long run and some consumers can be hurt by the opening of trade, as suggested by Eaton and Kierzkowski (1984).

The short-run analysis herein contemplates vertical relationships to show that free trade is not necessarily desirable for consumers in both countries. As is well known, consumer surplus is given by the triangle area below the linear demand curve and above the price. When comparing with the autarky equilibrium, the height of

[14]These computations and formal proofs are available from the authors upon request.

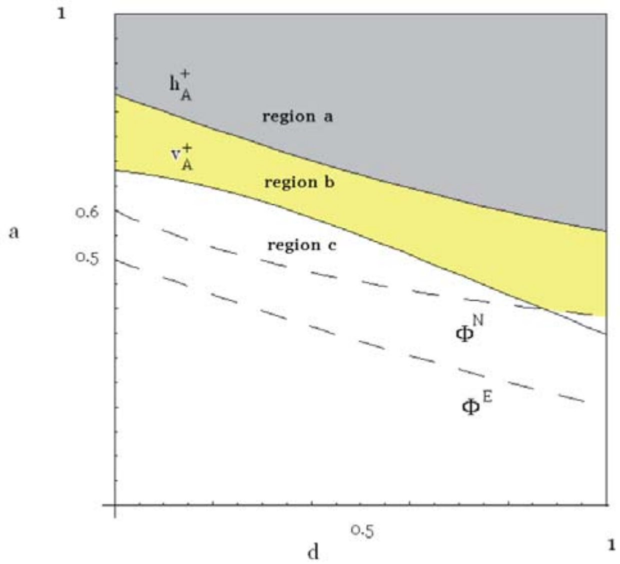

Figure 3: Consumer Surplus for the Small Country: Autarky vs. Free Trade with and without Exclusivity.

the triangle has to do with the outward/inward demand shift as well as with the price associated with the equilibrium under free trade, and the base with the equilibrium quantity. (How consumer surplus is calculated has been advanced in footnote 5)

Note that the opening of trade is affecting consumers welfare is several respects. First of all there is more product variety because with free trade four differentiated goods are sold in each country. Next, it is important to stress that the opening of trade may imply an inward demand shift. Finally, it can also happen that the equilibrium price under free trade be higher than the equilibrium price under autarky - which may happen for the small country. The interplay between these three effects determines whether consumers in the small country might lose from trade. Consider for example the case with exclusivities. It happens that depending on the degree of demand asymmetry there is a shift outwards in the demand and simultaneously and increase in price with respect to autarky. If the degree of demand asymmetry is more pronounced then the price effect dominates the shift effect. As spelled out above, equilibrium output under free trade not always exceeds that before trade opens. The combination of these competing effects may result in a reduction of consumer surplus.[15] The next Proposition addresses what happens in welfare terms. See Appendix sections A.2.3 and A.3.3 for the proof

Proposition 4 *The small country is always better off in a move from autarky to free trade regardless of the resulting distribution system. However, the large country may not support trade liberalization when the distribution system does not entail exclusivity and product differentiation is low enough combined with a sufficiently large demand asymmetry. That is,* $(SW^k)^{FTE} > (SW^k)^*$ *for* $k = A, B$; $(SW^A)^{FTN} > (SW^A)^*$ *but* $(SW^B)^{FTN} \gtreqless (SW^B)^*$.

The welfare analysis in Cordella (1993) discloses the relevance both of market and oligopoly sizes in determining trade liberalization welfare gains. Although firms in one country lose from trade, consumer gains can offset producer losses the larger the market of the trading partner and the less concentrated its industry is. A setting with vertical relationships confirms the idea that the small country always gets better with the opening of trade. Consider a distribution system with exclusivities. It is worth noting that, for the small country, such welfare increase occurs despite the fact that consumers might lose - as shown in Proposition 3 above. However, for the large country, firms may lose and yet welfare increases arise. Interestingly enough, and exclusivities aside, when competition is intense and countries are enough asymmetric, the manufacturer's losses more than compensate consumer and the retailer's gains so that welfare is indeed higher without trade - see Figure 4, dark area.

5 Trade Liberalization and Endogenous Distribution Systems

The foregoing analysis uncovers not only the conflict that may arise between agents within the same country but also between agents in both countries at different stages in the production process. This section addresses whether, given that trade liberalization takes place, manufacturers and/or retailers prefer a distribution system that

[15] This analysis is also applicable to the case without exclusivities with the same conclusion. However, it is possible to find situations where consumer surplus decreases because the price is higher under free trade and there is a shift inwards in the demand. This additional case shows up when the degree of product differentiation is not important.

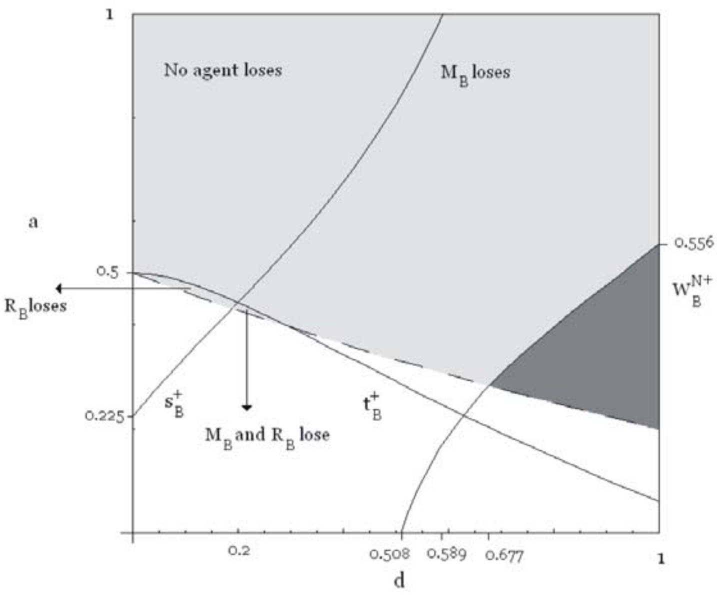

Figure 4: Welfare for the Large Country: Autarky vs. Free Trade with Non-Exclusivity.

involves exclusivity relationships. We begin by comparing equilibrium profits for manufacturers and retailers under an exclusive and a non-exclusivity arrangements. Then we move on and contemplate the possibility that the products of one of the manufacturers be sold through only one retailer whereas the rival manufacturer's products be sold through both retailers. The consideration of the latter distribution system will allow us to endogenize the choice of distribution system by assuming an initial stage where manufacturers, alternatively retailers, decide on the introduction of an exclusivity clause. In other words, countries abandon the use of any trade policy and we wish to examine the agents' incentives to employ a vertical restraint as is exclusivity. Thus, this part of our analysis keeps a relation with the ideas developed in Richardson (2004) and Raff and Schmitt (2005).[16]

[16] Raff and Schmitt (2005), in a setting where contract choice is endogenous, show that trade liberalization may lead manufacturers to employ vertical restraints thus creating a case for competition policy in an environment with free trade. A similar result is shown by Richardson (2004) but in a spatial model where the number of retailers is endogenously determined.

Free Trade with Exclusivity vs. Nonexclusivity.

Note that $(M^k)^{FTE} > (M^k)^{FTN}$ if $d > 0.342$, while $(R^k)^{FTE} > (R^k)^{FTN}$ if $d < 0.112$. This further emphasizes the conflicting interests of manufacturers and retailers. Consumers are always better off when retailers are not exclusive. Considering the aggregate profits of manufacturers and retailers in each country, free trade with exclusivity reaches higher profits if $d > 0.756$. Considering each country's social welfare, free trade without exclusivity achieves greater welfare than with exclusivity.

Endogenous Distribution System when Manufacturers May Impose the Exclusivity Clause.

For the sake of the exposition, a change in notation is introduced in order to stress the agents' decision on exclusivity. Denote by $(M^k)^{lm}$ the equilibrium profits of manufacturer k where the first superscript indicates whether manufacturer A establishes the exclusivity clause and the second corresponds with the choice of manufacturer B, $l, m = E, N$, for E standing for exclusivity and N for nonexclusivity. Therefore, $(M^k)^{FTE} = (M^k)^{EE}$ and $(M^k)^{FTN} = (M^k)^{NN}$. Consider now that for example M^A introduces an exclusive distribution clause on its products while M^B does not. Under this situation we have that retailer R^A is the exclusive seller of $M^{A\prime}s$ products and distributes the four products in the market. However, retailer R^B only distributes the products of M^B. The solution of the two-stage subgame (first choice of $w's$ and then quantities) under this asymmetric distribution system yields the following manufacturers' equilibrium profits:

$$(M^A)^{EN} = \frac{(a^A+a^B-2c)^2(1-d)(2+6d+3d^2)^2}{2(1+d)(1+3d)(4+8d-3d^2)^2} \quad (M^B)^{EN} = \frac{(a^A+a^B-2c)^2(1-d)(1+2d)(4+9d)^2}{6(1+d)(1+3d)(4+8d-3d^2)^2}$$

There is now an initial stage where manufacturers decide simultaneously and independently whether to introduce the exclusivity clause. It can be shown that $(M^A)^{EE} > (M^A)^{EN}$, $(M^A)^{NN} > (M^A)^{EN}$ and that $(M^B)^{NN} < (M^B)^{EN}$ for all $d \in (0, 1)$. However, $(M^B)^{EE} > (M^B)^{EN}$ if and only if $d > 0.518$. Given symmetry, it happens that $(M^A)^{EN} = (M^B)^{NE}$ and that $(M^B)^{EN} = (M^A)^{NE}$. In view of this, it is easy to see that the best response for each manufacturer, if the other introduces exclusivity, is to introduce exclusivity if and only if $d > 0.518$. Also, the best response for each manufacturer if the other does not introduce exclusivity is *not* to introduce exclusivity, since $(M^A)^{NN} > (M^A)^{EN}$. Then, we have the following result:

Proposition 5 *Suppose manufacturers decide whether to introduce an exclusive distribution clause. The equilibrium distribution systems are:*
i) Both manufacturers do not use exclusive clauses when $0 < d < 0.518$.
ii) Either both manufacturers use exclusive clauses or both do not when $0.518 < d < 1$.

Endogenous Distribution System when Retailers Impose the Exclusivity Clause.

Suppose now that in the initial stage retailers decide simultaneously and independently whether to introduce the exclusivity clause. Under the asymmetric distribution system presented above we have the following retailers' equilibrium profits:

$$(R^A)^{EN} = \frac{(a^A+a^B-2c)^2(13+53d+60d^2+18d^3)}{36(1+d)(1+3d)(4+8d-3d^2)} \quad (R^B)^{NE} = \frac{(a^A+a^B-2c)^2(4+11d+3d^2)^2}{36(1+d)(4+8d-3d^2)^2}$$

By employing the same obvious notation as above, we find that $(R^A)^{EE} < (R^A)^{EN}$ and $(R^A)^{NN} < (R^A)^{EN}$ and $(R^B)^{NN} > (R^B)^{EN}$ for all $d \in (0,1)$. However, $(R^B)^{EE} > (R^B)^{EN}$ if and only if $d < 0.439$. It is straightforward to characterize the Nash equilibrium in the choice of exclusivity by retailers.

Proposition 6 *Suppose retailers decide whether to introduce an exclusive distribution clause. The equilibrium distribution systems are:*
i) Both retailers use exclusive clauses when $0 < d < 0.439$.
ii) One retailer uses the exclusive clause and the rival does not when $0.439 < d < 1$.

Given that trade liberalization occurs, the statements in the above two propositions leads us to conclude that retailers and manufacturers *never agree* about their preference for endogenous distribution systems. Note that a prisoner's dilemma shows up since manufacturers prefer to introduce the exclusivity clause yet the Nash equilibrium is not to introduce it. Specifically this occurs for $0.342 < d < 0.518$. Similarly for retailers in that they prefer *not* to introduce the exclusivity clause while the Nash equilibrium is to introduce it; this occurs for $0.112 < d < 0.439$. An interesting by-product of the foregoing analysis is that there is a parameter region for which, although countries refuse to use any trade policy instruments, the agents do not necessarily find it profitable to use vertical restraints such as exclusivity.

6 Conclusions

This paper has looked at the desirability of trade liberalization in a setting that explicitly considers vertical relationships and studied their distributive effects under different market structures. The departing situation is one of autarky with a multiproduct successive monopoly. The opening of trade involves a multiproduct successive duopoly structure allowing for the introduction of intrabrand competition. The analysis unveils that not only a conflict may arise between agents within the same country but also between agents in both countries at different stages in the production process. We hope to have shed some light on the derived effects of trade liberalization suggesting that one should evaluate the process not just on a country basis but rather look at the agents' incentives, regardless of the country they belong to.

Conflicts between different agents involved in the production process in an open economy are exemplified by the recent expiration of the World Trade Organisation's longstanding system of textile quotas.[17] The European Commission was rushing in shaping an agreement that may please manufacturers, retailers and the Chinese. Clearly, the battle over Chinese textile trade has set manufacturers against retailers and consumers. Of course, China's textile is probably an example that does not fit exactly into the model but can serve as an illustration. This is a necessary step to better identify the forces behind the likely damages to some agents in trade liberalization processes and hence to understanding why they might be contrary to such processes.

Our analysis has assumed that retailers compete in quantities. One wonders whether similar results would obtain under price competition. Such an assumption would imply a reinforcement of the competition effect stemming from a process of trade liberalization. This would reduce the agents' incentives towards trade liberal-

[17] In this way, "China has been heading for a showdown with America and the European Union, where powerful textile lobbies have frantically agitated for legislative action to stop the flood of cheap Chinese apparel from swamping their businesses. The EU tried to resolve the issue in June, when it signed an agreement with China imposing new quotas on ten categories of textile goods, limiting growth in those categories to between 8% and 12.5% a year. The agreement, which runs to 2007, was to give domestic manufacturers time to adjust to a world of unfettered competition" (*The Economist*, "Europe's textile war with China—and itself", Sep 1st 2005). It seems that European retailers' opinion has been disregarded and, just a month after the deal was agreed, quotas on Chinese textiles have been exceeded.

ization and increase the incentives to introduce exclusivity clauses. An alternative modeling could have considered that the departing situation was one with trade under non-prohibitive tariffs. Trade liberalization would imply the elimination of tariffs. One would expect that our results will remain valid for a sufficient high level of tariff protection.

A Appendix

A.1 Derivation of the inverse demand functions for the integrated markets case

Note that in the integrated markets case there is only one price for each product in both countries. Each representative consumer maximizes its utility function subject to its income constraint for any given vector price (p_1, p_2, p_3, p_4). The inverse demand function system for each representative consumer reads:

$p_i = a^A - q_i^A - d\sum_{j\neq i} q_j^A \ i,j = 1,2,3,4.$ for consumer in country A and $p_i = a^B - q_i^B - d\sum_{j\neq i} q_j^B \ i,j = 1,2,3,4$ for consumer in country B. Considering the case where $a^A \leq a^B$, it happens that the aggregate inverse demand for product i, given $\sum_{j\neq i} Q_j$, where $Q_i = q_i^A + q_i^B$, is equal to,

$$p_i = \begin{cases} a^B - q_i^B - d\sum_{j\neq i} Q_j & if\ p_i > a^A \\ \frac{1}{2}(a^A + a^B - Q_i - d\sum_{j\neq i} Q_j) & if\ p_i \leq a^A \end{cases}$$

The upper branch corresponds to the case where the large market is so prevalent that the firms prefer to concentrate on this market by setting a price that is above the highest price the consumers in the small country are willing to pay. The second branch is just the case where the countries are not too asymmetric and then consumers of both countries have positive demand.

A.2 Autarky vs. Free Trade with Exclusivity: Notation and Complete Characterization of the Agents' Incentives to Trade Liberalization

First of all note that there is a constraint on the ratio a in order to guarantee that the equilibrium for the integrated markets case is on the lower branch of the aggregate inverse demand function. This constraint comes from $p_i^{FTE} \leq a^A$ since $0 < a_A \leq a_B$. It reads $\Phi^E(d) \leq a \leq 1$, where $\Phi^E(d)$ is equal to $\frac{3+6d+d^2}{5+14d+7d^2}$ and is a decreasing function of d ranging from $\frac{3}{5}$ to $\frac{5}{26}$.

A.2.1 Firms' Gains from Free Trade

1.a) $(M^A)^{FTE} > M^{A*}$ implies that the small country manufacturer benefits from free trade. $(M^A)^{FTE} > M^{A*}$ iff $2(1+d)^2 + 4(1+d)^2 a - (2+8d+7d^2+2d^3)a^2 > 0$, where $a = \frac{a_A}{a_B}$ and $0 < a_A \leq a_B$. Denote by $f_A^-(d)$ and $f_A^+(d)$ the lower and the greater roots of the above concave polynomial. These roots read:

$f_A^-(d) = \frac{2(1+d)^2-(2+d)\sqrt{2(1+d)(1+2d)}}{2+8d+7d^2+2d^3}$ and $f_A^+(d) = \frac{2(1+d)^2+(2+d)\sqrt{2(1+d)(1+2d)}}{2+8d+7d^2+2d^3}$,
and verify that $f_A^-(d) < 0 < 1 < f_A^+(d)$ for all $d \in (0,1)$.

- Then $(M^A)^{FTE} > M^{A*}$ iff $a \in (0,1)$

1.b) Similarly, $(M^B)^{FTE} > M^{B*}$ iff $2(1+d)^2a^2+4(1+d)^2a-(2+8d+7d^2+2d^3) > 0$. Denote by $f_B^-(d)$ and $f_B^+(d)$ the lower and the greater roots of the above convex polynomial in a. These roots read:

$f_B^-(d) = \frac{-2(1+d)-(2+d)\sqrt{1+2d}}{2(1+2d)(2+d)^2}$ and $f_B^+(d) = \frac{-2(1+d)+2(2+d)\sqrt{1+2d}}{2(1+2d)(2+d)^2}$,
and satisfy that $f_B^-(d) < 0 < f_B^+(d) < 1$ for all $d \in (0,1)$.

- Then $(M^B)^{FTE} > M^{B*}$ iff $a \in (f_B^+(d), 1)$

1.c) $(R^A)^{FTE} > R^{A*}$ iff $2(1+d)^4 + 4(1+d)^4 a - a^2(1+4d+2d^2)(2+4d+d^2) > 0$. Denote by $g_A^-(d)$ and $g_A^+(d)$ the lower and the greater roots of the above concave polynomial. These roots read:

$g_A^-(d) = \frac{(1+d)^2[-2(1+d)^2-\sqrt{(1+d)^4-2(1+4d+2d^2)(2+4d+d^2)}]}{(1+4d+2d^2)(2+4d+d^2)}$ and
$g_A^+(d) = \frac{(1+d)^2[-2(1+d)^2+\sqrt{4(1+d)^4-2(1+4d+2d^2)(2+4d+d^2)}]}{(1+4d+2d^2)(2+4d+d^2)}$
and verify that $g_A^-(d) < 0 < 1 < g_A^+(d)$ for all $d \in (0,1)$.

- Then $(R^A)^{FTE} > R^{A*}$ iff $a \in (0,1)$

1.d) $(R^B)^{FTE} > R^{B*}$ iff $2(1+d)^4a^2 + 4(1+d)^4 a - (1+4d+2d^2)(2+4d+d^2) > 0$. Denote by $g_B^-(d)$ and $g_B^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$g_B^-(d) = \frac{-2(1+d)^2-\sqrt{4(1+d)^4-2(1+4d+2d^2)(2+4d+d^2)}}{2(1+d)^2}$ and
$g_B^+(d) = \frac{-2(1+d)^2+\sqrt{4(1+d)^4-2(1+4d+2d^2)(2+4d+d^2)}}{2(1+d)^2}$
and verify that $g_B^-(d) < 0 < g_B^+(d) < 1$ for all $d \in (0,1)$.

- Then $(R^B)^{FTE} > R^{B*}$ iff $a \in (g_B^+(d), 1)$.

Also it is easy to see that $f_B^+(d) - g_B^+(d) > 0$ for all $d \in (0,1)$, then the following ranking holds: $0 < g_B^+(d) < f_B^+(d) < 1$ for all $d \in (0,1)$.

By combining the five items above we have the following result:

Proposition 7 *For all* $d \in (0,1)$:
a) if $0 < a < g_B^+(d) < f_B^+(d) < 1$ *then only the agents of the small country benefit from free trade;*
b) if $0 < g_B^+(d) < a < f_B^+(d) < 1$ *then the manufacturer of the large country is the unique agent not benefiting from free trade;*
c) if $0 < g_B^+(d) < f_B^+(d) < a < 1$ *then all agents (manufacturers and retailers) benefit from free trade.*

The above result is qualified by the constraint on a such that $\Phi^E(d) \leq a \leq 1$. The constraint corresponds with the dashed line in Figure 1, and then the three regions specified in Proposition 5 arise.

A.2.2 As for consumers

1.e) $(CS^A)^{FTE} > CS^{A*}$ iff

$(46 + 441d + 1523d^2 + 3597d^3 + 2505d^4 + 944d^5 + 147d^7)a^2$
$-2(1+d)^2(2+3d)(3+6d+d^2)(5+14d+7d^2)a$
$+(1+d)^2(2+3d)(3+6d+d^2)^2 > 0$ Denote by $h_A^-(d)$ and $h_A^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$$h_A^-(d) = \frac{30+d(249+844d+1503d^2+1502d^3+827d^4+224d^5+21d^6)-(1+d)(1+2d)(1+3d)(2+d)(3+6d+d^2)\sqrt{2+3d}}{(46+441d+1523d^2+3597d^3+2505d^4+944d^5+147d^7)}$$

and

$$h_A^+(d) = \frac{30+d(249+844d+1503d^2+1502d^3+827d^4+224d^5+21d^6)+(1+d)(1+2d)(1+3d)(2+d)(3+6d+d^2)\sqrt{2+3d}}{(46+441d+1523d^2+3597d^3+2505d^4+944d^5+147d^7)}$$

and verify that $0 < h_A^-(d) < \Phi^E(d) < h_A^+(d) < 1$ for all $d \in (0,1)$.

- Then $(CS^A)^{FTE} > CS^{A*}$ iff $a \in (h_A^+(d), 1)$.

1.f) $(CS^B)^{FTE} > CS^{B*}$ iff

$(1+d)^2(2+3d)(3+6d+d^2)^2a^2$
$-2(1+d)^2(2+3d)(3+6d+d^2)(5+14d+7d^2)a$
$+(46+441d+1523d^2+3051d^4+3597d^4+2505d^5+944d^6+147d^7) > 0$. Denote by $h_B^-(d)$ and $h_B^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$$h_B^-(d) = \frac{30+d(249+844d+1503d^2+1502d^3+827d^4+224d^5+21d^6)-(1+d)(1+2d)(1+3d)(2+d)(3+6d+d^2)\sqrt{2+3d}}{(1+d)^2(2+3d)(3+6d+d^2)^2}$$

and

$$h_B^+(d) = \frac{30+d(249+844d+1503d^2+1502d^3+827d^4+224d^5+21d^6)+(1+d)(1+2d)(1+3d)(2+d)(3+6d+d^2)\sqrt{2+3d}}{(1+d)^2(2+3d)(3+6d+d^2)^2}$$

and verify that $1 < h_B^-(d) < h_B^+(d)$ for all $d \in (0,1)$.

- Then $(CS^B)^{FTE} > CS^{B*}$ for all $a, d \in (0,1)$.

A.2.3 Each country's total welfare

1.g) $(SW^A)^{FTE} > (SW^A)^*$ iff $Aa^2 - Ba + C > 0$.

Where,

$A \equiv (34 + 255d + 705d^2 + 837d^3 + 303d^4 - 161d^5 - 148d^6 - 33d^7) > 0$,

$B \equiv 2(1+d)^2(3 + 6d + d^2)(6 + 15d + 4d^2 + 15d^3) > 0$,

$C \equiv (1+d)^2(3 + 6d + d^2)(10 + 49d + 80d^2 + 39d^3) > 0$.

It happens that the lower and the greater roots of the above convex polynomial do not exist since the discriminant is negative. That is,

$sign(B^2 - 4AC) = sign(-58 - 173d - 106d^2 + 49d^3 + 42d^4) < 0$ for all $d \in (0,1)$.

- Then $(SW^A)^{FTE} > (SW^A)^*$ for all $a, d \in (0,1)$.

1.h) $(SW^B)^{FTE} > (SW^B)^*$ iff $Ca^2 - Ba + A > 0$. Where A, B and C are the same as in item 1.g).

It happens that the lower and the greater roots of the above convex polynomial do not exist since the discriminant is negative. It coincides with the one corresponding to item 1.g).

- Then $(SW^B)^{FTE} > (SW^B)^*$ for all $a, d \in (0,1)$.

A.3 Autarky vs. Free Trade without Exclusivity. Notation and Complete Characterization of the Agents' Incentives to Trade Liberalization

As before we first compute the constraint on a such that the equilibrium price is on the lower branch of the aggregate inverse demand. The constraint comes from $p_i^{FTN} \leq a^A$ and reads $\Phi^N(d) \leq a \leq 1$, where $\Phi^N(d) = \frac{2-d}{4+d}$ and is a decreasing function of d ranging from $\frac{1}{2}$ to $\frac{1}{5}$.

A.3.1 Firms' Gains from Free Trade

2.a) $(M^A)^{FTN} > M^{A*}$ implies that the small country manufacturers benefits from free trade. $(M^A)^{FTN} > M^{A*}$ iff $2(1 + d - d^2 - d^3) + 4(1 + d - d^2 - d^3)a - (1 + 7d +$

$2d^2 + 2d^3)a^2 > 0$. Denote by $s_A^-(d)$ and $s_A^+(d)$ the lower and the greater roots of the above concave polynomial. These roots read:

$s_A^-(d) = \frac{2(1+d-d^2-d^3)-\sqrt{6(1+4d+2d^2-4d^3-3d^4)}}{1+7d+2d^2+2d^3}$ and $s_A^+(d) = \frac{2(1+d-d^2-d^3)+\sqrt{6(1+4d+2d^2-4d^3-3d^4)}}{1+7d+2d^2+2d^3}$.

It happens that $s_A^-(d) < 0 < 1 < s_A^+(d)$ when $0 < d < 0.589$; while $s_A^-(d) < 0 < s_A^+(d) < 1$ for $0.589 < d < 1$.

- Then we conclude that $(M^A)^{FTN} > M^{A*}$ either if $a \in (0,1)$ when $0 < d < 0.589$ or if $s_A^-(d) < 0 < a < s_A^+(d) < 1$ when $0.589 < d < 1$.

2.b) $(M^B)^{FTN} > M^{B*}$ iff $-(1 + 7d + 2d^2 + 2d^3)^2 + 4(1 + d - d^2 - d^3)a + 2(1 + d - d^2 - d^3)a^2 > 0$. Denote by $s_B^-(d)$ and $s_B^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$s_B^-(d) = \frac{-2(1+d-d^2-d^3)-\sqrt{6(1+4d+2d^2-4d^3-3d^4)}}{2(1+d-d^2-d^3)}$ and $s_B^+(d) = \frac{-2(1+d-d^2-d^3)+\sqrt{6(1+4d+2d^2-4d^3-3d^4)}}{2(1+d-d^2-d^3)}$.

It happens that $s_B^-(d) < 0 < s_B^+(d) < 1$ for $0 < d < 1$.

- Then we conclude that $(M^B)^{FTN} > M^{B*}$ iff $a \in (s_B^+(d), 1)$.

2.c) $(R^A)^{FTN} > R^{A*}$ iff $4(1 + d)^3 + 8(1 + d)^3a - (5 + 15d - 12d^2 - 4d^3)a^2 > 0$. Denote by $t_A^-(d)$ and $t_A^+(d)$ the lower and the greater roots of the above concave polynomial. These roots read:

$t_A^-(d) = \frac{4(1+d)^3-6\sqrt{1+6d+12d^2+10d^3+3d^4}}{5+15d-12d^2-4d^3}$ and $t_A^+(d) = \frac{4(1+d)^3+6\sqrt{1+6d+12d^2+10d^3+3d^4}}{5+15d-12d^2-4d^3}$.

It happens that $t_A^-(d) < 0 < 1 < t_A^+(d)$ for all $d \in (0,1)$.

- Then $(R^A)^{FTE} > R^{A*}$ for all $a \in (0,1)$.

2.d) $(R^B)^{FTN} > R^{A*}$ iff $-(5 + 15d - 12d^2 - 4d^3) + 8(1 + d)^3a + 4(1 + d)^3a^2 > 0$. Denote by $t_B^-(d)$ and $t_B^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$t_B^-(d) = \frac{-2(1+d)^3-3\sqrt{1+6d+12d^2+10d^3+3d^4}}{2(1+d)^3}$ and $t_B^+(d) = \frac{-2(1+d)^3+3\sqrt{1+6d+12d^2+10d^3+3d^4}}{2(1+d)^3}$.

It happens that $t_B^-(d) < 0 < t_B^+(d) < 1$ for all $d \in (0,1)$.

- Then $(R^A)^{FTE} > R^{A*}$ if $a \in (t_B^+(d), 1)$.

Next we construct the ranking of the four thresholds on a defined above. It is easy to show that the ranking is:

i) $0 < s_B^+(d) \leq t_B^+(d) < 1 < t_A^+(d) \leq s_A^+(d)$ if $0 < d \leq 0.2$,

ii) $0 < t_B^+(d) < s_B^+(d) \leq 1 \leq s_A^+(d) < t_A^+(d)$ if $0.2 < d \leq 0.589$,

iii) $0 < t_B^+(d) \leq s_A^+(d) < 1 < s_B^+(d) \leq t_A^+(d)$ if $0.589 < d \leq 0.995$,

iv) $0 < s_A^+(d) < t_B^+(d) < 1 < t_A^+(d) < s_B^+(d)$ if $0.995 < d < 1$.

Combining the above items we provide the complete characterization of the four agents incentive to trade liberalization in the $d \times a$ parameter space.

Proposition 8 *i) Consider* $0 < d \leq 0.2$ *then*

i.a) if $0 < a < s_B^+(d) \leq t_B^+(d) < 1$ *then only the agents of the small country benefit from free trade;*

i.b) if $0 < s_B^+(d) < a \leq t_B^+(d) < 1$ *then the retailer of the large country is the unique agent not benefiting from free trade;*

i.c) if $0 < s_B^+(d) \leq t_B^+(d) < a < 1$ *then all agents (manufacturers and retailers) benefit from free trade.*

ii) Consider $0.2 < d \leq 0.589$ *then*

ii.a) if $0 < a < t_B^+(d) < s_B^+(d) \leq 1$ *then only the agents of the small country benefit from free trade;*

ii.b) if $0 < t_B^+(d) < a < s_B^+(d) \leq 1$ *then the manufacturer of the large country is the unique agent not benefiting from free trade;*

ii.c) if $0 < t_B^+(d) < s_B^+(d) < a \leq 1$ *then all agents (manufacturers and retailers) benefit from free trade.*

iii) Consider $0.589 < d \leq 0.995$ *then*

iii.a) if $0 < a < t_B^+(d) < s_A^+(d) \leq 1$ *then only the agents of the small country benefit from free trade;*

iii.b) if $0 < t_B^+(d) < a < s_A^+(d) < 1$ *then the manufacturer of the large country is the unique agent not benefiting from free trade;*

iii.c) if $0 < t_B^+(d) < s_A^+(d) < a < 1$ *then only retailers benefit from free trade.*

iv) Consider $0.995 < d < 1$ *then*

iv.a) if $0 < a < s_A^+(d) < t_B^+(d) \leq 1$ *then only the agents of the small country benefit from free trade;*

iv.b) if $0 < a < s_A^+(d) < t_B^+(d) < 1$ *then the retailer of the small country is the unique agent benefiting from free trade;*

iv.c) if $0 < s_A^+(d) < t_B^+(d) < a < 1$ *then only retailers benefit from free trade.*

However, as displayed in Figure 2, the constraint on a rules out part iv) above since $0 < s_A^+(d) < t_B^+(d) < \Phi^N(d)$ when $0.995 < d < 1$. The other three rankings in Proposition 6 are not ruled out.

A.3.2 As for consumers

2.e) $(CS^A)^{FTN} > CS^{A*}$ iff

$16(119 + 266d + 183d^2 + 80d^3 + 8d^4)a^2$

$-256(1 + d)^2(2 - d)(4 + d)a$

$+128(1 + d)^2(2 - d)^2 > 0$ Denote by $v_A^-(d)$ and $v_A^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$v_A^-(d) = \frac{2(4(1+d)^2(2-d)(4+d)-3(1+d)(1+3d)(2-d)\sqrt{2})}{(119+266d+183d^2+80d^3+8d^4)}$ and

$v_A^+(d) = \frac{2(4(1+d)^2(2-d)(4+d)+3(1+d)(1+3d)(2-d)\sqrt{2})}{(119+266d+183d^2+80d^3+8d^4)}$

and verify that $0 < v_A^-(d) < \Phi^N(d) < v_A^+(d) < 1$ for all $d \in (0, 1)$.

- Then $(CS^A)^{FTN} > CS^{A*}$ iff $a \in (v_A^+(d), 1)$.

2.f) $(CS^B)^{FTN} > CS^{B*}$ iff

$128(1 + d)^2(2 - d)^2a^2 - 256(1 + d)^2(2 - d)(4 + d)a$

$+16(119 + 266d + 183d^2 + 80d^3 + 8d^4) > 0$. Denote by $v_B^-(d)$ and $v_B^+(d)$ the lower and the greater roots of the above convex polynomial. These roots read:

$v_B^-(d) = \frac{4(1+d)(4+d)-3(1+3d)\sqrt{2}}{4(1+d)(2-d)}$ and

$v_B^+(d) = \frac{4(1+d)(4+d)+3(1+3d)\sqrt{2}}{4(1+d)(2-d)}$

and verify that $1 < v_B^-(d) < v_B^+(d)$ for all $d \in (0, 1)$.

- Then $(CS^B)^{FTN} > CS^{B*}$ for all $a, d \in (0, 1)$.

A.3.3 Each country's total welfare

2.g) $(SW^A)^{FTN} > (SW^A)^*$ iff $A'a^2 - B'a + C' > 0$.

Where,

$A' \equiv (97 + 64d - 339d^2 - 278d^3 - 56d^4 - 48d^5 \lesseqgtr 0$,

$B' \equiv 16(1 + d)^2(2 - d)(2 - 7d - 6d^2)$,

$C' \equiv 8(1 + d)^2(2 - d)(4 + 7d + 6d^2) > 0$.

It happens that $A' > 0$ if $d \in (0, 0.508)$ and negative otherwise. It also happens that the discriminant is negative for $d \in (0, 0.468)$. Then, for $d \in (0, 0.468)$ the lower and the greater roots of the convex polynomial do not exist and we conclude that $(SW^A)^{FTE} > (SW^A)^*$ for all a if $d \in (0, 0.468)$. In case of $d \in (0.468, 0.508)$ the polynomial is convex and the roots exists. They read,

$W_A^{N-}(d) = \frac{-8(1+d)^2(2-d)(2-7d-6d^2)-6(1+d)\sqrt{2(2-d)(1+3d)(-36-35d+111d^2+224d^3+108d^4)}}{(97+64d-339d^2-278d^3-56d^4-48d^5}$ and

$W_A^{N+}(d) = \frac{-8(1+d)^2(2-d)(2-7d-6d^2)+6(1+d)\sqrt{2(2-d)(1+3d)(-36-35d+111d^2+224d^3+108d^4)}}{(97+64d-339d^2-278d^3-56d^4-48d^5}$.

It is easy to show that both roots are negative for $d \in (0.468, 0.508)$, and thus we conclude that $(SW^A)^{FTE} > (SW^A)^*$ for all a if $d \in (0.468, 0.508)$.

Finally, for $d \in (0.508, 1)$ the polynomial is concave and it happens that $W_A^{N-}(d) < 0 < 1 < W_A^{N+}(d)$ with the conclusion of $(SW^A)^{FTE} > (SW^A)^*$ for all a if $d \in (0.508, 1)$.

- Putting all the reasoning together, $(SW^A)^{FTN} > (SW^A)^*$ for all $a, d \in (0, 1)$.

2.h) $(SW^B)^{FTE} > (SW^B)^*$ iff $C'a^2 - B'a + A' > 0$. Where A', B' and C' are the same as in the 2.g) item.

It happens that the discriminant is negative for $d \in (0, 0.468)$. Then, for $d \in (0, 0.468)$ the lower and the greater roots of the convex polynomial do not exist and we conclude that $(SW^A)^{FTE} > (SW^A)^*$ for all a if $d \in (0, 0.468)$. Denote by $W_B^{N-}(d)$ and $W_B^{N+}(d)$ the lower and the greater roots of the above convex polynomial when $d \in (0.468, 1)$. These roots read,

$W_B^{N-}(d) = \frac{2(1+d)(2-d)(2-7d-6d^2)-3\sqrt{2(2-d)(1+3d)(-36-35d+111d^2+224d^3+108d^4)}}{2(1+d)(2-d)(4+7d+6d^2)}$ and

$W_B^{N+}(d) = \frac{2(1+d)(2-d)(2-7d-6d^2)+3\sqrt{2(2-d)(1+3d)(-36-35d+111d^2+224d^3+108d^4)}}{2(1+d)(2-d)(4+7d+6d^2)}$

They verify that $W_B^{N-}(d) < 0$, and $W_B^{N+}(d) < 0$ for $d \in (0.468, 0.508)$ while $0 < W_B^{N+}(d) < 1$ for $d \in (0.508, 1)$.

- Then

a)$(SW^B)^{FTN} > (SW^B)^*$ for all a, if $d \in (0, 0.508)$;
b)$(SW^B)^{FTN} > (SW^B)^*$ for all $W_B^{N+}(d) < a < 1$ if $d \in (0.508, 1)$;
c)$(SW^B)^{FTN} > (SW^B)^*$ for all $0 < a < W_B^{N+}(d)$ if $d \in (0.508, 1)$.

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