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Trade Liberalization and Distribution

by

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Abstract

We analyze how the organization of imports of agricultural products due to trade liberalization affects domestic production, profits and welfare. A local wholesaler owned by local farmers (cooperative) competes with an independent wholesaler, and both may distribute their products through independent retailers. The cooperative has exclusive rights for distributing local products, but both firms may import competing products from a world market. In equilibrium the cooperative refrain from importing and the private wholesaler imports exclusively, leading to a suboptimal welfare result compared to the situation where both firm import the foreign good. As expected, trade liberalization always improve welfare compared to autharky, but once trade is taking place further trade liberalization may sometimes hurt welfare.

Introduction

The signing of the Uruguay Round agreement on agriculture (URAA) in 1994 was a significant step towards the liberalization of world agricultural trade. Global competitiveness has arisen as a concern of many governments who have been under pressure to subsidize exports or to protect from imports in order to enhance the competitiveness of a country's firms in the face of increased global competition. While direct export subsidies footnote and import protection measures are forbidden by the Uruguay round GATT agreement, various other impediments to free trade and competition do still persist. Examination of imperfect competition has been an important topic in agricultural trade research for several decades. footnote

The main concern for policymakers has been the existence of market power at the processing level due to economies of scale, public institutions and international mergers and acquisitions. Less understood and far less studied are the sources of market power that stems from imperfections in marketing or distribution footnote . These imperfections may not only survive GATT, but may also survive international competition stemming from the liberalization of world trade. Indeed, many of the agribusiness cases cited as justifying the need to address competition policy are at the marketing and distribution level and not at the production level (see OECD, 1996; Solana-Rosillo and Abbott, 1998).

In this paper I want to focus on a specific issue related to distribution, namely the fact that in many agricultural markets distribution is dominated by marketing cooperatives, at least at the wholesale level. These organizations are characterized by that they are jointly owned by the producers of agricultural products (the farmers) and have substantial market power in that they are often exclusive distributors of domestic agricultural products. In the face of lower trade barriers, an interesting question is how these organizations will an should behave. When protection ends and trade with competing products are available, competing independent wholesalers may import. This will obviously pose a threat to marketing cooperatives as their sales and profit would be expected to fall due to imports An interesting question therefore is how these organizations are affected by trade liberalization and how they might react to the threat of increased international trade with their core products. For instance, one important question is: Should they import themselves or leave import of competing agricultural products to independent wholesalers? As opposed to locally produced products, marketing cooperatives cannot hope to gain exclusivity for imported goods, and if they import, they will most likely face competition from other wholesalers.

The focus of this paper therefore is to analyze the effect for farmers and their marketing cooperatives from trade liberalization in the market for an agricultural product. The central question is whether local production, sales and profit will increase or decrease as a result of trade liberalization. Moreover, we are also interested in welfare effects from trade liberalization. Intuitively, one should think that the answer to this question should be straight forward. Since imports will steal sales from local production, revenues and profits for local producers are expected to fall. Moreover, since freer trade increases competition one should expect lower prices, hence welfare should increase. However, the analysis presented in this paper demonstrates that effects from trade liberalization for local production, profitability and welfare depend critically on how import is organized.

We consider a setting where the local production of the domestic agricultural product is distributed exclusively by a farmers' cooperative at the wholesale level to an independent retail sector. Competing with the cooperative there is an independent wholesaler that is excluded from distribution of the locally produced goods, but both wholesale firms may import a foreign good when the trade costs falls below the prohibitive level. footnote

We show that if the farmers' cooperative imports the foreign good exclusively this will benefit the local producers compared to autharky. Moreover, once import is taken place, marginal decreases in trade costs will benefit local farmers. Domestic production decreases as trade barriers are build down, and for sufficiently low trade costs domestic production will fall

short of its level under autharky. Second, if both the farmers' cooperative and the private wholesaler import the foreign product, the cooperative will lose profit compared to autharky. Under trade, lower trade costs will hurt the profitability of the cooperative. The reason is that head to head competition for the imported product will drive its price to marginal costs. Hence, import is high and trade liberalization reduces both the price of the domestic product as well as domestic production as compared to autharky. Finally, when the private wholesaler imports exclusively, the cooperative and the private wholesaler will compete with differentiated products. When full franchise fee extraction of retail profit can be achieved the profits of the separate wholesalers stem from two sources: product differentiation and strategic delegation (see Bonanno and Vickers (1988)). Strategic delegation induces each wholesaler to increase his wholesale price above marginal cost which will induce the retailer to increase the retail price. The strategic response from the rival product's retailer will be to increase his price as well, a response that is beneficial to each wholesaler. The reason is that the extra profit generated by this kind of delegation can be captured by the wholesalers through the fixed part of the wholesale contracts.

Not surprisingly, the analysis reveals that trade liberalization always improves welfare as compared to autharky. Once trade with the foreign good is taken place, a further reduction is trade costs will hurt the cooperative wholesaler except for the case when the cooperative itself imports the foreign good exclusively. The effect from trade liberalization on welfare depend on three sources. First, trade will increase product variety which is good for welfare. Second, trade will increase competition which will tend to lower retail prices which is also good for welfare. Third, and this is a potentially negative effect, trade will replace efficient local production with more or less inefficient import depending on the trade cost. However, it turns out that once trade is taken place, further trade liberalization will benefit welfare in every cases except one. We show that trade liberalization may affect welfare adversely when the private wholesaler imports exclusively and trade costs are relatively high. It turns out that in this case the beneficial effects from increased product variety and increased competition are insufficient to compensate for the negative effect from inefficient import replacing domestic production.

Finally, in a game where each wholesaler independently may choose whether to import or not, we show that the best strategy for the cooperative is to leave import of the foreign good to the private wholesaler, and that this is indeed the equilibrium outcome. Moreover, the outcome yields a suboptimal welfare result as welfare would benefit from the extra competition effect that would result if both wholesalers imported the foreign good.

The paper is organized as follows. The next section puts up the model and we compute the equilibrium outcomes for autharky and the three different modes of organizing import in this model. In this section we also present comparative static results assessing the effect from further trade liberalization when trade takes place. In Section 4 we compare welfare for the four different outcomes from Section 3. In this section we also analyze the game where each wholesaler independently may choose whether to import or not. Section 5 offers some concluding remarks and discussion of possible extensions of the present model. All proofs are relegated to the appendix.

The model

We have two products; a domestic product (d) and an imported product (i). The domestic product is produced by independent farmers and distributed to consumers exclusively through a cooperative wholesaler and a privately owned retail sector. The imported product may either be distributed by the cooperative or a private wholesaler exclusively or jointly by both wholesalers. Each wholesaler use separate but identical retailers. A representative consumer has utility

$$U = (q_d + q_i) - \left(\frac{q_d^2}{2} + \frac{q_i^2}{2} \right) - \gamma q_d q_i - p_d q_d - p_i q_i$$

from consumption of the two goods, where q is quantity and p denotes price. Utility

maximization yields the system of inverse demand functions:

$$p_d = 1 - q_d - \gamma q_i$$

$$p_i = 1 - q_i - \gamma q_d$$

where the parameter $\gamma \in (0,1)$ measures the degree of product differentiation. When γ is close to zero the products are poor substitutes for the consumer and when γ is close to one the products are almost perfect substitutes. Solving the system above yields direct demand functions:

$$q_d = \frac{1 - p_d + \gamma p_i - \gamma}{1 - \gamma^2}$$

$$q_i = \frac{1 - p_i + \gamma p_d - \gamma}{1 - \gamma^2}$$

We assume that the marginal cost of domestic production is constant and we normalize this to $c = 0$ and that the imported product is produced at marginal cost c (also equal to zero) and can be imported at a trade cost t (transportation, tax etc.) per unit. Local distribution of goods at the wholesale level is executed either by an independent wholesaler or a marketing cooperative owned by local producers. All distribution costs are normalized to zero. At the retail level, the retailers are independent private firms, and the retail sector is perfectly competitive. footnote We assume that domestic production is always distributed exclusively by the marketing cooperative. Trade liberalization lowers the per unit trade cost t. Our aim is to study three different scenarios; i) the cooperative distributes both products exclusively (no private import), ii) the cooperative distributes both products and the private retailer distributes the imported product, and iii) the cooperative distributes the domestic product exclusively and the private wholesaler distributes the imported good exclusively.

Welfare (W) consists of the sum of consumer utility (U), the cooperative's profit π, the profit of the private wholesaler (Π) and aggregate profit of the retail sector. Wholesale contracts are two-part tariffs (F, w) consisting of a fixed fee F and a marginal wholesale price w. We consider the case where full franchise extraction of retail profit is possible, hence in all outcomes retail profit will be zero. As a benchmark case we first consider the case when trade costs are prohibitively high (denoted by autharky (AU). If so, demand for the domestic product is $q_d = 1 - p_d$, and we have

Proposition *Under autharky (AU) the cooperative and the private wholesaler earn* $\pi_{AU} = \frac{1}{4} = \pi^m$ *and* $\Pi_{AU} = 0$. *Domestic production and price are* $q_d = p_d = \frac{1}{2}$ *and welfare* $W_{AU} = \frac{3}{8}$.

Proof See the appendix.

When trade is blockaded, the cooperative have the domestic market power of a monopolist. The domestic good is distributed to the downstream retailer at a marginal wholesale price equal to the marginal cost of production. This induces the retailer to set the monopoly price, and the monopoly profit is appropriated by the cooperative with the fixed fee in the wholesale contract. The private wholesaler naturally earns zero, since he does not import. footnote Next we consider the case when the cooperative imports the foreign good exclusively.

Exclusive cooperative import (CE)

When the cooperative imports exclusively it can always set the wholesale prices of the two goods to the retailer in a way that induces the retailer to set the retail prices that maximizes aggregate rent. As before, the retail profit can be extracted by the cooperative with a fixed fee. Therefore, abstracting from wholesale pricing, the maximization problem of the cooperative is:

$$\max_{p_d} p_d q_d + (p_i - t) q_i$$

Solving this problem yields the following result:

Proposition *Exclusive cooperative import. Import will take place whenever $t \leq 1 - \gamma$. If so, the cooperative and the private wholesaler earn*

$$\pi_{CE} = \pi_{CE}(\gamma, t) = \frac{1}{4} \frac{2(1 - \gamma + t(\gamma - 1)) + t^2}{1 - \gamma^2} \geq \pi^m$$

$$\Pi_{CE} = 0$$

domestic production and import are

$$q_d = \frac{1}{2} \frac{1 - \gamma + \gamma t}{1 - \gamma^2}$$

$$q_i = \frac{1}{2} \frac{1 - t - \gamma}{1 - \gamma^2}.$$

Equilibrium prices are

$$p_d = \frac{1}{2}$$

$$p_i = \frac{1 + t}{2}$$

and welfare

$$W_{CE} = \frac{3}{8} \frac{2 - 2\gamma + 2\gamma t - 2t + t^2}{1 - \gamma^2}$$

Trade liberalization will benefit both the cooperative and welfare.

Proof See the appendix.

When the cooperative wholesaler imports the foreign good exclusively, the cooperative will generate profits from the sale of both products. The lower the trade cost, the larger is the share of profits that stems from the sale of the imported product. This can easily be seen from the equilibrium expression for domestic and import sales, q_d is increasing in t and q_i is decreasing in t. When trade costs become sufficiently low, domestic production falls short of production under autharky ($q_d^m = \frac{1}{2}$), whereas the price of domestic production is unaffected by changes in the trade costs. The reason is that the cooperative's price setting power ensures that collusive prices are always set, but the price of the imported good is reduced as trade costs are reduced. Hence, for sufficiently low trade costs, local production is hurt and replaced by imports. Note also that cooperative profit is increasing as trade costs are reduced.

Again, the private wholesaler earns zero as he by definition does not import in this case.

Private and Cooperative import (PC)

When both wholesalers import the foreign good at cost t, retail competition drives the price of the imported good to marginal cost, which for the retailer is the wholesale price w_i, i.e. $p_i = w_i$. Wholesale competition in turn, drives the wholesale price equal to the marginal cost of importing the foreign good. Hence, we must have that $p_i = w_i = t$. If so, the private wholesaler earns zero. Inserting $p_i = t$ in the demand functions above yields

$$q_d = \frac{1 - p_d + t\gamma - \gamma}{1 - \gamma^2}$$

$$q_i = \frac{1 - t + \gamma p_d - \gamma}{1 - \gamma^2}$$

and the cooperative solves footnote

$$\max_{p_d} p_d q_d + (p_i - t)q_i$$

$$\Updownarrow$$

$$\max_{p_d} p_d \frac{p_d - 1 - t\gamma + \gamma}{-1 + \gamma^2}.$$

Solving this problem yields the following outcome.

Proposition *Private and cooperative import. Import will take place whenever* $t \leq (1 - \gamma)\frac{2+\gamma}{2-\gamma^2}$. *If so, the cooperative and the private wholesaler earn*

$$\pi_{PC} = \pi_{PC}(\gamma, t) = \frac{1}{4}\frac{(1 + t\gamma - \gamma)^2}{1 - \gamma^2}$$

$$\Pi_{PC} = 0.$$

Domestic production and imports are

$$q_d = \frac{1}{2}\frac{1 + t\gamma - \gamma}{1 - \gamma^2}$$

$$q_i = \frac{1}{2}\frac{-2t + 2 - \gamma + t\gamma^2 - \gamma^2}{1 - \gamma^2}.$$

Equilibrium retail prices are written

$$p_d = \frac{1 + t\gamma - \gamma}{2}$$

$$p_i = t$$

and welfare

$$W_{PC} = \frac{1}{8}\frac{(-6t\gamma^2 + \gamma^2 + 5t^2\gamma^2 + 6t\gamma - 10\gamma + 9 - 4t^2)}{1 - \gamma^2}$$

Moreover, trade liberalization hurts the cooperative and benefits welfare.

When both the private and the cooperative wholesaler import the foreign good and distribute the good through separate channels, retail competition ensures that the retail price on the imported good is equal to its wholesale price. Moreover, wholesale competition with a homogeneous good ensures that the wholesale price is set at marginal cost, which in this case is equal to the trade cost. Therefore no distributor earns any profit on the imported good, but since its price is low, imports are high, and even higher as the trade cost decreases. As the trade costs decrease, both the domestic production and the price of the domestic product decrease. Both effects hurt the profits of the cooperative.

Exclusive private import (PE)

If the cooperative refrains from import, the private wholesaler imports the foreign good exclusively. In this case the wholesalers distribute differentiated products through separate retailers. The cooperative offers its retailer a wholesale price w_d, and given that the retailer solves

$$\max_{p_d}(p_d - w_d)q_d$$

The private wholesaler offers its retailer a wholesale price w_i, and the retailer solves

$$\max_{p_i}(p_i - w_i)q_i$$

Retail prices will generally depend on the vector of wholesale prices (w). Since all rent can be extracted by the upstream wholesalers, each upstream wholesaler chooses simultaneously his wholesale price to maximize aggregate profit of the product in question. Solving this game yields

the following outcome.

Proposition *Exclusive Private import (PE). Import will take place whenever*
$t \leq (1 - \gamma)\frac{\gamma^2 - 2\gamma - 4}{3\gamma^2 - 4}$. *If so, the cooperative and the private wholesaler earn*

$$\pi_{PE} = \pi_{PE}(\gamma, t) \leq \pi^m,$$

$$\Pi_{PE} \geq 0$$

Domestic production and imports are

$$q_d = \frac{-\gamma^5 + t\gamma^5 + 3\gamma^4 - 4t\gamma^3 + 4\gamma^3 - 10\gamma^2 + 4t\gamma - 4\gamma + 8}{(1 - \gamma^2)(\gamma^4 - 12\gamma^2 + 16)}$$

$$q_i = \frac{\gamma^5 + 3t\gamma^4 - 3\gamma^4 - 4\gamma^3 + 10\gamma^2 - 10t\gamma^2 + 4\gamma + 8t - 8}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)}$$

Equilibrium prices are

$$p_d = -2\frac{-\gamma^3 + t\gamma^3 + 3\gamma^2 + 2\gamma - 2\gamma t - 4}{\gamma^4 - 12\gamma^2 + 16}$$

$$p_i = \frac{t\gamma^4 + 2\gamma^3 - 6t\gamma^2 - 6\gamma^2 - 4\gamma + 8t + 8}{\gamma^4 - 12\gamma^2 + 16}.$$

Moreover, trade liberalization always hurts the cooperative and benefits welfare if the trade cost is sufficiently low.

Proof See the appendix.

When the private wholesaler imports exclusively he will compete with the cooperative with a differentiated product. The wholesalers can in this case benefit from strategic delegation to retailers and increase the profitability of their products above the level that stems purely from the degree of horizontal product differentiation between the products. When imports take place, a further lowering of the trade cost will hurt the cooperative because both the price and sale of the locally produced good will fall. The effect on welfare, however, is ambiguous. When the trade cost is relatively high so that import (when it occurs) is relatively low, a further decrease in the trade cost may in fact reduce welfare. The reason is that in this case, even if the prices on both products will fall, local production is replaced by very inefficient import. footnote For lower levels of the trade cost, the effect from trade liberalization on the prices will be sufficiently high to overcome the negative effect from inefficient import, so as to make the total effect on welfare positive.

Welfare comparison and equilibrium outcome

In this section we first compare welfare in the four different outcomes from the previous analysis. Then we ask whether the agents will realize the socially optimal outcome from a game where each wholesaler independently decides whether to import the foreign good or not. Comparing welfare yields the following result:

Proposition $W_{PC} \geq W_{PE} \geq W_{CE} \geq W_{AU}$

Proof See the appendix.

Welfare is highest when both wholesalers import the foreign good. If import is managed exclusively by either of the wholesalers it is better for welfare that the private retailer imports exclusively than when the cooperative imports exclusively. The intuition is that when both wholesalers import the foreign good, retail and wholesale competition will drive the price of the foreign good down to the marginal cost of importing it. Furthermore, the margin that can be earned on the domestic good is low due to the competition from the imported good. Under exclusive import fierce competition in the market can be avoided. If the cooperative imports exclusively it will coordinate the price setting of the two goods in a way that maximizes

aggregate profit, which will imply that collusive pricing will be the result. On the other hand, if the private wholesaler imports exclusively, resulting retail prices will be above marginal costs due to product differentiation and strategic delegation by the wholesalers. Finally, all outcomes improves welfare as compared to autharky because increased product variety and/or some competition is introduced.

Considering the game where each wholesaler may independently decide whether to import or not it is clear from the previous analysis that it is a dominant strategy for the private wholesaler to import. The reason for this is that if he does not import he will earn zero. Given this, the question for the cooperative is whether it should import or not. Then we can show the following:

Proposition *In the game where each wholesaler can decide whether to import or not, the equilibrium outcome is exclusive private import (PE).*

Proof See the appendix.

If the trade costs are below the prohibitive level, the private wholesaler always imports. Then it is a best reply that the cooperative refrains from importing the foreign good. This equilibrium outcome is not the one that maximizes social welfare. From the society's point of view we would like to see that both wholesalers imported the foreign good.

Concluding remarks

The purpose of this paper has been to analyze the effect for farmers and their cooperative distribution systems from trade liberalization in a market for a agricultural product. The analysis has demonstrated that the way distribution is organized has important implications for how welfare and the profits of the agents are affected by liberalization of international trade.

We have shown that if import is managed exclusively by either of the wholesalers it is better for welfare that the private retailer imports exclusively than when the cooperative imports exclusively. The reason is that when both wholesalers import the foreign good, retail and wholesale competition will drive the price of the foreign good down to the marginal cost of importing it. Furthermore, the margin that can be earned on the domestic good is low due to the competition from the imported good. Under exclusive import, fierce competition in the market can be avoided. If the cooperative imports exclusively it will coordinate the price setting of the two goods in a way that maximizes aggregate profit, which will imply that collusive pricing will be the result. On the other hand, if the private wholesaler imports exclusively, resulting retail prices will be above marginal costs due to product differentiation and strategic delegation by the wholesalers.

The analysis has also demonstrated that the equilibrium outcome is that the independent wholesaler imports the foreign good exclusively, and that this yields a suboptimal outcome from the society's point of view. An even worse situation would occur if the marketing cooperative could achieve exclusive import privileges, and thereby exclude the independent wholesaler from distributing the imported good. This outcome could also come as a result of high entry barriers at the wholesale level. However, in the present model the cooperative is unable to deter entry at the wholesale level. Realizing that the independent wholesaler will import anyway, the cooperative refrains from import.

One important lesson from the analysis is that it is not necessarily enough to lower trade costs in order to reap the benefits from increased competition. If domestic agents, like the marketing cooperative in our case, has market power on a level in the distribution chain, the major benefits from trade liberalization may be higher profits for the distributors, leaving consumers and welfare largely unaffected. It is therefore of vital importance for policymakers to ensure that entry into every level of the distribution chain are open to newcomers when trade is liberalized and that no exclusive import rights can be obtained.

In future research we would like to focus on the role of alternative wholesale contracts and distribution systems. In the present article we have assumed two-part tariffs in wholesale contracts and that all bargaining power is upstream. Moreover, we have assumed that wholesalers use separate distribution channels for their products. While these assumptions make

perfectly sense in some situations, they may not fit other real market observations. These, and other issues are left for future research.

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Appendix

Proof of Proposition 1. Demand is $q_d = 1 - p_d$. For a given wholesale price w_d the retailer solves $\max_{p_d}(p_d - w_d)(1 - p_d)$. The foc to this problem is $1 - 2p_d + w_d = 0$, yielding $p_d = \frac{1}{2} + \frac{1}{2}w_d$ and gross retail profit $\Pi^g_{AU} = \left(\frac{1}{2} - \frac{1}{2}w_d\right)^2$. All retail profit can be appropriated by the wholesaler by a fixed fee, hence his problem is $\max_{w_d} w_d\left(1 - \left(\frac{1}{2} + \frac{1}{2}w_d\right)\right) + \left(\frac{1}{2} - \frac{1}{2}w_d\right)^2$. The foc to this problem is $-\frac{1}{2}w_d = 0 \Rightarrow w_d = 0$. The wholesaler's profit equal his fixed fee $F = \pi_{AU} = \frac{1}{4}$, and the price and quantity are $p_d = q_d = \frac{1}{2}$. Welfare is written $W_{AU} = \pi_{AU} + U_c$, and when plugging in the equilibrium price and quantity for in the expression for U_d we get $W_{AU} = \frac{3}{8}$. QED.

Proof of Proposition 2. Under CE the maximization problem of the cooperative is:

$$\max_{p_d, p_i} p_d q_d + (p_i - t)q_i$$

yielding the foc's

$$\frac{2p_d - 1 - 2\gamma p_i + \gamma + t\gamma}{-1 + \gamma^2} = 0$$

$$\frac{-2\gamma p_d - 1 + 2p_i + \gamma - t}{-1 + \gamma^2} = 0$$

Solving these yields the retail prices

$$p_d = \frac{1}{2}$$

$$p_i = \frac{1}{2} + \frac{1}{2}t$$

and plugging these prices back into the demand function give sales

$$q_d = \frac{1}{2}\frac{1 - \gamma + \gamma t}{1 - \gamma^2}$$

$$q_i = \frac{1}{2}\frac{1 - t - \gamma}{1 - \gamma^2}.$$

We must have that $t \leq 1 - \gamma \equiv t_1$ for the imported product to be sold in a positive quantity. Plugging equilibrium prices and quantities into the cooperative's profit function yields

$$\pi_{CE} = \frac{1}{4}\frac{2(1 - \gamma(1 - t) - t) + t^2}{1 - \gamma^2}$$

Differentiating this with respect to t yields

$$\frac{\partial \pi_{CE}}{\partial t} = \frac{1}{2}\frac{\gamma + t - 1}{1 - \gamma^2}$$

which is always negative for $t \leq t_1$, hence trade liberalization will always benefit the cooperative when it imports exclusively. Plugging equilibrium quantities and prices into the utility function and adding the profit of the cooperative wholesaler yields welfare

$$W_{CE} = \frac{3}{8}\frac{2 - 2\gamma + 2\gamma t - 2t + t^2}{1 - \gamma^2}$$

Differentiating this expression with respect to t yields

$$\frac{\partial W_{CE}}{\partial t} = \frac{3}{4}\frac{t + \gamma - 1}{1 - \gamma^2}$$

which is always negative for $t \leq t_1$, hence trade liberalization will always benefit welfare in this case. QED.

Proof of Proposition 3. When both wholesalers import the foreign good at cost t, wholesale and retail price competition with a homogeneous good drives the price of the imported good to marginal cost, i.e. $p_i = t$. If so the private wholesaler earns zero. The demand for the products are

$$q_d = \frac{p_d - 1 - t\gamma + \gamma}{-1 + \gamma^2}$$

$$q_i = \frac{t - 1 - \gamma p_d + \gamma}{-1 + \gamma^2}$$

and the cooperative solves

$$\max_{p_d} p_d q_d + (p_i - t)q_i$$

$$\Updownarrow$$

$$\max_{p_d} p_d \frac{p_d - 1 - t\gamma + \gamma}{-1 + \gamma^2}$$

yielding

$$p_d = \frac{1}{2} + \frac{1}{2}t\gamma - \frac{1}{2}\gamma$$

At this price the sale of the domestic and imported products are

$$q_d = \frac{1}{2}\frac{1 + t\gamma - \gamma}{1 - \gamma^2}$$

$$q_i = \frac{1}{2}\frac{-2t + 2 - \gamma + t\gamma^2 - \gamma^2}{1 - \gamma^2}.$$

We have that $q_i \geq 0 \Leftrightarrow t \leq (1 - \gamma)\frac{2+\gamma}{2-\gamma^2} \equiv t_2$. If so, the cooperative's profit is written

$$\pi_{PC} = \frac{1}{4}\frac{(1 + t\gamma - \gamma)^2}{1 - \gamma^2}$$

Differentiating with respect to t yields

$$\frac{\partial \pi_{PC}}{\partial t} = \frac{1}{2}(1 + t\gamma - \gamma)\frac{\gamma}{1 - \gamma^2} > 0$$

hence trade liberalization will hurt the cooperative. Plugging prices and quantities into the expression for welfare yields

$$W_{PC} = \frac{1}{8}\frac{(2t\gamma^2 - \gamma^2 t^2 - \gamma^2 + 6\gamma t - 6\gamma + 7 + 4t^2 - 8t)}{1 - \gamma^2}$$

Welfare is decreasing in t whenever

$$\frac{\partial W_{PC}}{\partial t} = \frac{1}{4}\frac{\gamma^2 - t\gamma^2 + 3\gamma + 4t - 4}{1 - \gamma^2} \leq 0$$

$$\Updownarrow$$

$$t \leq (1 - \gamma)\frac{4 + \gamma}{4 - \gamma^2} \geq (1 - \gamma)\frac{2 + \gamma}{2 - \gamma^2}.$$

We see that when there is trade, welfare always increases as trade costs go down. QED.

   Proof of Proposition 4. The cooperative offers its retailer a wholesale price w_d, and given that the retailer solves

$$\max_{p_d}(p_d - w_d)q_d$$

and its foc is written

$$-\frac{-2p_d + 1 + \gamma p_i - \gamma + w_d}{-1 + \gamma^2} = 0$$

Similarly, the private wholesaler offers its retailer a wholesale price w_i, and the retailer solves

$$\max_{p_i}(p_i - w_i)q_i$$

and the foc is:

$$-\frac{-2p_i + 1 + \gamma p_d - \gamma + w_i}{-1 + \gamma^2} = 0$$

and the retail prices are given by

$$p_i(w) = \frac{2 - \gamma - \gamma^2 + \gamma w_d + 2w_i}{4 - \gamma^2}$$

$$p_d(w) = \frac{2 - \gamma^2 - \gamma + \gamma w_i + 2w_d}{4 - \gamma^2}$$

Since all rent can be extracted by the upstream wholesalers, the cooperative solves:

$$\max_{w_d} p_d(w)q_d(p(w))$$

and the private wholesaler solves:

$$\max_{w_i}(p_i(w) - t)q_i(p(w))$$

The foc's are written:

$$-\frac{-8w_d + 2\gamma^2 + 4\gamma^2 w_d - \gamma^4 - \gamma^3 + \gamma^3 w_i}{(-4 + \gamma^2)^2(-1 + \gamma^2)} = 0$$

$$-\frac{-8w_i + 2\gamma^2 + 4\gamma^2 w_i - \gamma^3 - \gamma^4 + \gamma^3 w_d + 8t - 6t\gamma^2 + t\gamma^4}{(-4 + \gamma^2)^2(-1 + \gamma^2)} = 0$$

and the optimal wholesale prices are

$$w_i = \frac{4\gamma^2 - 16t\gamma^2 + 16t - 2\gamma^3 - 3\gamma^4 + 4t\gamma^4 + \gamma^5}{\gamma^4 - 12\gamma^2 + 16}$$

$$w_d = -\gamma^2 \frac{-\gamma^3 + t\gamma^3 + 3\gamma^2 + 2\gamma - 2t\gamma - 4}{\gamma^4 - 12\gamma^2 + 16}$$

Plugging the wholesale prices into the expression for retail prices yields

$$p_d = -2\frac{-\gamma^3 + t\gamma^3 + 3\gamma^2 + 2\gamma - 2\gamma t - 4}{\gamma^4 - 12\gamma^2 + 16}$$

$$p_i = \frac{t\gamma^4 + 2\gamma^3 - 6t\gamma^2 - 6\gamma^2 - 4\gamma + 8t + 8}{\gamma^4 - 12\gamma^2 + 16}.$$

and sales

$$q_d = -\frac{-\gamma^5 + t\gamma^5 + 3\gamma^4 - 4t\gamma^3 + 4\gamma^3 - 10\gamma^2 + 4t\gamma - 4\gamma + 8}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)}$$

$$q_i = \frac{\gamma^5 + 3t\gamma^4 - 3\gamma^4 - 4\gamma^3 + 10\gamma^2 - 10t\gamma^2 + 4\gamma + 8t - 8}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)}$$

We have that $q_i \geq 0 \Leftrightarrow t \leq (1 - \gamma)\frac{\gamma^2 - 2\gamma - 4}{3\gamma^2 - 4} \equiv t_3$.

Computing the cooperative profit yields

$$\pi_{PE} = 2(-\gamma^5 + t\gamma^5 + 3\gamma^4 + 4\gamma^3 - 4t\gamma^3 - 10\gamma^2 - 4\gamma + 4t\gamma + 8)$$

$$\times \left(\frac{-\gamma^3 + t\gamma^3 + 3\gamma^2 + 2\gamma - 2t\gamma - 4}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)^2} \right)$$

and the private wholesaler's profit is written

$$\Pi_{PE} = 2(\gamma^5 - 3\gamma^4 + 3t\gamma^4 - 4\gamma^3 - 10t\gamma^2 + 10\gamma^2 + 4\gamma - 8 + 8t)$$

$$\times \left(\frac{\gamma^3 - 3\gamma^2 + 3t\gamma^2 - 2\gamma + 4 - 4t}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)^2} \right)$$

The welfare is written

$$W_{PE} = U_{PE} + \pi_{PE} + \Pi_{PE}$$

$$= \frac{1}{2(1 - \gamma^2)(\gamma^4 - 12\gamma^2 + 16)^2}$$

$$\times (2\gamma^8 - 2\gamma^9 - 384t - 256\gamma - 448t\gamma^3 - 104\gamma^6 + 56\gamma^7$$

$$+ 236\gamma^4 t^2 + 104\gamma^6 t - 52\gamma^6 t^2 - 56\gamma^7 t + \gamma^8 t^2 + 2t\gamma^9 - 2$$

$$t\gamma^8 + 384 - 368\gamma^2 t^2 + 192t^2 - 736\gamma^2 + 256\gamma t + 736t$$

$$\gamma^2 + 448\gamma^3 + 472\gamma^4 - 264\gamma^5 - 472t\gamma^4 + 264t\gamma^5)$$

Differentiating the expression for profit of the cooperative with respect to t yields

$$\frac{\partial \pi_{PE}}{\partial t} = \frac{4\gamma}{(1 - \gamma^2)(\gamma^4 - 12\gamma^2 + 16)^2}$$

$$\times (\gamma^7 - \gamma^7 t - 3\gamma^6 - 6\gamma^5 + 6t\gamma^5 + 16\gamma^4 + 12\gamma^3 - 12t\gamma^3$$

$$- 28\gamma^2 - 8\gamma + 8\gamma t + 16)$$

which is positive as long as $t \geq (\gamma^2 - 2\gamma - 4)\frac{\gamma - 1}{\gamma(\gamma^2 - 2)} \leq 0$, i.e. always. Hence, trade liberalization hurts the cooperative.

Differentiating the expression for welfare with respect to t yields

$$\frac{\partial W_{PE}}{\partial t} = -\frac{1}{(-1 + \gamma^2)(\gamma^4 - 12\gamma^2 + 16)^2} \times$$

$$(-192 - 224\gamma^3 + 236t\gamma^4 + 52\gamma^6 - 52\gamma^6 t - 28\gamma^7 + t\gamma^8 + \gamma^9$$

$$- \gamma^8 - 368t\gamma^2 + 192t + 128\gamma + 368\gamma^2 - 236\gamma^4 + 132\gamma^5)$$

which is negative as long as $t \leq (\gamma^2 - 2\gamma - 4)^2 (1 - \gamma)\frac{\gamma^2 + 4\gamma - 6}{\gamma^6 - 50\gamma^4 + 136\gamma^2 - 96} \equiv t_4$. From above we know that import will take place when $t \leq t_3$. Therefore if $t_3 - t_4 > 0$ for $\gamma \in (0,1)$ trade liberalization reduces welfare. That this can occur is most easily seen by plotting the difference:
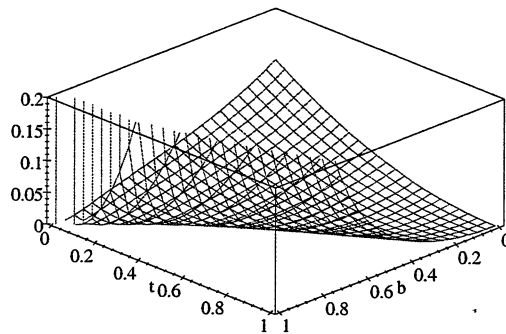
QED.
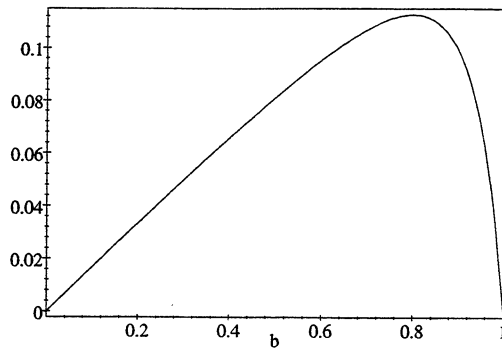
Proof of Proposition 5. This result is most easily seen by plots. Using the expressions for welfare from Propositions 1-4 we plot the difference
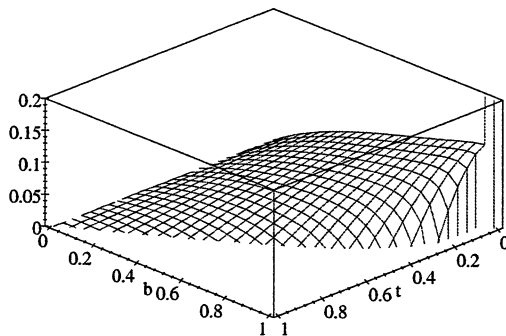
$$W_{PC} - W_{PE}$$

showing

and

$$W_{PE} - W_{CE}$$

showing

Finally we have that

$$W_{CE} - W_{AU} \geq 0$$

$$\Updownarrow$$

$$t \leq 1 - \gamma$$

and we have shown

$$W_{PC} \geq W_{PE} \geq W_{CE} \geq W_{AU}$$

QED.

Proof of Proposition 6. Since the private wholesaler only will earn profit if he imports, it is a dominant strategy for him to import. Comparing cooperative profit when the private wholesaler imports exclusively (*PE*) and when both import (*PC*), the cooperative should refrain from importing when

$$\pi_{PE} - \pi_{PC} \geq 0$$

$$\Updownarrow$$

$$t \leq (\gamma^2 - 2\gamma - 4) \frac{-1 + \gamma}{\gamma(192 - 16\gamma^6 + 128\gamma^4 - 288\gamma^2 + \gamma^8)} \times$$

$$(\gamma^6 + 2\gamma^5 - 8\gamma^4 - 24\gamma^3 + 32\gamma^2 + 32\gamma - 32 - 4\sqrt{(-2\gamma^2 + 4)}\,\gamma^3$$

$$- 12\sqrt{(-2\gamma^2 + 4)}\,\gamma^2 + 8\sqrt{(-2\gamma^2 + 4)}\,\gamma + 16\sqrt{(-2\gamma^2 + 4)}$$

Moreover, from Proposition 4 we have that the wholesaler will import whenever $t \leq t_3$. Now plotting these two critical values yields
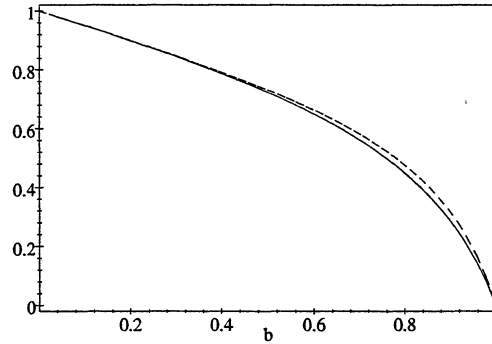
where the dotted line is t_3. Hence, the equilibrium outcome is that the private retailer imports exclusively (*PE*). QED.