"Oligopoly and Customs Unions"

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ABSTRACT

We analyze a model of international oligopoly when customs unions are possible. We show that importer-exporter customs unions are pro-competitive in the sense that internally they will tend to have industries produce at their competitive output level, but will tend to exclude imports from non-member countries. Exporter customs unions are anti-competitive and will produce the monopoly output. We apply core theory to determine which unions would form. With one firm in each country the importer will form a union with the low cost exporter. With identical costs, but variable numbers of firms, when the number of firms is small an importer-exporter customs union forms. A union of the exporters will form if there are four or more firms in the world.

I. Introduction

Although there has been extensive research analyzing international trade with oligopolistic firms[1] and customs unions[2] until recently the profit shifting literature has ignored the effects of customs unions and the customs union literature has assumed perfect competition. We have a dual purpose in combining these topics. First, to see how the possibility that countries can form customs unions changes our views about profit shifting. Second, how does the existence of imperfectly competitive firms alter our thinking about customs unions?

We find that customs unions change the way profit shifting is manifest in the world economy. If an importer-exporter customs union forms then the exporter produces the competitive output and imports from the outside are very small (in some cases zero.) If both exporters form a customs union they produce the monopoly output. Despite the fact that world welfare is higher when an importer-exporter union forms we show that the exporter union will sometimes emerge as the equilibrium. Thus, customs unions change profit-shifting behavior.

A central motivation for customs union formation that comes out of the literature is that unions form to enable member countries to compete more effectively on world markets. That motivation is present here, but new motivations emerge. With imperfect competition customs unions also function as a coordination device in the case of the exporter customs union. Through customs union the world's exporters are able to monopolize the world market by not only coordinating the firms within countries, but also coordinating across countries. The importer-exporter union also is able to use the customs union to counteract the distortion caused by the oligopolistic market structure. This suggests that profit-shifting behavior is different when customs unions can form and that the existence of oligopolistic market structures

[1]See Brander and Spencer (1985), Eaton and Grossman (1986) and Cooper and Riezman (1989).

[2]See Riezman (1985) and Kennan and Riezman (1990).

present new motivations for customs unions to form.

There has been some recent work on customs unions with imperfectly competitive markets. Gatsios (1987) and Gehrig (1990) have developed models somewhat different that the one here. Unlike the model presented below they assume segmented markets, do not allow side payments within a customs union, and have only one firm in each country. The results they obtain have a different flavor. Gatsios finds that either free trade or a customs union between the high cost countries will be the only core allocations. In our model free trade is never in the core and the importer will prefer the country with the most efficient firms as its partner. Gehrig analyzes a two period model and finds that customs unions may form as a "protection union" so inefficient firms can eliminate their cost disadvantage.

II. The Model

We consider a market for a homogeneous good produced by a relatively small number of firms, F, n_1 of which are located in country 1 and n_2 of which are in country 2. Consumers are located in country C. For simplicity we ignore domestic consumption in countries 1 and 2 and assume that the good is not produced in country C.[3] Firms in country i produce at constant marginal cost c_i, so profits of a country i firm are

$$\pi_i = (p_i - c_i) q_i$$

where p_i is the price received by producers in country i and q_i is the output produced by a country i firm.

Assume that the inverse demand in country C is

$$p = a - bQ \qquad (1)$$

[3]Allowing for domestic consumption will not alter the qualitative results as long as countries 1 and 2 are net exporters for all parameter values.

where p is the price consumers pay and Q is total production. The parameters a and b are both positive. With no government intervention the Cournot-Nash equilibrium level of firm output is

$$q_1 = \frac{a - (1 + n_2)c_1 + n_2 c_2}{b(1 + n_1 + n_2)}$$

$$q_2 = \frac{a - (1 + n_1)c_2 + n_1 c_1}{b(1 + n_1 + n_2)}$$

Total world production is

$$Q = \frac{n_1(a - c_1) + n_2(a - c_2)}{b(1 + n_1 + n_2)} \qquad (2)$$

The producer price is

$$p = \frac{a + n_1 c_1 + n_2 c_2}{1 + n_1 + n_2}$$

Per firm profits in the producing countries are

$$p_1 = \frac{(a - (1 + n_2)c_1 + n_2 c_2)^2}{b(1 + n_1 + n_2)^2}$$

$$p_2 = \frac{(a - (1 + n_1)c_2 + n_1 c_1)^2}{b(1 + n_1 + n_2)^2}$$

Welfare in each country is just total profits. In the consuming country welfare given by total consumer surplus is

$$W_c = \frac{(n_1(a - c_1) + n_2(a - c_2))^2}{2b(1 + n_1 + n_2)^2}$$

We now consider government intervention in a three stage game. In the first stage the government decides which countries, if any, it will cooperate with. Given the first stage decisions, the government chooses optimal export subsidies/taxes and tariffs, and in the third stage firms and consumers make their decisions taking government policies as fixed. The novel element of the game is the first stage, which is typically ignored in this literature.[4]

As usual, we solve the third stage first. Given firm reaction functions we next determine how countries set export subsidies/taxes and import tariffs for each possible coalition structure. Given this we determine which coalition structures are equilibria.

III. Nash Equilibrium- No Customs Unions

In this section we determine what happens if no customs unions form. Countries 1 and 2 set export subsidies/taxes, s_1 and s_2 respectively, and country C sets its tariff, t (which is allowed to be negative),

[4]For exceptions see Gatsios (1987) and Gehrig (1990).

taking into account how firms and consumers will react. Consumer demand is

$$p = a - bQ - t \tag{3}$$

Solving the firm reaction functions we determine what firms will produce for a given set of government policies.

$$q_1 = \frac{a - t - (1 + n_2)(c_1 - s_1) + n_2(c_2 - s_2)}{b(1 + n_1 + n_2)} \tag{4}$$

$$q_2 = \frac{a - t - (1 + n_1)(c_2 - s_2) + n_1(c_1 - s_1)}{b(1 + n_1 + n_2)} \tag{5}$$

These expressions have the expected properties. Higher tariffs reduce output in both countries. Higher subsidies increase output in the subsidizing country and reduce output in the other country.

Governments use these relationships in computing their optimal policies. Countries 1 and 2 choose export subsidies/taxes which maximize profits net of subsidies for its firms.

$$\max_{s_i} (p - c_i) q_i$$

Using (3), (4), and (5) solving these maximization problems we get reaction functions for countries 1 and 2. For country 1 we have

$$s_1 = -\frac{(n_1 - n_2 - 1)(a - c_1(n_2 + 1) + c_2 n_2 - n_2 s_2 - t)}{2 n_1 (n_2 + 1)}$$

(6)

Country 2's reaction function is

$$s_2 = \frac{(n_1 - n_2 + 1)(a + c_1 n_1 - c_2(n_1 + 1) - n_1 s_1 - t)}{2 n_2 (n_1 + 1)}$$

(7)

Country C chooses its tariff to maximize its welfare, consumer surplus plus tariff revenue.

$$\max_t .5 b Q^2 + tQ$$

Solution of this problem using (4) and (5) yields country C's reaction function

$$t = \frac{a(n_1 + n_2) - (n_1 c_1 + n_2 c_2) + n_1 s_1 + n_2 s_2}{(n_1 + n_2)(n_1 + n_2 + 2)} \qquad (8)$$

Solve (6), (7), and (8) to obtain equilibrium values of s_1, s_2 and t

$$s_1 = -\frac{(n_1 - n_2 - 1)(a(n_1 + n_2) - c_1(n_1^2 + n_1(n_2 + 3) + 2n_2 + 1) + c_2(n_1 + n_2 + 1)(n_1 + 1))}{n_1 A}$$

(9)

(10)

$$s_2 = \frac{(n_1 - n_2 + 1)(a(n_1 + n_2) + c_1(n_2 + 1)(n_1 + n_2 + 1) - c_2(n_2^2 + n_2(n_1 + 3) + 2n_1 + 1))}{n_2 A}$$

$$t = \frac{a(n_1 + n_2 + 2) - c_1(n_2 + 1) - c_2(n_1 + 1)}{A} \qquad (11)$$

where A = $n+n+4(n_1+n_2)+2(n_1n_2+1)$

Notice that whether exporting countries tax or subsidize depends on the relative number of firms in each country and on relative costs. To see this consider the special case, $c_1=c_2$. Then, sign s_1= sign (1-

n_1+n_2), the exporter will subsidize if it has few firms relative to the other country and will tax if it has a relatively large number of firms. To see the effects of relative costs let $n_1=n_2=1$. Then,

$$s_1 = \frac{a - 4c_1 + 3c_2}{7}$$

Country 1's subsidy will be higher the higher country 2 cost is relative to country 1 cost. If country 1 firms are inefficient enough then country 1 will actually tax its firms. Thus, exporters are more likely to subsidize the more efficient its own firms are relative to its rival.

For the case of Nash equilibrium with no customs unions one can calculate equilibrium prices, quantities, profits, and country welfare (profits net of subsidies) by substituting (9), (10), and (11) into the appropriate expressions. As expected, countries with lower costs and fewer firms do better at Nash equilibrium than those with high costs and many firms. To save space we do not report the details of these calculations. We next turn to the consideration of importer-exporter customs unions.

IV. Importer-Exporter Customs Union

In customs unions between importers and exporters there is a conflict of interest since importers want low prices and exporters do better with high prices. We deal with this problem by allowing side payments within the customs union. In particular, we assume that the union sets production subsidies and tariffs jointly and that the Nash bargaining solution determines each country's payoff. In this case there is no conflict of interest and subsidies and tariffs will be set to maximize the joint surplus.

IV.1 Union with the high cost firm {C,1}

Two types of importer-exporter customs unions could form. The importer could form a customs union with either the high cost or the low cost country. For concreteness we assume that country 1 is the

high cost country, that is, $c_1 > c_2$. We first analyze a customs union between countries C and 1.

With this type of customs union it is no longer true that producers in countries 1 and 2 face the same prices. Let p_i be the price faced by producers in country i, then

$$\begin{aligned} p_1 &= a - bQ \\ p_2 &= a - bQ - t \end{aligned} \qquad (3')$$

Since only country 2 firms now face the tariffs the firm reaction functions are

$$q_1 = \frac{a + n_2 t - (1 + n_2)(c_1 - s_1) + n_2(c_2 - s_2)}{b(1 + n_1 + n_2)} \qquad (4')$$

$$q_2 = \frac{a - (1 + n_1)t - (1 + n_1)(c_2 - s_2) + n_1(c_1 - s_1)}{b(1 + n_1 + n_2)} \qquad (5')$$

Notice that q_1 is now positively related to the tariff since it is only levied on country 2, and the tariff now has a larger negative effect on country 2's output than it did in the Nash equilibrium case.

We assume that the customs union chooses the tariff rate and subsidy on good 1 to maximize total welfare of both countries and redistributes income in accordance with the Nash bargaining solution, using Nash equilibrium welfare as the security level. This gives rise to the following optimization problem

$$\max_{t, s_i} .5bQ^2 + tn_2 q_2 + (p_1 - c_1) n_1 q_1$$

The union chooses values for t and s_1 to maximize consumer surplus in country C plus profits in country 1. What each country gets is their security value (welfare at Nash equilibrium) plus one-half of the remaining surplus left at the customs union equilibrium. For purposes of determining policy the union tries to maximize the total surplus accruing to the union. Solving this optimization problem we get two reaction functions for the customs union

$$s_1 = \frac{a(2n_2+1)+c_1(n_1n_2-(n_2+1)^2)-c_2n_2(n_1-n_2)-tn_2(2n_1+1)-s_2n_2(n_2-n_1)}{n_1(2n_2+1)} \tag{12}$$

$$t = \frac{a(2n_1+1)+c_1n_1(n_1-n_2)-c_2((n_1+1)^2-n_1n_2)-s_1n_1(2n_1+1)+s_2(n_1n_2-(n_1+1)^2)}{2(n_1+1)^2+n_2} \tag{13}$$

The non-member country chooses s_2 taking t and s_1 as given to maximize profits net of subsidies for its firms yielding

$$s_2 = \frac{(n_1-n_2+1)(a+c_1n_1-c_2(n_1+1)-t(n_1+1)-s_1}{2n_2(n_1+1)} \tag{14}$$

Comparing (12) and (13) with (6) and (8) the formation of the union has changed the reaction functions of the member countries in that s_1 and t are now negatively related, higher tariffs mean larger subsidies for union firms. The non-member's reaction function is essentially the same as before.

The next step is to solve (12)-(14) to get equilibrium values for s_1, s_2, and t.

$$s_1 = \frac{a(n_1+n_2+1) - c_1(n_1(n_2+1)+2n_2+1) + c_2 n_2(n_1+1)}{n_1(n_1+n_2+1)} \qquad (15)$$

$$t = \frac{(n_1+1)(c_1-c_2)}{n_1+n_2+1} \qquad (16)$$

$$s_2 = \frac{(n_1-n_2+1)(c_1-c_2)}{n_1+n_2+1} \qquad (17)$$

The union subsidy is higher the more efficient union firms are relative to non-union firms, but the tariff is higher the more **inefficient** union firms are relative to their rivals. The non-member subsidy is higher the more efficient its own firms are. Using (15)-(17) one can compute that $p_1=c_1$, $Q=(a-c_1)/b$. What the union does is to set subsidies and tariffs to get the competitive output for a market with country 1 costs. Country 2 firms supply more output to the union the more cost efficient its firms are as $q_2=(n_1+1)(c_1-c_2)/b(n_1+n_2+1)$. In the limit as country 2's cost advantage goes to zero they are squeezed completely out of the market.

IV.2 Union with the low cost country {C,2}

We now look at the case of union between the importer and the efficient country, country 2. Equations (3'), (4') and (5') are modified as follows.

$$q_1 = \frac{a-(1+n_2)t - p_1(1+n_2) + bQ_1 + t s_1 + n_2(c_2 - s_2)}{p_2(1+n_1+n_2) - a + bQ} \qquad (4'')$$

$$q_2 = \frac{a+n_1 t - (1+n_1)(c_2-s_2) + n_1(c_1-s_1)}{b(1+n_1+n_2)} \qquad (5'')$$

We follow the same procedure as in the above subsection, and derive reaction functions for the union and

the non-member country. To save space we only report the solution to the reaction functions keeping in mind the restriction that quantities must be non-negative. The solution is $s_1=t=0$ and $s_2=(a-c_2)/n_2$. Total industry output $Q=(a-c_2)/b$, the competitive level with country 2 costs. Foreign firms are completely shut out, $q_1=0$. The price in both countries is country 2's cost, $p_1=p_2=c_2$.

So if the non-member is a less efficient producer than the member country the optimal policy is to exclude the non-member completely from the market. Then, the union internally produces the competitive output. Since member's welfare depends only on total union welfare under customs union and the security levels (Nash equilibrium welfare) this policy makes sense despite zero firm profits (net of subsidies). What the union is able to do is not only coordinate member firms to play effectively against the outside firms, but it is also able to counteract the distortion caused by the oligopolistic industry structure. To summarize, in a union between an exporter and an importer what the union does is to subsidize union firms to produce the competitive output (relative to the member firm's cost). At the same time the union sets the tariff to exclude all non-union products unless foreign firms have a cost advantage over union firms (in which case some imports will be allowed).

Welfare levels can also be computed using the equilibrium tariff and subsidy levels. One interesting question is will the importing country prefer a union with the high or low cost country? We put off answering that question until section VI.

V. Exporter Customs Union {1,2}

A customs union between the two exporters implies a model similar to that of section III. Demand is given by (3) and firm reaction functions by (4) and (5). The problem for the customs union is to maximize joint profits. Given constant marginal costs the solution to the custom unions' problem is quite simple. Have the firms in the efficient country produce the monopoly level of output and have the inefficient firms produce nothing. Setting $n_2q_2=(a-c_2-t)/2b$, and $q_1=0$ we get the two reaction functions for

the customs union

$$s_1 = -\frac{a - c_1(n_2 + 1) + n_2(c_2 - s_2) - t}{n_2 + 1} \tag{18}$$

$$s_2 = \frac{a(n_1 - n_2 + 1) - 2c_1 n_1 n_2 + c_2(2n_1 n_2 - n_1 + n_2 - 1) + 2n_1 n_2 s_1 - t(n_1 - n_2 + 1)}{2n_2(n_1 + 1)} \tag{19}$$

The importer faces the same problem as in the Nash equilibrium case and hence has a reaction function given by equation (8). We solve (18), (19) and (8) to get equilibrium values for s_1, s_2 and t.

$$s_1 = -\frac{a(n_1 + n_2) - c_1(2n_1 + 2n_2 + 1) + c_2(n_1 + n_2 + 1)}{(2n_1 + 2n_2 + 1)} \tag{20}$$

$$s_2 = -\frac{(n_2 - 1)(n_1 + n_2)(a - c_2)}{n_2(2n_1 + 2n_2 + 1)} \tag{21}$$

$$t = \frac{a - c_2}{2n_1 + 2n_2 + 1} \tag{22}$$

This yields an equilibrium price and quantity of

$$p = \frac{a(n_1 + n_2) + c_2(n_1 + n_2 + 1)}{2n_1 + 2n_2 + 1} \quad Q = \frac{(n_1 + n_2)(a - c_2)}{b(2n_1 + 2n_2 + 1)} \tag{23}$$

The payoffs are computed the same way as before. Each customs union member receives it Nash equilibrium payoff plus one-half the remaining surplus. In the next section we discuss welfare comparisons

among different customs unions.

VI. Welfare Comparisons

To determine which customs unions will form we need to be able to compare welfare across different customs union structures. Here we solve for welfare levels and make some preliminary comparisons. The problem we face is that the expressions for welfare are very complicated since the exporters differ both in cost and number of firms. To simplify we consider two special cases, one in which there is only one firm in each country, $n_1=n_2=1$, and second, the case in which costs are the same in each country, $c_1=c_2=c$.

Recall that country 1 has the high cost firms so, $c_1>c_2$. Let $W^i\{jk\}$ be the welfare of country i when there is a customs union between countries j and k. $W^i\{FT\}$ and $W^i\{NE\}$ is the welfare of country i when there is free trade or at Nash equilibrium, respectively. We report each of these welfare measures for both special cases in an appendix.

First examine the $n_1=n_2=1$ case. The Nash equilibrium is important because it determines the security values used in determining the customs union payoffs. Notice that $W^1\{NE\}<W^2\{NE\}$, the low cost country does better than the high cost country at Nash equilibrium. Also note that $W^c\{NE\}>W^c\{FT\}$, the importing country prefers the Nash equilibrium to free trade. This result is consistent with the profit shifting literature.

Exporters also prefer to be in a union with the importer than excluded from such a union, $W^1\{C1\}>W^1\{C2\}$ and $W^2\{C2\}>W^2\{C1\}$. This result is not surprising. Likewise, the importer prefers union with either exporter to having the exporter's union form, $W^c\{12\}<\min[W^c\{C1\},W^c\{C2\}]$.

There are two comparisons that are not so straightforward. First, does the importer prefer union with the low or high cost country? The advantage of the low cost country is that more output gets produced giving higher total welfare. However, the low cost country has a higher security value since it

does better at Nash equilibrium than the high cost country, so the importer keeps a smaller share of the total payoff to the union. To determine the answer taking (A15)-(A12) we have

$$sgn(W^c\{C2\} - W^c\{C1\}) = sgn(54a(c_1 - c_2) - 83c_1^2 + 112c_1c_2 - 29c_2^2) \qquad (24)$$

Assuming that quantities are always non-negative we have the constraint that $c_2 \le c_1 \le (a+3c_2)/4$. Given this condition it is easy to show that the right hand side of (24) is always non-negative and hence the importer will always prefer a union with the low cost country. The intuition is that the gain from union with the low cost country in terms of increased total welfare for the union outweighs the smaller share country C gets in such a union.

The second interesting issue concerns whether or not the exporting countries prefer a union with each other to a union with the importer. One would expect that both exporters would prefer a union with the importer since the total surplus is largest in that case and that indeed turns out to be the case as the reader can easily verify by computing (A7)-(A10) and (A8)-(A14). Given these welfare results in the next section we can determine what the outcome will be by formulating the problem of coalition choice.

The second set of special cases examines what happens when costs are the same, $c_1=c_2=c$, but the number of firms in each country varies. Equations (A16)-(A30) give the appropriate welfare values. If we consider Nash equilibrium the country with the smaller number of firms does better, $W^1\{NE\}>W^2\{NE\}$ as $n_2>n_1$. This is consistent with earlier work (see Cooper and Riezman (1989)) on the effects of the number of firms. Also note that as in the previous case the importing firm does better at Nash equilibrium than free trade $W^c\{NE\}>W^c\{FT\}$.

Also, as in the previous case exporters prefer to be in a union with the importer than excluded from such a union, $W^1\{C1\}>W^1\{C2\}$ and $W^2\{C2\}>W^2\{C1\}$. Likewise, the importer prefers union with either importer to having the exporter's union form, $W^c\{12\}<\min[W^c\{C1\},W^c\{C2\}]$.

Which exporter will the importer want a union with? It will prefer a union with the country that has the most firms, $W^c\{C1\}>W^c\{C2\}$ as $n_1>n_2$. The intuition is clear. Both countries have the same costs and production will be identical. The only difference will be in how the surplus gets shared. Since the country with the large number of firms does worse at Nash equilibrium it has a lower security value and gets less of the surplus, hence is the preferred partner for the importing country.

The final comparison of interest concerns whether exporters prefer union with each other or the importer. Here the results are sharply different than before. Recall that when costs differed but there was only one firm in each country exporters always prefer union with the importer. Here exporters prefer union with each other provided that the total number of firms in the world exceeds three. In other words if there are four or more firms in the world exporters will prefer a union with each other to one with the importer. This result is surprising since total surplus is maximized when an importer and an exporter form a union. However, as the number of firms grow the distribution of the surplus in the importer-exporter customs union becomes so unfavorable to the exporter that they prefer an exporter customs union.

Using these welfare results in the next section we turn to determining what customs union will actually form.

VII. Customs Union Choice

We use the results of previous sections to determine which customs unions will be chosen. To model the choice of customs unions we use the core solution concept. This approach was first used in Riezman (1985) for a model with competitive industries. The essential idea is that one would expect to observe customs unions that are in the core. A customs union is in the core if it cannot be blocked by any coalition. The notion of blocking is a bit complicated.

There are five possible coalition (customs union) structures possible,

Free Trade (FT) ({1,2,C})

Nash Equilibrium (NE) ({1},{2},{C})

{1,2} Customs Union ({1,2},{C})

{C,1} Customs Union ({C,1},{2})

{C,2} Customs Union ({C,2},{1}).

FT could be blocked by NE if any single country is better off at NE or it could be blocked by a customs union if both member countries are better off. NE is blocked by FT if each country is better off at FT or by any customs union in which all members are better off than NE. Any customs union can be blocked by NE or FT if any member country is better off at NE or FT. A customs union can also be blocked by another customs union if both members of the blocking customs union are better off than they are when the blocked customs union forms.

Using these definitions we analyze the two special cases considered to this point. First, suppose $n_1=n_2=1$ and recall we have assumed that $c_1>c_2$. FT is blocked by NE since $W^c\{NE\}>W^c\{FT\}$, and NE is clearly blocked by any customs union. The {1,2} customs union is blocked by the {C,2} customs union because $W^c\{C,2\}>W^c\{1,2\}$ and $W^2\{C,2\}>W^2\{1,2\}$ and the {C,1} customs union is blocked by {C,2} since $W^c\{C,2\}>W^c\{C,1\}$ (recall the importer prefers union with the low cost country) and $W^2\{C,2\}>W^2\{C,1\}$. The {C,2} customs union is unblocked and therefore the unique core solution. Thus, in the special case in which there is one firm in each country, a customs union between the importer and the exporter with the efficient firms will be the outcome.

The solution is different in our other special case, $c_1=c_2=c$. As before FT and NE are blocked by NE and any customs union, respectively. When $n_1+n_2>3$ then $W^i\{1,2\}>W^i\{C,i\}$ for i=1,2. This means that {1,2} blocks both {C,1} and {C,2} and is itself unblocked. Hence, when the total number of firms in the world is larger than three a customs union among the exporters is the outcome. This is somewhat surprising since the total surplus available is larger when an importer-exporter union forms, but the distributional advantages outweigh the efficiency considerations in this case.

When the total number of firms is three or less then an importer-exporter union will emerge. In the case $n_1=n_2=1$ both {C,1} and {C,2} are unblocked and either could form. If $n_1=1$ and $n_2=2$, the importer prefers a union with 2 and the {C,2} union will form. Conversely. if $n_1=2$ and $n_2=1$ the solution will be the {C,1} union.

VlII. Conclusion

We have analyzed importer-exporter and exporter customs unions when industries are imperfectly competitive. Importer-exporter customs unions will be pro-competitive in the sense that internally they will tend to have industries produce at their competitive output level, but will tend to exclude imports from non-member countries. Exporter customs unions are anti-competitive and will produce the monopoly output.

We allowed costs and the number of firms to vary across countries. Countries with lower costs and fewer firms fared better at Nash equilibrium. This means that high cost and large number of firm countries have lower security values and hence less bargaining power within any customs union. However, from the importer's point of view the low cost country is a more desirable coalition partner because the increased efficiency in terms of lower cost outweighs the benefit of a partner with less bargaining power. Importers always prefer a union with the country with a large number of firms since there is no difference in efficiency and it can take advantage of the weaker bargaining power.

From the exporting countries point of view in the case where there is one firm in each country, exporters will prefer union with the importer to union with each other. The total surplus for the coalition is higher with an importer-exporter customs union, and in this case the exporter gets a big enough share of the surplus to make it more attractive than the exporter customs union. When the number of firms vary, but both exporters have the same costs exporters prefer union with each other if the number of firms in the world is larger than three. Here the problem is that when the number of firms increases exporters fare so

poorly in the bargaining game with the importer that the lower surplus exporters customs union is better for them.

Finally, we applied core theory to determine which unions would form. With one firm in each country the importer will form a union with the low cost exporter. With identical costs, but variable numbers of firms, when the number of firms is small an importer-exporter customs union will forms. A union of the exporters will form if there are four or more firms in the world.

References

Brander, J.A. and B.J. Spencer, (1985), "Export Subsidies and International Market Share Rivalry", Journal of International Economics, 18, 83-100.

Cooper, R. and R. Riezman, (1989), "Uncertainty and the Choice of Trade Policy in Oligopolistic Industries", Review of Economic Studies, 56, 129-140.

Eaton, J. and G. Grossman, (1986), "Optimal Trade and Industrial Policy Under Oligopoly", Quarterly Journal of Economics, 101, 383-406.

Gatsios, K., (1987), "Customs Unions and the Core: A Reciprocal Dumping Model", Economic Theory Discussion Paper, University of Cambridge.

Gehrig, A., (1990), "Customs Unions Versus Free Trade: A Two-Period Model with International Cournot-Oligopoly", Discussion Paper No. 90-18, University of Munich.

Kennan, J. and R. Riezman, (1990), "Optimal Tariff Equilibria with Customs Unions", Canadian Journal of Economics, 23, 70-83.

Riezman, R., (1985), "Customs Unions and the Core", Journal of International Economics, 19, 355-365.

Appendix

Welfare for $n_1=n_2=1$

$W^1\{FT\}=(a-2c_1+c_2)^2/9b$ (A1)

$W^2\{FT\}=(a+c_1-2c_2)^2/9b$ (A2)

$W^c\{FT\}=(2a-c_1-c_2)^2/18b$ (A3)

$W^1\{NE\}=2(a-4c_1+3c_2)^2/49b$ (A4)

$W^2\{NE\}=2(a+3c_1-4c_2)^2/49b$ (A5)

$W^c\{NE\}=4(2a-c_1-c_2)^2/49b$ (A6)

$W^1\{12\}=(14a^2-2a(25c_1-11c_2)+25c_1^2-11c_2^2)/175b$ (A7)

$W^2\{12\}=(14a^2+2a(25c_1-39c_2)-25c_1^2+39c_2^2)/175b$ (A8)

$Wc\{12\}=4(a-c_2)^2/25b$ (A9)

$W^1\{C1\}=(27a^2-18a(7c_1-4c_2)+191c_1^2-256c_1c_2+92c_2^2)/252b$ (A10)

$W^2\{C1\}=2(c_1-c_2)^2/9b$ (A11)

$W^c\{C1\}=(99a^2-18a(7c_1+4c_2)+47c_1^2+32c_1c_2+20c_2^2)/252b$ (A12)

$W^1\{C2\}=0$ (A13)

$W^2\{C2\}=(3a^2+2a(4c_1-7c_2)+4c_1^2-16c_1c_2+15c_2^2)/28b$ (A14)

$W^c\{C2\}=(3a^2+2a(4c_1-7c_2)+4c_1^2-16c_1c_2+15c_2^2/28b$ (A15)

Welfare results for the case $c_1=c_2$

$W^1\{FT\}=n_1(a-c)/b(1+n_1+n_2)^2$ (A16)

$W^2\{FT\}=n_2(a-c)/b(1+n_1+n_2)^2$ (A17)

$W^c\{FT\}=(n_1+n_2)^2(a-c)^2/2b(1+n_1+n_2)^2$ (A18)

$W^1\{12\}=(n_1+n_2)^2(n_{14}+4n_1^3(n_2+1)+2n_1^2(3n_2^2+10n_2+8)+n_1(4n_2^3+28n_2^2+40n_2+15)+n_2^4+12n_2^3+24n_2^2+17n_2+4)(a$

$-c)^2/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2(2n_1+2n_2+1)^2)$ (A19)

$W^2\{12\}=(n_1+n_2)^2(n_1^4+4n_1^3(n_2+3)+2n_1^2(3n_2^2+14n_2+12)+n_1(4n_2^3+20n_2^2+40n_2+17)+n_2^4+4n_2^3+16n_2^2+15n_2+4)(a$

$-c)^2/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2(2n_1+2n_2+1)^2)$ (A20)

$W^c\{12\}=(n_1+n_2)(n_1+n_2+2)(a-c)^2/(2b(2n_1+2n_2+1)^2)$ (A21)

$W^1\{NE\}=(n_2+1)(n_1+n_2)^2(a-c)^2/(b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$ (A22)

$W^2\{NE\}=(n_1+1)(n_1+n_2)^2(a-c)^2/(b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$ (A23)

$W^c\{NE\}=(n_1+n_2)(n_1+n_2+2)^3(a-c)^2/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$

(A24)

$W^1\{C1\}=(n_1^3+n_1^2(4n_2+5)+n_1(5n_2^2+10n_2+4)+2n_2^3+5n_2^2+4n_2+2)(a^2-2ac+c^2)/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$ (A25)

$W^2\{C1\}=0$ (A26)

$W^c\{C1\}=(n_1^4+n_1^3(4n_2+7)+n_1^2(6n_2^2+20n_2+15)+n_1(4n_2^3+19n_2^2+30n_2+12)+n_2^4+6n_2^3+15n_2^2+12n_2+2)(a^2-2ac+c^2$

$)/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$

(A27)

$W^1\{C2\}=0$ (A28)

$W^2\{C2\}=(2n_1^3+5n_1^2(n_2+1)+2n_1(2n_2^2+5n_2+2)+n_2^3+5n_2^2+4n_2+2)(a-c)^2/(2b(n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$ (A29)

$W^c\{C2\}=(n_1^4+2n_1^3(2n_2+3)+n_1^2(6n_2^2+19n_2+15)+2n_1(2n_2^3+10n_2^2+15n_2+6)+n_2^4+7n_2^3+15n_2^2+12_2+2)(a-c)^2/(2b($

$n_1^2+2n_1(n_2+2)+n_2^2+4n_2+2)^2)$ (A30)