

Tariff Equilibrium with Customs Union*

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It is well known from Kemp and Wan (1976) that under customs union an increase in group welfare can occur without affecting that of the rest of the world whenever the common external tariff is positioned in a way so as to offset exactly the terms of trade and export quantity effects felt by it. The purpose of this paper is to study the effects of the customs union starting from arbitrary given initial tariff rates and determine cases when the union as well as the non-union countries may gain from the formation of the customs union.

1. THE MODEL

The basic framework of our analysis is the neo-classical two-sector, two-factor and 3 country model of international trade. Each country (potentially) produces two homogeneous products, Q_1 and Q_2 , with the aid of two factors of production, capital K and labour L . Each sector has the constant elasticity of substitution (CES) production function

$$Q_i^j = \left[a_i K_{ij}^{\beta_i} + b_i L_{ij}^{\beta_i} \right]^{1/\beta_i} \quad (i=1, 2; j=1, \dots, 3) \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

where Q_i^j denotes quantity of commodity i supplied by country j , K_{ij} capital employed in sector i of country j , L_{ij} the labour employed in sector i of country j , and $\rho_i = 1/(1 - \beta_i)$ is the elasticity of substitution. We assume that factors of production move costlessly between industries within a country, but are completely immobile between countries. Commodities move internationally at zero cost of transport. Individuals in each country maximise the CES utility function

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$$u_j = [\alpha_1 X_{1j}^\gamma + \alpha_2 X_{2j}^\gamma]^{1/\gamma} \quad (j=1,..,3)$$

where X_{ij} denotes the amount of commodity i ($i=1,2$) consumed in country j ($j=1,..,3$). The factor endowments in each country are given by

$$V^j = \begin{bmatrix} \bar{L}^j \\ \bar{K}^j \end{bmatrix} \quad (j = 1, .., 3)$$

where L^j denotes labour and K^j capital available in country j . Both commodity and factor markets are assumed to clear competitively in the sense that all agents act as if they could buy or sell unlimited quantities at the prevailing market prices. The tariff rate imposed by country j on the imports of commodity i is represented by t_i^j ($i = 1, 2; j = 1,..,3$).

Let p^* be the relative price of commodity 2 in terms of commodity 1 in the world economy, p^j the relative price of commodity 2 in terms of commodity 1 in country j , $Q^j = Q_1^j + p^j Q_2^j$ the value of total output in country j , and $X^j = X_1^j + p^j X_2^j$ the value of expenditure in country j both measured in terms of the first commodity. Under profit maximisation the marginal rate of substitution of capital for labour in sector 1 will be equated in each country to the marginal rate of substitution of capital for labour in sector 2. Furthermore the value of marginal product of capital in sector 1 will be equated to the value of marginal product in sector 2.

$$\frac{\partial Q_1^j / \partial L_{1j}}{\partial Q_1^j / \partial K_{1j}} = \frac{\partial Q_2^j / \partial L_{2j}}{\partial Q_2^j / \partial K_{2j}} \quad (j = 1,..,3) \quad \dots \quad (2a)$$

$$(\partial Q_1^j / \partial K_{1j}) = p^j (\partial Q_2^j / \partial K_{2j}) \quad (j = 1,..,3) \quad \dots \quad (2b)$$

The full employment conditions in factor markets are

$$\begin{aligned} L_{1j} + L_{2j} &= \bar{L}^j \\ K_{1j} + K_{2j} &= \bar{K}^j \end{aligned} \quad (j = 1,..,3) \quad \dots \quad (2c)$$

Given the world price ratio p^* and the tariff rates $t_1^j = 0$ and $t_2^j = t^j$ we note that the domestic relative price is given by

$$p^j = p^* (1 + t^j) \quad (j = 1,..,3) \quad \dots \quad (3a)$$

Suppose that country j exports commodity 1 and imports commodity 2. Let E_1^j be

countries 2 and 3 form the union. Thereafter we consider the union to consist of countries 1 and 2, and lastly of countries 1 and 3. In each case we determine the endowment vector of the union as the sum of the endowment vectors of the union members. Since the tariff and subsidy rates are set equal to zero for trade between the union countries we consider the determination of equilibrium in the world economy with the union in two steps. First, we take the union as one country with the new endowment vector and the rest of the world as the second country. The tariff rate of the union is determined as the average of the tariff rates on imports of the two union countries. The tariff rates of the third country do not change. To determine the world equilibrium with customs union we start with an arbitrarily given value of the world price ratio. For that price ratio we determine in the non-union country the resource allocation as in the previous case. But for the union we note that total expenditure of the union does not equal the value determined by Equation (3d). Suppose that the union imports the first commodity, and that the tariff rate of the union equals t^u . Then total expenditure of the union is given by the relation

$$X^u = Q^u + [t^u/(1+t^u)] M_1^u$$

where M_1^u denotes imports of the union from the non-union (third) country. Since in equilibrium imports of the union from the third country equals the excess supply of the first commodity in non-union country, $M_1^u = ES_1^{nu}$ we determine it as the value of the excess supply of commodity 1 in the non-union country. The world equilibrium is determined as that value of the world price ratio for which the world excess supply of commodity 2 in this simplified two country model equals zero.

Once the equilibrium domestic price ratio in the union is determined we obtain the resource allocation within the union as the corresponding allocation. Here the only problem is faced when confronted with the problem of allocating the tariff revenue between the two union countries. In this case we follow the convention of dividing the tariff revenue in proportion to the country's GDP in total GDP of the union.

2. SOME ILLUSTRATIVE EXAMPLES

Customs unions are usually analysed by comparing a particular customs union equilibrium with some arbitrarily given tariff equilibrium. We consider the parameter values: $a_1 = 0.25$; $b_1 = 0.75$; $\beta_1 = 0.5$; $a_2 = 0.75$; $b_2 = 0.25$; $\beta_2 = -0.5$; $\alpha_1 = 0.3$; $\alpha_2 = 0.7$; and $\gamma = 0.6$. Hence the value elasticity of substitution in sector 1 equals 2, and that in sector 2 equals 2/3, and the value of the elasticity of substitution

in consumption equals 2.5.

The endowment vectors in the three countries are given by:

$$V^1 = \begin{bmatrix} 1000 \\ 500 \end{bmatrix}, \quad V^2 = \begin{bmatrix} 1000 \\ 1400 \end{bmatrix}, \quad V^3 = \begin{bmatrix} 1000 \\ 1100 \end{bmatrix}$$

We note that countries 2 and 3 are relatively capital abundant and that country 1 is relatively labour abundant as

$$\bar{k}_1 = 0.5 < \bar{k}_w = 1; \quad \bar{k}_2 = 1.4 > \bar{k}_w = 1; \quad \bar{k}_3 = 1.1 > \bar{k}_w = 1$$

where \bar{k}_j is the capital-labour ratio in country j ($j = 1, \dots, 3$) and \bar{k}_w is the capital-labour ratio in the world economy.

Free Trade Equilibrium

According to Heckscher-Ohlin theorem we expect countries 2 and 3 to export the relatively capital intensive commodity, and country 1 to export the relatively labour intensive commodity. Table 1 shows the results of calculations, where w denotes the wage rate, r the rental rate of capital both measured in terms of commodity 1, and ES_i^j ($i = 1, 2; j = 1, \dots, 3$) the excess supply of commodity i in country j . Since the endowment vectors are within the factor price equalisation set the three countries have the same sectoral capital-labour ratios. As a result they all have the same wage and rental rates. Country 1 exports the relatively labour intensive commodity, namely commodity 1 whereas the countries 2 and 3 export the relatively capital intensive commodity, namely commodity 2.

Table 1
Equilibrium Solutions under Free Trade and Tariffs

	Free Trade			Tariffs		
	Country 1	Country 2	Country 3	Country 1	Country 2	Country 3
p^*	1.4370	1.4370	1.4370	1.4383	1.4383	1.4383
Tariffs (%)	0	0	0	20	10	2
p	1.4370	1.4370	1.4370	1.7260	1.3075	1.4101
k_1	0.0519	0.0519	0.0519	0.0295	0.0703	0.0551
k_2	1.6136	1.6136	1.6136	1.3372	1.7856	1.6462
w	0.6052	0.6052	0.6052	0.5947	0.6122	0.6065
r	0.8858	0.8858	0.8858	1.1538	0.7697	0.8615
ES1	284.4612	-227.5760	-56.8972	145.3230	-109.2380	-36.0951
ES2	-197.9550	158.3691	39.5941	-101.0380	75.9495	25.0957
Welfare	456.3287	808.4249	687.7262	450.8477	801.0112	687.6546

Tariff Equilibrium

We assume that country 1 imposes 20 percent tariffs on the imports. The tariff rate in country 2 is 10 percent and the tariff rate in country 3 is 2 percent. Under tariffs we note that world price of commodity 2 in terms of commodity 1 is the same for the three countries. But the equilibrium values of domestic prices differ between the countries because of the different tariff rates. As a result the equilibrium values of sectoral capital-labour ratios and of wage rate and of rental rate of capital deviate from each other in the three countries. The solution reported in Table 1 indicates that as a result of tariffs the domestic price ratio goes up in country 1 and decreases in countries 2 and 3. As the domestic price ratio increases (decreases) the equilibrium capital-labour ratio in the two sectors decrease (increase) and as a result the wage rate decreases (increases) and the rental rate of capital increases (decreases). Furthermore imports of commodity 2 in country 1, and imports of commodity 1 in countries 2 and 3 decrease substantially. The imposition of tariffs leads to welfare losses in the three countries. The welfare loss of country 1 amounts to 1.2011 percent of the free trade equilibrium utility level. The loss in the case of country 2 is 0.3004 percent, and the loss in the case of country 3 is 0.0104 percent. Hence the welfare loss is larger, the larger the difference across countries in factor composition.

Customs Union

In the case of the customs union we consider three cases. First countries 2 and 3 form a union. Then the union is formed by countries 1 and 2, and finally by countries 1 and 3. The external tariff and subsidy rates as well as the results of calculations are reported in Table 2.

When countries 2 and 3 form the customs union the endowment vectors of the non-union and union become

$$V^{nu} = \begin{bmatrix} 1000 \\ 500 \end{bmatrix}, \quad V^u = \begin{bmatrix} 2000 \\ 2500 \end{bmatrix}$$

The union applies the tariff rate of 6 percent and the non-union country the 20 percent tariff rate. We note that in equilibrium the non-union country (country 1) exports commodity 1 and imports commodity 2. On the other hand the union as a whole imports commodity 1 and exports commodity 2. But this does not mean that each of the union countries imports commodity 1 and exports commodity 2. The union member country 2 imports commodity 1 and exports commodity 2 whereas the other union member country 3 exports commodity 1 and imports commodity 2.

Table 2

Alternative Equilibria under Custom Unions

	Customs Union 2 and 3				Customs Union 1 and 2				Customs Union 1 and 3			
	Non-union Country (Country 1)	Union	Country 2 in the Union	Country 3 in the Union	Non-union Country (Country 1)	Union	Country 2 in the Union	Country 3 in the Union	Non-union Country (Country 1)	Union	Country 2 in the Union	Country 3 in the Union
Capital/Labour	0.50	1.25	1.40	1.10	1.10	0.95	0.50	1.40	1.40	0.80	0.50	1.10
p*	1.4365	1.4365	1.4365	1.4365	1.3020	1.3020	1.3020	1.3020	1.4016	1.4016	1.4016	1.4016
Tariffs (%)	20	6	6	6	2	0	0	0	10	11	11	11
Subsidy (%)	0	0	0	0	0	15	15	15	0	0	0	0
p	1.7238	1.3552	1.3552	1.3552	1.3230	1.4973	1.4973	1.4973	1.2742	1.5558	1.5558	1.5558
k1	0.0296	0.0626	0.0626	0.0626	0.0668	0.0456	0.0456	0.0456	0.0765	0.0405	0.0405	0.0405
k2	1.3389	1.7176	1.7176	1.7176	1.7556	1.5456	1.5456	1.5456	1.8369	1.4855	1.4855	1.4855
w	0.5948	0.6094	0.6094	0.6094	0.6110	0.6025	0.6025	0.6025	0.6144	0.6002	0.6002	0.6002
r	1.1517	0.8122	0.8122	0.8122	0.7879	0.9407	0.9407	0.9407	0.7403	0.9945	0.9945	0.9945
ES1	146.2791	-146.3410	-152.4800	6.1389	28.0292	-26.9653	256.4001	-283.4250	-77.9073	77.8777	228.5249	-150.6470
ES2	-101.8300	101.8759	109.2318	-7.3558	-20.6918	20.7082	-170.3140	191.0223	55.5846	-55.5655	-149.0540	93.4880
Welfare	451.0019		800.5178	688.8359	686.9919		450.9596	806.8272	798.6080	1142.3540	449.0892	693.2647

Hence trade diversion effect of Viner (1950) is important. As a result of the customs union the non-union country when compared relative to the tariff equilibrium will be better off. Similarly country 3 gains from customs union while country 2 loses.

When countries 1 and 2 form the customs union the endowment vectors of non-union and union become

$$V^m = \begin{bmatrix} 1000 \\ 1100 \end{bmatrix}, \quad V^u = \begin{bmatrix} 2000 \\ 1900 \end{bmatrix}$$

In this case consider first the free trade solution between the union and non-union solution. We note that under free trade equilibrium will be reached when the world price ratio equals 1.437. In equilibrium the relatively capital abundant non-union country will export the capital intensive commodity, commodity 2, whereas the relatively labour abundant country, the union, will export the relatively labour intensive commodity, commodity 1. When the union imposes tariffs on the imports of commodity 2 the world demand for the commodity decreases leading to a decrease in the world price ratio. The imposition of tariffs by the non-union country on the imports of commodity 1 will further reduce the world price ratio. With the tariff rates of 2 percent in the non-union country and 15 percent in the union we note that the non-union country becomes an exporter of commodity 1 and an importer of commodity 2. The union in this case is assumed to grant subsidies to the exports of commodity 2. The subsidy rate is 15 percent. Consideration of the solution in Table 2 reveals that in equilibrium the non-union country (country 3) exports commodity 1 and imports commodity 2. On the other hand the union as a whole imports commodity 1 and exports commodity 2. But within the union country 1 exports commodity 1 and country 2 commodity 2. There is substantial amount of intra union trade. As a result of the customs union the non-union country when compared relative to the tariff equilibrium is worse off. The union countries 1 and 2 are both better off relative to the tariff equilibria.

When countries 1 and 3 form the customs union the endowment vectors of the non-union and union become

$$V^m = \begin{bmatrix} 1000 \\ 1400 \end{bmatrix}, \quad V^u = \begin{bmatrix} 2000 \\ 1600 \end{bmatrix}$$

The union applies the 11 percent tariff rate and the non-union country (country 2) the 10 percent tariff rate. In this case the non-union country exports the commodity 2 and imports the commodity 1. On the other hand the union as a whole

imports commodity 2 and exports commodity 1. But this does not mean that each of the union countries imports commodity 1 and exports commodity 2. The union member country 1 imports commodity 2 and exports commodity 1 whereas the other union member country 3 exports commodity 2 and imports commodity 1. Hence trade diversion effect is important. As a result of the customs union the non-union country when compared relative to the tariff equilibrium will be worse off. Similarly country 1 loses from the customs union while country 3 gains.

The effects of the customs union on the country's welfare level relative to its position under tariffs is shown in Table 3. From the table it follows that the non-union country gains in one and loses in two of the three cases. On the other hand both of the union countries gain in one case (union of 1 and 2) only. In the other two cases one of the countries gains from the customs union whereas the other loses. The gainer is always the country 3 which has the lowest tariff rate and which has a capital-labour ratio that is closer to that of the world economy than the other two economies.

Table 3

Welfare Levels of the Countries

	Country I	Country II	Country III
Free Trade	456.3287	803.4249	687.7262
Tariff Equilibria	450.8477	801.0112	687.6546
Customs Union 2 and 3	451.0019	800.5178	688.8359
Customs Union 1 and 2	450.9596	806.8272	686.9919
Customs Union 1 and 3	449.0892	798.608	693.2647
Percentage Change in Welfare Level			
Customs Union 2 and 3	0.0342	-0.0616	0.1718
Customs Union 1 and 2	0.0248	0.7261	-0.0964
Customs Union 1 and 3	-0.3900	-0.3000	0.8158

When countries 2 and 3 form the union we note that these countries import at the start the same good (commodity 1). There is initially no trade among them. But after the formation of the union the initial trade pattern is changed. While country 2 still imports commodity 1 country 3 imports commodity 2. The non-union country experiences a marginal increase in exports of commodity 2 and also experiences a terms of trade gain. As a result, the non-union country gains from the formation of the union. The welfare effect on the union becomes ambiguous. Country 2 increases its exports. But as a result of the terms of trade effect there is a

welfare loss. On the other hand trade pattern changes in country 3. Because of the terms of trade effect the country ends up gaining from the formation of the union.

In the case of the union between countries 1 and 2 or 1 and 3 we note that these countries initially import different goods. Hence, there is trade between them. After the formation of the union trade increases in each of the union countries. But the non-union country experiences a decrease in trade. Furthermore the trade pattern in the non-union country changes in the case of the union between the countries 1 and 2, but remains the same in the case of the union 1 and 3. The non-union country loses in both cases. We note that trade creation by itself does not determine the welfare effect for the union countries. Both of the countries forming the union gain in the case of the union 1 and 2. In the case of the union 1 and 3 country 3 gains and country 1 loses from the formation of the union.

Optimal Tariffs and Customs Union

The analysis until now has been carried under the assumption that the tariff rates have been chosen arbitrarily as 20 percent in country 1, 10 percent in country 2 and 2 percent in country 3. There is nothing optimal about these tariff rates. When countries form a customs union they take the average tariff rate as the tariff rate of the union. We now turn to the question of optimal tariffs under customs union, and concentrate on the case when countries 2 and 3 form the union. The non-union country is country 1.

Given the endowment vectors of the non-union and union countries

$$V^m = \begin{bmatrix} 1000 \\ 500 \end{bmatrix}, \quad V^u = \begin{bmatrix} 2000 \\ 2500 \end{bmatrix}$$

we note that the optimal tariff rates of the non-union for given values of the tariff rates for the union and of the union for given values of the tariff rates for the non-union are as follows:

Reaction of the Non-union

Union Tariff Rate	Optimal Non-union Tariff Rate
0	11
20	6

Reaction of the Union

Non-union Tariff Rate	Optimal Union Rate
0	22
20	13

The intersection of the reaction functions of the non-union and of union yields the optimal values of the tariff rates. Hence the optimal value of the tariff rate for the non-union country is 6.2 percent and for the union 19.2 percent.

Table 4 shows the tariff equilibrium when country 1 imposes optimal tariff rate of 6.2 percent and the countries 2 and 3 set the tariff rates at their initial levels of 10 and 2 percent respectively. Next, we assume that country 1 holds the tariff rate at its optimal level of 6.2 percent, and that countries 2 and 3 form a customs union by setting the common external tariff rate at its optimal level of 19.2 percent. In this case we note that both of the union countries gain from the formation of the customs union. On the other hand the non-union country loses from the customs union.

Table 4

World Equilibrium under Optimal Tariffs and Customs Union

	Optimal Tariffs			Customs Union			
	Country 1	Country 2	Country 3	Non-Union Country 1	Union	Union Country 2	Union Country 3
p*	1.6182	1.6182	1.6182	1.6182	1.61817	1.6182	1.6182
Tariffs (%)	6.2	10.0	2.0	6.2	19.2	19.2	19.02
p	1.5749	1.3482	1.4539	1.7185	1.3575	1.3575	1.3575
k1	0.0390	0.0636	0.0500	0.0299	0.0622	0.0622	0.0622
k2	1.4670	1.7272	1.5938	1.3430	1.7144	1.7144	1.7144
w	0.5995	0.6098	0.6044	0.5949	0.6093	0.6093	0.6093
r	1.0123	0.8059	0.9012	1.1468	0.8143	0.8143	0.8143
ES1	217.7704	-147.4170	-70.3083	152.9192	-152.9490	-156.0520	3.1032
ES2	-146.8450	99.4048	47.4095	-94.5013	94.5231	105.2001	-10.6771
Welfare	452.0511	804.2844	688.6425	443.7561		804.6481	692.2811

Table 5 summarising the welfare effects of free trade, tariff equilibria and customs union reveals that free trade as world equilibrium may not be attainable. For some of the countries customs union with optimal tariffs may be superior as in the case of the customs union 2 and 3. The non-union country even though it imposes optimal tariffs loses from the formation of the customs union.

Table 5
Welfare Levels of the Countries

	Country I	Country II	Country III
Free Trade	456.3287	803.4249	687.7262
Tariff Equilibria with Arbitrary Tariff Rates	450.8477	801.0112	687.6546
Tariff Equilibria with Optimal Tariff Rates	452.0511	804.2844	688.6425
Customs Union 2 and 3 Starting with Arbitrary Tariff Schedules	451.0019	800.5178	688.8359
Customs Union 2 and 3 Starting with Optimal Tariff Schedules	443.7561	804.6481	692.2811

3. CONCLUSION

The analysis reveals the difficulties in obtaining general results in this area. As a step we have developed a model which illustrates by means of examples some pieces of the puzzle. The examples show the importance of country size, factor endowments and initial tariff rates of non-union and union countries as the determinants of the welfare effects of customs union. When countries forming the union import at the start the same good there is initially no trade among them. But after the formation of the union the initial trade pattern may change. The non-union country may gain whereas one of the union countries may experience a welfare loss. When countries forming the union initially import different goods, the non-union country may experience a welfare loss. In general one cannot assert that countries forming the union will gain from the customs union unless the union imposes the optimal tariffs. Finally, one can assert that the customs union can improve its members welfare over free trade by imposing optimal tariffs as long as the union is large enough. The example shows that it may be difficult to sustain free trade in the world economy.

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