Harmony and Disagreement in Customs Unions: The Role of Demand

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Very Preliminary. Not to be quoted!

Abstract

The paper investigates how the level of demand can influence the delegation decision in a customs union regarding the choice of the policy maker as well as the cohesion of the union. In the context of a simple model involving three strategic agents – two union members and ROW – it is shown that there is unanimity in the union regarding the most cost efficient country being the policy maker only if the level of demand is relatively high. In the case of a relatively low level of demand, however, there is disagreement in the union, as each union member would prefer itself to be the policy maker. The cohesion of the union is secured only in the case where the more cost efficient member, acting as the policy maker, is willing to make transfers to its less cost efficient partner. We show that an appropriate level of transfers exists that would make both countries prefer to stay in the union than to split it and engage in a non-cooperative behavior.

Keywords: Customs union; Common external tariff; Delegation decision; Welfare analysis

JEL Classification: F12, F13, F42

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1 Introduction

Article XXIV of the GATT, which provides the major exception to the Most Favored Nation (MFN) principle\(^1\), allows for the establishment of regional blocs such as free trade areas (FTAs) and customs unions (CUs). There is ample evidence in the world economy pointing to the continuing growth, increasing prominence and deepening in content of preferential trade agreements (PTAs)\(^2\).

Regarding customs unions, in particular, Viner’s (1950) seminal work identifies that they must exhibit three discrete characteristics: i) free trade among member countries, ii) the commitment by members in setting a common external tariff (CET) or a subsidy in their trade with non-member countries and iii) the choice of a sharing rule for the disposition of revenues from the CET\(^3\).

The central question about the optimal level of the common trade policy instrument of a CU has been discussed thoroughly in international trade literature (see, for instance, Ohyama, 1972; Kemp and Wan, 1976; Kennan and Riezman, 1990; Krugman, 1991; Bhagwati, 1991; Bond and Syropoulos, 1996; Srinivasan, 1997; Riezman, 1999; Perroni and Whalley, 2000; Kose and Riezman 2000; Bond et al., 2001; Abrego et al., 2006; Bandyopadhyay et. al, 2011)\(^4\).

There is, in addition, a strand in the literature that focuses on the decision making process that lies behind the choice of the optimal level of a customs union’s common trade policy and which investigates the determination of the policy maker in the union that sets this common policy. Gatsios and Karp (1991) initiated that line of research by constructing a partial equilibrium model in which the union members and the rest of the world (ROW) behave strategically. They show that when the policies used by

\(^1\) There are many ‘GATT-legal’ exceptions to the MFN clause, such as tariff preferences offered to developing countries and to subgroups of those countries, quantitative import restrictions for balance of payments reasons, the Multi-Fibre arrangement, dumping etc.

\(^2\) According to 2011 WTO report, the number of PTAs in force was close to 300. All WTO members except for Mongolia belong to at least one PTA.

\(^3\) Syropoulos (2003) tackles the third characteristic. He shows that sharing rules play an important role in the determination of national preferences over CET levels and the subsequent formation of trade policy. Also, he points out that there is interdependence between the last two characteristics of CUs.

\(^4\) For an indicative survey of the literature regarding the optimal external tariffs in a FTA see, for instance, Kennan and Riezman,1990; Richardson, 1995; Bagwell and Staiger, 1997a; Yi, 2000; Panagaryia and Krishna, 2002; Mukunoki, 2004; Bond et al., 2004; Ornelas, 2005.
the customs union (export tax) and ROW (import tariff) are strategic substitutes, then the member state of the union which is less “aggressive” in the setting of the union’s common policy would find it advantageous to delegate that authority to its more “aggressive” union partner, even if the latter chooses the common policy purely to maximize its own welfare\textsuperscript{5,6}. The underlying notion is commitment. The less “aggressive” union member prefers the export tax to be set at the level chosen by its more “aggressive” partner, yet it cannot credibly enforce it if it were itself the policy maker of the union as it would not constitute in such a case an equilibrium in the game with ROW. Policy aggressiveness in Gatsios and Karp (1991) is related to cost efficiency: the more cost efficient union member would set a higher level of export tax for any level of import tariff set by ROW.

Gatsios and Karp (1995) extend the analysis in a pure exchange, general equilibrium trade model. Policy aggressiveness in that case is related to factor endowments: the union member relatively better endowed in the export good is shown to be the optimal policy maker of the union. Syropoulos (2002) enriches the literature by introducing a model with production. In a Heckscher-Ohlin trade model he proves that the most preferred CETs can be ranked with the help of compensated price elasticities of import demand functions which, in turn, depend on inter-country differences in relative factor endowments and inter-sectoral differences in technology. This allows the identification of the optimal policy maker in a CU. Melatos and Woodland (2007) construct a pure exchange, general-equilibrium trade model to introduce a more generalized concept of delegation and distinguish between “partial” and “super” delegation. In particular, they show that a Pareto-efficient CU may require members to share authority over CET choice (partial delegation). They extend their analysis in Melatos and Woodland (2009) by allowing coalition formations among trading countries. They confirm that when customs unions are observed in the core, members-states might wish to share responsibility for CET choice in a variety of ways. Generally, however, the union member that is relatively better endowed or has more elastic consumer preferences tends to be the optimal policy maker.

\textsuperscript{5} The result is reversed in the case the policy instruments are strategic complements. In such a case, the less “aggressive” union member will be the policy maker.

\textsuperscript{6} Collie (1997) and Miller and Pazgal (2005) study the delegation issue in an international trade context, but not in that of customs union theory.
The paper in hand belongs to this latter strand of research. It builds on Gatsios and Karp (1991) by developing a partial equilibrium model of three strategic agents, two union members and ROW, to shed light on the importance the level of demand might have on the stability and the choice of the optimal policy maker in a customs union. We show that for a given difference in production costs between the union members, there is agreement between the union members on the choice of the policy maker only for relatively high levels of demand. In such a case, the less cost efficient union member finds it to its benefit to delegate authority to its most cost efficient partner to set the common policy of the union in a way that maximizes the latter’s own welfare. However, in periods of relatively low levels of demand there is a disagreement between the unions’ members, as each one of them would prefer to be itself the policy maker. In particular, the less cost efficient country is no more willing to delegate the authority to its more cost efficient partner, unless there are transfers from the latter to the former. We show that such an appropriate level of transfers, which both union members would prefer as opposed to breaking the union and acting non-cooperatively, does exist so that the cohesion of the union can be sustained. It is, perhaps, interesting to note in this context that in the conditions of world recession that we experience since 2008, the issue of transfers within the EU from the more cost-efficient North to the less cost-efficient South has become central in policy discussions.

2 The basic model
There are three strategic agents: two customs union members and the rest of the world (ROW). Each union member is represented by a single firm producing a homogeneous good under different costs solely for exports to ROW; there is no local consumption of this good in the union countries. This is a facilitating assumption; it can be relaxed without altering our main results. We denote by \( x_i \) the amount of the homogeneous product supplied by firm \( i = 1, 2 \) and by \( P(X) = \alpha - \beta X \) the linear inverse demand of the ROW, where \( \alpha > 0, \beta \) is normalized to 1, and \( X = x_1 + x_2 \). This demand function comes from a strictly concave, quadratic utility function \( U(X) = \alpha X - \frac{1}{2} X^2 \). Let \( c_i \) denote the constant average (marginal) cost of firm \( i \).
Suppose without any loss of generality that \( c_1 < c_2 = 1 \) or \( c \equiv \frac{c_1}{c_2} \in (0,1) \). Finally, the customs union sets a common trade policy denoted by \( t \), which will turn out to be a common export tax (CET), while ROW imposes a uniform import tariff, denoted by \( t^* \).

The problem at hand is a two-stage game: in the first stage, the customs union and ROW choose simultaneously their export tax and import tariff levels, whereas in the second stage the firms choose their optimal output levels. We are looking for the sub-game Nash equilibria of the game. In particular, we are interested to see whether the more cost efficient or the less cost efficient union member will be the policy maker of the union, setting the union’s policy for the sole purpose of maximizing its own welfare. No intra-union transfers are allowed at this stage.

Starting from the second stage of the game, firms choose their output levels treating common export tax and import tariff parametrically, so as to maximize profits, that is

\[
\max_{x_i} \pi_i(x_i, x_j; t, t^*) = \left[ P(X) - \left( c_i + t + t^* \right) \right] x_i \quad i, j = 1, 2 \text{ and } i \neq j \tag{1}
\]

The first-order necessary conditions yield the best response functions of the two union members, given by:

\[
x_i(x_j; t, t^*) = \frac{1}{2} \left( \alpha - x_2 - c - t - t^* \right) , \tag{2}
\]

\[
\frac{\partial^2 \pi_i}{\partial x_i^2} = -2 < 0, \quad i = 1, 2 . \quad \text{Moreover, the two goods are strategic substitutes i.e.,} \quad \frac{\partial^2 \pi_i}{\partial x_i \partial x_j} = -1 < 0, \quad i, j = 1, 2 \text{ and } i \neq j
\]

and that the Routh-Hurwitz’s stability condition holds, i.e., \( \Delta = \frac{\partial^2 \pi_i}{\partial x_i^2} \frac{\partial^2 \pi_j}{\partial x_j^2} - \frac{\partial^2 \pi_i}{\partial x_i \partial x_j} \frac{\partial^2 \pi_j}{\partial x_j \partial x_i} > 3 > 0 \).
\[ x_2(x_i; t, t^*) = \frac{1}{2}(\alpha - x_i - 1 - t - t^*) \]  

(3)

Solving jointly the best response functions (2) and (3) we get the equilibrium outputs as a function of the export tax and the import tariff

\[ x_1(t, t^*) = \frac{1}{3}(\alpha + 1 - 2c - t - t^*) , \]  

(4)

\[ x_2(t, t^*) = \frac{1}{3}(\alpha - 2 + c - t - t^*) , \]  

(5)

\[ X(t, t^*) = \frac{1}{3}(2\alpha - 1 - c - 2t - 2t^*) . \]  

(6)

The comparative statics of the model imply that import tariff and export tax have a negative effect on output levels \( \frac{dx_i}{dt} = \frac{\pi_i - \pi_j}{\Delta} = \frac{dx_i}{dt^*} = \frac{1}{3} < 0 , \quad i, j = 1, 2 \quad \text{and} \quad i \neq j , \)

\( \frac{dX}{dt} = \frac{dX}{dt^*} = -\frac{2}{3} < 0 \) and that there is an incomplete “pass through” of the tariff and the tax \( 0 < \frac{dP}{dt} = \frac{dP}{dt^*} = \frac{2}{3} < 1 . \)

Turning to the first stage of the game, we denote by \( \pi_i \) and \( W_i \), respectively, the profits and the welfare of country \( i \) when country \( i \) is the policy maker in the union that sets the CET, and with \( W^* \) the welfare of ROW. Recall that the policy maker chooses the union’s CET with the sole scope of maximizing its own welfare. Hence, if country \( i = 1, 2 \) is the policy maker, the union’s common export tax rule is derived by solving

\[ \max_i W_i(t, t^*) = \pi_i(t, t^*) + t_\pi_i , \quad i = 1, 2 \]  

(7)

Similarly, ROW chooses its optimal import tariff rule by solving
\[
\max_{t^*} W^*(t, t^*) = U(X) - P(X)X + t^*X, \text{ where } U'(X) = P(X)
\]  

(8)

The first order necessary conditions of (7) and (8) provide the union’s optimal CET rule, \( t_i \), when country \( i = 1, 2 \) is the policy maker

\[
t_i = -\frac{\partial \pi_i}{\partial x_j} = x_i \quad i, j = 1, 2 \text{ and } i \neq j
\]

(9)

and ROW’s optimal tariff yields the optimal import tariff rule

\[
t^* = \frac{X \left( \frac{\partial P}{\partial t^*} - 1 \right)}{\frac{\partial X}{\partial t^*}} = \frac{1}{2} X
\]

(10)

Observe that eqs. (9) and (10) together with (4)-(6) indicate that the two policy instruments are strategic substitutes: \( \frac{dt_i}{dt^*} < 0 \) and \( \frac{dt_i}{dt^*_i} < 0 \).

Solving jointly (9) and (10) and after some calculations we get the equilibrium levels of the export tax, the import tariff and the outputs levels under the two delegation regimes, all of them being denoted by a “hat” over the corresponding variable. We report these values in Appendix A.I. We use those values to compute the welfare levels of the two union members and of the ROW under the two delegation regimes.

We notice that the more cost efficient country 1 will always be better off if it is itself the policy maker of the union. It will never wish to delegate that authority to its less cost efficient partner and will always be happy to assume it itself. This is because when it is itself the policy maker its welfare is

\[
W_{1i} = \hat{\pi}_{1i} + \hat{\pi}_i \hat{x}_{1i} = \frac{1}{50}(2\alpha + 3 - 5c)^2
\]

(11)
whereas in the case that its less cost-efficient partner country 2 is the policy maker its welfare is

$$W_{12} = \hat{\pi}_{12} + \hat{\pi}_{2} \hat{x}_{12} = \frac{1}{25}(2\alpha + 5 - 7c)(\alpha - c)$$  \hspace{1cm} (12)$$

and

$$W_{11} - W_{12} = \frac{1}{50}(1-c)(2\alpha - 11c + 9) > 0$$  \hspace{1cm} (13)$$

which is positive since $c < 1$ and $\alpha > 1$.

This is not so for the less cost efficient union member, country 2. It will want to assume the role of policy maker only for relatively low levels of demand. For relatively high levels of demand it will be happy to delegate that authority to its more cost efficient partner, country 1. This is because

$$W_{21} = \hat{\pi}_{2} + \hat{i}_{1} \hat{x}_{21} = \frac{1}{25}(2\alpha + 5c - 7)(\alpha - 1)$$  \hspace{1cm} (14)$$

$$W_{22} = \hat{\pi}_{2} + \hat{i}_{2} \hat{x}_{22} = \frac{1}{50}(2\alpha + 3c - 5)^2$$  \hspace{1cm} (15)$$

$$W_{21} - W_{22} = \frac{1}{50}(1-c)(2\alpha - 11 + 9c)$$  \hspace{1cm} (16)$$

It follows that $W_{21} - W_{22} > 0$ if and only if $\alpha > \frac{11 - 9c}{2} > \frac{7 - 5c}{2}$. This means that only for relatively high levels of demand the less cost efficient country is willing to delegate the authority of setting the common external tax to the more cost efficient partner. Also, observe that the more pronounced the cost difference between the two countries is, the higher the level of demand must be to sustain delegation.

Finally, the rest of the world would prefer the less cost efficient country to be the leader, since $W^*(\hat{i}_2, \hat{i}_2) = \frac{8}{50}(\alpha - c)^2 > W^*(\hat{i}_1, \hat{i}_1) = \frac{8}{50}(\alpha - 1)^2.$
Figure 1 below illustrates these results. So for harmony in the union\(^{10}\) the level of demand has to be sufficiently high i.e., \(\alpha > \frac{11 - 9c}{2}\) (area II). If demand contracts i.e., for \(\alpha \in \left( \frac{7 - 5c}{2}, \frac{11 - 9c}{2} \right)\) the less cost efficient country is no longer willing to delegate the authority to be the policy maker to its partner and there is a conflict in the union (area I): each union member would wish to be itself the policy maker.

We summarize our results in the following proposition.

**Proposition 1.** The more cost-efficient member-state of the union always wants to assume the authority of being the policy maker and set the common policy of the union. However, the less cost-efficient member state would delegate that authority to its more cost-efficient partner only for relatively high values of the levels of demand.

\(^{10}\) It is a basic behavioural assumption throughout this paper that all union member countries unanimously agree on the decisions aspects of the common external trade policy, otherwise the customs union collapses.
i.e., $\alpha > \frac{11-9c}{2}$. Otherwise, for relatively low levels of demand, i.e., for

$\alpha \in \left( \frac{7-5c}{2}, \frac{11-9c}{2} \right)$, the less cost efficient country would prefer to be itself the policy maker and there will thus be a disagreement between the union members regarding the choice of the policy maker. Finally, ROW would always prefer the less cost efficient country to be the one which sets the union’s policy.

3. The Delegation Decision for Relatively Low Levels of Demand

As we have shown above, when the level of demand is relatively low there is a disagreement between the member states regarding the choice of the policy maker that sets the union’s common export tax. This endangers the cohesion of the union. Member states may find it to their advantage to split the union and adopt a non-cooperative behavior. Up to this point of analysis intra-union transfers were not allowed. Recall that such transfers are not needed provided the level of demand is relatively high: in that case both union members concur that the more cost efficient of them assumes the role of the policy maker. As this is not so in the case of relatively low demand, we investigate whether the disagreement that arises in such a case between the union members could be overcome by allowing intra-union transfers\(^{11}\).

In the context of the model, intra-union transfers can take one of the following two forms. Either the country which assumes the role of the policy maker makes transfers to its union partner; or a supra-national agency that maximizes the joint welfare of the union assumes the role of the policy maker and allocates the surplus generated to the member states. If the union is not to dissolve, the level of transfers must, in both cases, be such that both union members prefer to stay in the union than split it and adopt a non-cooperative behavior.

We tackle this issue in two stages. First, we show that the total sum of the union’s welfare is higher in the case where the more cost efficient country is the policy maker.

\(^{11}\) Lipsey (1970) shows that if intra-union transfers are allowed common external tax should be chosen to maximize the joint welfare of the union. However, he does not take into account the strategic interaction between member states and the ROW. On the other hand Riezman (1985); Gatsios (1987), show that if side payments within the union are not feasible union’s members will vie to become the leader and maximize their own welfare.
Hence, if transfers are to sustain the union when demand is relatively low they should be delivered from the more cost efficient country to its less cost efficient partner, with the former exercising the role of the union’s policy maker. Secondly, we show that there exists an appropriate level of transfers of the kind described above which can make both union members prefer retaining the union than splitting it.

To establish the first part of our argument, notice that when the more cost efficient country 1 is the policy maker of the union then, by using (11) and (14), the sum of the two union members’ welfare is given by

\[ W_{11} + W_{21} = \frac{1}{50} \left( 8\alpha^2 - 6\alpha - 10\alpha c - 40c + 25c^2 + 23 \right) \]  

whereas in the case of the less cost efficient country 2 being the policy maker, it is given, by using (12) and (15), by

\[ W_{12} + W_{22} = \frac{1}{50} \left( 8\alpha^2 - 10\alpha - 6\alpha c - 40c + 23c^2 + 25 \right) \]  

It remains to examine the case in which a supra-national agent chooses the common external tax of the union, \( t_e \), with the purpose to maximize joint welfare, \( W_s \),

\[ \max_{t_e} W_s = \pi_1 + \pi_2 + t_e (x_1 + x_2) \]

The optimal common export tax rule emerging from the solution of the above problem is

\[ t_e^* = \frac{2\alpha - 1 - c - 2t^*}{8} \]  

Solving jointly (19) with (10) and after some routine calculations we get the equilibrium levels of the common export tax, the import tariff and outputs. We report these values in Appendix A.2. and we use them to compute the union’s joint welfare.
\[ W_s = \frac{1}{50}(8\alpha^2 - 8\alpha - 8\alpha c - 46c + 27c^2 + 27) \]  

(20)

Using (17), (18) and (20) we get

\[ (W_{11} + W_{21}) - W_s = \frac{1}{25}(1-c)(\alpha - 2 + c) > 0, \]  

(21)

\[ (W_{12} + W_{22}) - W_s = -\frac{1}{25}(1-c)(\alpha + 1 - 2c) < 0 \]  

(22)

since \( c < 1 \) and \( \alpha > 1 \).

We conclude, therefore, that \( W_{22} + W_{12} < W_s < W_{11} + W_{21} \). That is, the total welfare of the union is higher when the more cost efficient union member is the policy maker rather than a supra-national agent (or the less cost efficient partner)}

12. This statement holds for all levels of demand. Hence, in the case of disagreement between the union members regarding the policy maker which arises when demand is relatively weak, the investigation of transfers that can keep the union together must be examined in the context of the more cost efficient member being the policy maker who makes appropriate transfers to its less cost efficient partner.

The question, then, arises. Do such appropriate transfers exist? To answer this question we need to calculate first what the “outside option” for each of the two union members is. If they were to split the union and adopt a non-cooperative approach, the model would become a typical Brander and Spencer (1985) one. In the first stage of the game the governments of the exporting countries would set export subsidies, \( s_i, i = 1,2 \) to promote their firms in the market of ROW by solving

\[ \max_{s_i} W_i(s_i; s_j, t^*) = \pi_i(s_i; s_j, t^*) - s_i x_j \quad i, j = 1,2 \quad \text{and} \quad i \neq j \]  

(23)

while ROW would levy an optimal non-preferential import tariff, \( t^* \), by solving

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12 It is easy to show that ROW would prefer the supra-national agent being the policy maker or, even better, the less cost efficient union member.
\[
\max_j W^* (t^*; s_i, s_j) = U(X) - P(X)X + t^*X \quad i, j = 1, 2 \quad \text{and} \quad i \neq j, \quad U'(X) = P(X)
\] (24)

In the second stage of the game firms choose outputs to maximize profits

\[
\max_{s_i}(\pi_i(x_i, x_j; s_i, s_j, t^*)) = \left[ P(X) - (c_i + t^*) + s_i \right] x_i \quad i, j = 1, 2 \quad \text{and} \quad i \neq j
\] (25)

As the model is well-known we present the equilibrium values of subsidies, tariff and outputs in Appendix A.3 and use those values to calculate the equilibrium welfare of the two exporting countries, \( W_i^{NC} \quad i = 1, 2 \). Those are given by

\[
W_1^{NC} = \frac{2}{49}(\alpha - 4c + 3)^2,
\] (26)

\[
W_2^{NC} = \frac{2}{49}(\alpha - 4 + 3c)^2.
\] (27)

Now, the maximum transfers the more cost efficient country 1 is willing to offer to its less cost efficient partner in the union are given by \( W_{11} - W_1^{NC} \). For transfers larger than those, country 1 would prefer to leave the union. Similarly, the minimum transfers the less cost efficient country demands in order to stay in the union are given by \( W_2^{NC} - W_{21} \). Moreover, the maximum transfers country 1 is willing to make are greater than the minimum transfers country 2 is demanding. This is because

\[
(W_{11} - W_1^{NC}) - (W_2^{NC} - W_{21}) = (W_{11} + W_{21}) - (W_2^{NC} + W_1^{NC}) =
\]

\[
\frac{1}{2450}(192\alpha^2 - 94\alpha - 290\alpha c + 2840c - 1373 - 1275c^2) > 0
\] (28)

\[13\text{ This difference is always positive. In particular, } \frac{2}{70}\left[4(a-1)-5(1-c)\right][24(a-1)+75(1-c)] > 0, \text{ since } c < 1 \text{ and } a > 1.\]
We conclude that an appropriate level of intra-union transfers from country 1, who acts as the policy maker, to country 2 exist so that when the level of demand is relatively low both countries would prefer to stay in the union than to split it.

We summarize the above discussion as

**Proposition 2.** Even in the case where demand is relatively low, i.e.,
\[ \alpha \in \left( \frac{7-5\epsilon}{2}, \frac{11-9\epsilon}{2} \right) \] so that there is disagreement between the union members about the choice of policy maker, there exists an appropriate level of transfers from the more cost efficient country, who assumes the role of policy maker, to its less cost efficient partner, such that both countries prefer to stay in the union than to split it and behave non-cooperatively.

4. Conclusions

This paper has been motivated by the initial paper of Gatsios and Karp (1991) in which they shed light to the delegation decision in a customs union. They show that in a CU of two countries the cost difference plays a dominant role to the decision of the leadership in the CU. The more cost efficient country will be chosen as the policy maker.

The model we have described examines the influence of the level of demand on the delegation decision in a customs union for a given difference in production costs between the union members. The argument of delegation does not depend on the linearity of demand function. In the case of two countries in the customs union the less cost efficient union member finds it to its benefit to delegate authority to its more cost efficient partner to set the common policy of the union in a way that maximizes the latter’s own welfare. Otherwise, for relatively low levels of demand, the union members disagree on the delegation decision and the more cost efficient country can persuade the less cost efficient partner to be itself the policy maker only with the provision of side-payments. Without an appropriate level of intra-union side payments there is a conflict of interest and the operation of customs union is doubtful, since the less cost efficient country has an incentive to deviate and behave non-cooperatively.
Our analysis is indicative and helps us figuring out the decision making in a customs union in good and bad times. We have shown that during a world recession the stability and the coherence of a customs union is guaranteed by transfers within the union from the more cost-efficient country to the less cost efficient partner.
Appendix

A.1

In the case where the union’s member-state 1 is the PM, the equilibrium CET ($t_1$), the import tariff ($\hat{t}_1^*$) and firms’ output levels ($\hat{x}_{11}$, $\hat{x}_{21}$) are given by

\[
t_1 = \frac{2\alpha + 3 - 5c}{10} > 0 \tag{A.1.1}
\]

\[
\hat{t}_1^* = \frac{\alpha - 1}{5} > 0 \tag{A.1.2}
\]

\[
\hat{x}_{11} = \frac{2\alpha + 3 - 5c}{10} > 0 \tag{A.1.3}
\]

\[
\hat{x}_{21} = \frac{2\alpha - 7 + 5c}{10} > 0 \tag{A.1.4}
\]

Respectively, when the union’s member-state 2 is the policy-maker we get

\[
\hat{t}_2 = \frac{2\alpha + 3c - 5}{10} > 0 \tag{A.1.5}
\]

\[
\hat{t}_2^* = \frac{\alpha - c}{5} > 0 \tag{A.1.6}
\]

\[
\hat{x}_{12} = \frac{2\alpha + 5 - 7c}{10} > 0 \tag{A.1.7}
\]

\[
\hat{x}_{22} = \frac{2\alpha - 5 + 3c}{10} > 0 \tag{A.1.8}
\]

A.2

\[
\hat{t}_s = \hat{t}_s^* = \frac{2\alpha - 1 - c}{10} > 0 \tag{A.2.1}
\]

\[
\hat{x}_i^* = \frac{\alpha + 2 - 3c}{5} > 0 \tag{A.2.2}
\]
\[ \hat{x}^*_2 = \frac{\alpha - 3 + 2c}{5} > 0 \]  

(A.2.3)

Notice that the supra-national agency’s optimal tax lies between the union’s CET under both the cases where country 1 and country 2 are the PM i.e, \( \hat{i}_2 < \hat{i}_s < \hat{i}_1 \).

A.3

By solving the Cournot quantity problem (2\textsuperscript{nd} stage of the game) and after some routine calculations we get output rule

\[ x_1(s_1, s_2, t^*) = \frac{1}{3}(\alpha + 1 - 2c + 2s_1 - s_2 - t^*), \quad x_2(s_1, s_2, t^*) = \frac{1}{3}(\alpha - 2 + c + 2s_2 - s_1 - t^*), \]

\[ X(s_1, s_2, t^*) = \frac{1}{3}(2\alpha - 1 - c + s_1 + s_2 - 2t^*) \]  

(A.3.1)

The tariff and subsidy rule, are given by

\[ t^* = \frac{2\alpha - 1 - c + s_1 + s_2}{8}, \]  

(A.3.2)

\[ s_1 = \frac{\alpha + 1 - 2c - t^* - s_2}{4}, \]  

(A.3.3)

\[ s_2 = \frac{\alpha - 2 + c - t^* - s_1}{4}. \]  

(A.3.4)

By solving jointly the system (A.1.2-A.1.4) optimal import tariff and export subsidy levels are

\[ \hat{t}^* = \frac{2\alpha - 1 - c}{7}, \]  

(A.3.5)

\[ \hat{s}_1 = \frac{\alpha - 4c + 3}{7}, \]  

(A.3.6)

\[ \hat{s}_2 = \frac{\alpha - 4c + 3}{7}. \]  

(A.3.7)

and by replacing (A.1.5-A.1.7) to (A.1.2-A.1.4) we have the optimal output levels

\[ \hat{x}_1 = \frac{1}{7}(2\alpha + 6 - 8c), \quad \hat{x}_2 = \frac{1}{7}(2\alpha - 8 + 6c), \quad \hat{X} = \frac{1}{7}(4\alpha - 2 - 2c). \]  

(A.3.8)
References


Richardson, M., 1995, Tariff revenue competition in a free trade area, European Economic Review 39, 1429-.
