The Role of Flexible Technologies in International Economic Integration

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Abstract

This paper is in the Vinerian tradition and we wish to examine circumstances under which customs union formation leads to welfare gains for member and nonmember countries. This is done in a model of imperfect competition and a distinction is made whether markets are segmented or not. We solve a two-stage game where tariffs are chosen prior to quantity competition and compare the pre-union and customs union situation. With symmetric oligopoly size, market size and costs, the home and partner countries are better off and the rest of the world is worse off. However, if a country liberalizes trade with another one whose firms are less efficient in terms of costs, then firms will prefer customs union formation if oligopolies are sufficiently concentrated. Then, we assume that the home firm has a technology with diseconomies of scope to show that there are cases in which all countries gain with the formation of a customs union. This means that consumers and producers in the union and outside the union may gain with customs union formation, which also leads to multilateral tariff reduction even if tariffs are set strategically.

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1 Introduction

This paper analyzes customs union formation in a model of imperfect competition where governments first strategically set tariffs and second oligopolistic firms compete in quantities. There is now recent attention devoted to examine the incentives aspects of preferential trading agreements and the move towards multilateral free trade. We identify, for a class of examples, conditions under which firms in the union improve with customs union formation and also whether it is possible that nonmembers also improve their position.

International economic integration describes a process of gradual elimination of economic frontiers between countries. The recent and growing interest in trading agreements, sanctioned under Article XXIV of the GATT, is exemplified by the number of Regional Trade Agreements notified, about a hundred and fifty, since the creation of GATT in 1948. Free Trade Areas and Customs Unions are two of such types or levels of integration. As for the theory of customs unions, it is Viner (1950) who questioned that customs unions not only represented a move to freer trade but also involved elements of greater protection. Viner made the now-famous distinction between trade creation and trade diversion, the former meaning the replacement of high-cost domestic production of a union member by lower-cost production of other members, and the latter referring to the replacement of low-cost non-member production by higher-cost member production.\(^1\) There can be no general assessment regarding the welfare effects and desirability of customs union formation. Lipsey (1960) went on to show that a customs union can be welfare improving even in the presence of trade diversion. Subsequent work,

\(^1\)O’Brien (1976) argues that some nineteenth-century British economists were aware of trade creation and trade diversion in their assessments of commercial treaties and customs unions. Nevertheless, there can be no doubt that Viner’s book has been the catalyst to the large body of theoretical literature on customs unions.
such as that of Cooper and Massell (1965) and Wonnacott and Wonnacott (1981), has shown that a non-preferential tariff is superior to customs union formation and that, with foreign tariffs, reciprocal tariff reductions can result in a welfare improvement, respectively. The literature on customs union theory is massive although it has made only limited progress (see Hine, 1994, for a survey).

The present paper is in the Vinerian tradition to examine circumstances under which customs union formation leads to welfare gains for member countries. This is done in a model of imperfect competition and we will distinguish the effects on trade whether markets are segmented or not. A couple of recent references looking into the incentive aspects of forming a customs union are Bagwell and Staiger (1997) and Krishna (1998), who study multilateral tariff cooperation and multilateral liberalization. Our analysis is somehow related with Krishna (1998). We will propose two-stage game where first governments strategically set tariffs and second oligopolistic firms compete in quantities. Tariffs are set so as to maximize total surplus in each country (or the customs union). As consumers typically end up better off with the customs union, some authors take a "new political economy" approach and just look at firms’ profits, as in Krishna (1998). Some comparisons are undertaken between the pre-union and customs union situations.

Our main findings are the following. With symmetric oligopoly size, market size and costs, the common external tariff is smaller than before the formation of the customs union. tariff. Firms in the home and partner countries are better off; the same occurs to consumers. However, welfare in the rest of the world is lower. Symmetry implies that there is just a trade creation effect. We then suppose that firms in the partner country are more ineffi-
cient than the rest - their costs of production are higher. Then, Viner’s trade creation and trade diversion effects are recovered in a partial equilibrium setting; firms will prefer customs union formation if oligopolies are sufficiently concentrated. Again, the rest of the world is worse off in total welfare terms. Finally, we suppose that there are diseconomies of scope for home country firms concerning the output exported. This is a fairly simple way of eliminating market segmentation. Competition intensity transmits from one country to another even before the formation of the customs union. In addition to the trade creation effect, there arises an output reallocation effect by the home firm. For sufficiently high cost substitutability, consumers and producers in the union and outside the union may gain with customs union formation, which also leads to multilateral tariff reduction even if tariffs are set strategically.

2 The Model

Suppose there are three countries, the home country $h$, the partner country $p$ and the rest of the world $w$. Let $i = h, p, w$, and $j = h, p, w$, to country indices. The market structure is one of imperfect competition with $n_j$ oligopolistic firms producing goods that are perfect substitutes for each other. Demand in country $j$ is given by

$$Q_j = \gamma_j(a - p)$$

and quantity $q^i_j$ denotes the output of a firm from country $i$ in country $j$’s market, for $i, j = h, p, w$. Thus, $Q_j$ is equal to $\sum_i n_i q^i_j$, the total output in

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2 There is a preoccupation with terminology. Thus, Ethier and Horn (1984) describe as trade modification the change in trade with outside countries due to the elimination of tariffs on goods traded only within the union. These authors explain how this differs from trade diversion.
country $j$ produced by firms from $h,p$ and $w$. There are assumed to be no fixed costs of production and marginal costs are constant as follows: $c$ for home country firms, $c + \Delta_p$ for partner country firms and $c + \Delta_w$ for the rest of the world country firms. In principle, $\Delta_p$ and $\Delta_w$ can be positive or negative. Each country can apply a uniform nondiscriminatory tariff on imports from the other two countries. Let $t_j$ denote the per unit tariff.

We begin by characterizing a situation with trade among the three countries in which tariffs are strategically set before quantity competition takes place. Given the above assumptions, markets are segmented and we proceed to solve a standard game in the strategic trade policy literature. Firms in country $h$ solve the following problem:

$$\max_{q_h^k} \pi_h^k = \left( a - \frac{1}{\gamma_h} \left[ \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^p + \sum_{m=1}^{n_w} q_{hm}^w \right] - c \right) q_{hk}^k \quad \text{for } k = 1, \ldots, n_h$$

$$\max_{q_h^p} \pi_h^p = \left( a - \frac{1}{\gamma_h} \left[ \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^p + \sum_{m=1}^{n_w} q_{hm}^w \right] - c - \Delta_p - t_h \right) q_{hl}^p \quad \text{for } l = 1, \ldots, n_p$$

$$\max_{q_h^w} \pi_h^w = \left( a - \frac{1}{\gamma_h} \left[ \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^p + \sum_{m=1}^{n_w} q_{hm}^w \right] - c - \Delta_w - t_h \right) q_{hm}^w \quad \text{for } m = 1, \ldots, n_w$$

This yields

$$q_h^k = \frac{\gamma_h (a - c + n_p (\Delta_p + t_h) + n_w (\Delta_w + t_h))}{n_h + n_p + n_w + 1}$$

$$q_h^p = \frac{\gamma_h (a - c - \Delta_p (n_h + n_w + 1) + \Delta_w n_w - t_h (n_h + 1))}{n_h + n_p + n_w + 1}$$

$$q_h^w = \frac{\gamma_h (a - c - \Delta_w (n_h + n_p + 1) + \Delta_p n_p - t_h (n_h + 1))}{n_h + n_p + n_w + 1}$$

One can then obtain $Q_h$, $p_h$ and construct the (standard) welfare function for the home country, $W_h = CS_h + n_h (\pi_h^h + \pi_h^p + \pi_h^w) + t_h (n_p q_h^p + n_w q_h^w)$. Setting $\partial W_h / \partial t_h$ equal to zero and solving yields,

$$t_h^* = \frac{(a - c) (2n_h + 1) (n_p + n_w) + (n_p \Delta_p + n_w \Delta_w) (n_h (n_p + n_w - n_h - 2) - 1)}{\left( n_p + n_w \right) (2 + 2n_h (2 + n_h) + n_p + n_w)}$$
Substituting back we obtain equilibrium outputs, profits, consumer surplus and welfare in country $h$. A similar analysis applies to countries $p$ and $w$.

### 2.1 Customs Union Formation and Segmented Markets

Now countries $h$ and $p$ form a customs union. The Cournot equilibrium in the market of size $\gamma_h + \gamma_p$ is obtained from solving,

$$
\max_{q_h^k} \pi_h^k = \left( a - \frac{1}{\gamma_h + \gamma_p} \left( \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^k + \sum_{m=1}^{n_w} q_{hm}^k \right) - c \right) q_{hk}^k \quad \text{for } k = 1, \ldots, n_h
$$

$$
\max_{q_{hl}^l} \pi_p^l = \left( a - \frac{1}{\gamma_h + \gamma_p} \left( \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^k + \sum_{m=1}^{n_w} q_{hm}^k \right) - c - \Delta_p \right) q_{hl}^l \quad \text{for } l = 1, \ldots, n_p
$$

$$
\max_{q_{hm}^m} \pi_w^m = \left( a - \frac{1}{\gamma_h + \gamma_p} \left( \sum_{k=1}^{n_h} q_{hk}^k + \sum_{l=1}^{n_p} q_{hl}^k + \sum_{m=1}^{n_w} q_{hm}^k \right) - c - \Delta_w - t_u \right) q_{hm}^m \quad \text{for } m = 1, \ldots, n_w
$$

The subscript $u$ stands for the customs union case and the equilibrium quantities are given by,

$$
q_h^u = \frac{(\gamma_h + \gamma_p)(a - c + \Delta_p n_p + (\Delta_w + t_u) n_w)}{n_h + n_p + n_w + 1}
$$

$$
q_p^u = \frac{(\gamma_h + \gamma_p)(a - c - \Delta_p (n_h + n_w + 1) + (\Delta_w + t_u) n_w)}{n_h + n_p + n_w + 1}
$$

$$
q_w^u = \frac{(\gamma_h + \gamma_p)(a - c + \Delta_p n_p - (\Delta_w + t_u) (n_h + n_p + 1))}{n_h + n_p + n_w + 1}
$$

The tariff $t_u$ is set to maximize welfare in the union, $W_u = CS_u + n_h \pi_u^h + n_p \pi_u^p + t_u n_w q_u^w$ so that we obtain

$$
t_u^* = \frac{(a - c)(2n_h + 2n_p + 1) + \Delta_p n_p (n_h + n_p - n_w) - \Delta_w [(n_h + n_p + 1)^2 - (n_h + n_p) n_w]}{2(n_h + n_p + 1)^2 + n_w}
$$

The equilibrium in country $w$ remains the same given that markets are segmented. We may now make some comparisons with the equilibrium before and after the formation of the customs union. The proof is straightforward.
Proposition 1 Consider the symmetric case, \( n_h = n_p = n_w = n; \gamma_h = \gamma_p = \gamma_w = \gamma \) and \( \Delta_p = \Delta_w \). Then,

i) the tariff \( t^*_u = \frac{(a-c)(1+4n)}{2+n(9+8n)} \) is smaller than \( t^*_j = \frac{(a-c)(1+2n)}{2+n(6+2n)} \).

ii) equilibrium output by firms in the customs union increases and imports from country \( w \) decrease. The same happens to profits.

iii) Consumer surplus in the union is higher and welfare increases. Welfare in \( w \) is lower after the formation of the customs union.

It has been shown by Anderson et al. (1989) that trade liberalization under oligopoly is harmful for firms in at least one of the countries. Furthermore, for symmetric market and oligopoly sizes it is the case that both countries lose in a move from autarky to free trade. The intuition behind these results rests on two opposite effects: a market expansion effect, associated with firms operating in a market of a larger size, and a competition effect, since there are more firms in the market. Cordella (1993) undertakes a welfare analysis to show that the gains to consumers can outweigh the losses to producers and hence both countries would gain from intra-industry trade liberalization. In any case, at the world level, free trade is welfare improving with respect to autarky. Our analysis goes one step further by considering that there is a third country and trade liberalization between two partner countries also involves the strategic choice of a tariff on imports from the third country. The tariff \( t^*_u \) is lower than before the formation of the customs union but enough for firms in both countries to gain, that is, for the market expansion effect to offset the competition effect even under complete symmetry. Outputs are strategic substitutes, that is, reaction functions are downward sloping. The increase in output from firms in the customs union implies a decrease in output from firms in the rest of the world. This occurs both because of trade liberalization and by the effect of the tariff. Overall, output in the union is higher, price is lower and consumers improve. Imports
from the rest of the world diminish and, given that the tariff is lower, tariff revenue decreases. In sum, the gains to consumers and firms are larger than the loss associated with tariff revenue. Given market segmentation, it follows that welfare in the rest of the world decreases because firms’ profits decrease and both consumer surplus and tariff revenue remain the same. If we translated Viner’s trade creation and trade diversion effects to our partial equilibrium setting we would conclude that the formation of a customs union only entails a trade creation effect under the symmetry conditions of the above proposition.

It is possible to "recover" Viner’s point by e.g. considering asymmetric costs.\(^3\) We take the case where country \(p\) firms are less efficient than those of country \(w\).

**Proposition 2** Consider the symmetric case, \(n_h = n_p = n_w = n\); \(\gamma_h = \gamma_p = \gamma_w = \gamma\). Assume \(\Delta_p > 0\) and \(\Delta_w = 0\). If \(\frac{a-c}{\Delta_p} > \frac{3+n(8+3n)}{2}\) then,

i) Country \(h\) and country \(p\) firms earn higher profits before the formation of the customs union for \(n > 3\).

ii) Consumer surplus in \(h\) and \(p\) is higher after the union.

iii) Welfare in the union is higher than before.

Let us consider market \(h\). The formation of a customs union supposes that intra-industry trade is liberalized between home and partner. This means that output of a country \(h\) firm in \(p\), and viceversa, increases. As indicated above, imports from the rest of the world decrease since outputs are strategic substitutes. Thus, there are fewer output units produced at cost \(c\) (smaller \(q^w_h\)) and more units produced at cost \(c + \Delta_p\). \((q^p_u\) is greater than

\(^3\)We might also consider different oligopoly sizes or different market sizes and obtain the same qualitative results presented in proposition 2. However, we believe that costs differences better conforms with Viner’s original definitions of trade creation and diversion.
This is a trade diversion effect. On the other hand, a country $h$ firm and a country $p$ firm now produce more, which is a trade creation effect. The above proposition establishes that the trade diversion effect offsets the trade creation effect when oligopoly size is large enough and thus competition is sufficiently intense. The same occurs in market $p$. In any case, total output after the formation of a customs union increases and so does consumer surplus. More specifically, welfare in $h$ always increases following the formation of a customs union but consumer gains do not offset firms’ losses in country $p$. Given that welfare in the union is higher than before, there is room for country $h$ to give some kind of compensation to country $p$; otherwise the agreement will not be reached. It is straightforward that welfare in country $w$ decreases since exports from country $w$ firms are now smaller.

2.2 Customs Union Formation and Technologically Related Markets

The previous analysis discloses that consumers and firms gain with the customs union when the signing countries are similar (proposition 1) or when oligopoly is concentrated if there are cost asymmetries (proposition 2). The next question we wish to analyze is whether it is possible that firms lose with the formation of a customs union even if the intensity of competition is very low.

Assume that $n_h = n_p = n_w = 1$ and that $\gamma_h = \gamma_p = \gamma_w = 1$. Marginal costs of production for the firms in $p$ and $w$ are constant and equal to $c$. However, the cost function for the home firm is given by,

$$C_h = c(q_h^h + q_p^h + q_w^h) + \beta q_p^h q_w^h$$

where $\beta$ is a positive constant. It multiplies the outputs exported by the home firm and the fact that it is positive indicates cost substitutability (formally,
that $\partial C_h^2/\partial q_p^h\partial q_w^h > 0$). This property means in our simple setting that there are diseconomies of scope in export production; the higher the output exported the higher the costs. This interactive term makes it such that markets are not segmented any longer and competition intensity transmits across markets. Thus, we solve the above described two-stage game before and after the formation of a customs union. More specifically, the equilibrium tariffs are

$$t_h^* = \frac{3(a - c)}{10}; \quad t_p^* = t_w^* = \frac{(a - c)(-24 - 12\beta + 19\beta^2 + 9\beta^3)}{(2 + \beta)(27\beta^2 - 4\beta - 40)}$$

The second order conditions for a maximum in the choice of tariffs requires that $\beta \in (0, 1.17)$ or that $\beta > 1.69$. Given this, the equilibrium tariffs are positive. So are the equilibrium quantities and prices. The equilibrium quantities are

$$q_h^* = \frac{2(a - c)}{5}; \quad q_p^* = q_w^* = \frac{(a - c)}{10}$$

$$q_p^* = q_w^* = \frac{2(a - c)(3\beta^2 - 8)}{(2 + \beta)(27\beta^2 - 4\beta - 40)}$$

$$q_p^* = q_w^* = \frac{(a - c)(1 + \beta)(3\beta^2 - 8)}{(2 + \beta)(27\beta^2 - 4\beta - 40)}$$

Now countries $h$ and $p$ form a customs union. Then, the equilibrium tariffs are the following

$$t_u^* = \frac{(a - c)(-51200 - 512\beta + 79168\beta^2 + 2112\beta^3 - 41384\beta^4 - 720\beta^5 + 7533\beta^6)}{-194560 + 315072\beta^2 - 159256\beta^3 + 25515\beta^4}$$

$$t_{wu}^* = \frac{(a - c)(-58368 + 8192\beta + 99808\beta^2 - 15296\beta^3 - 52112\beta^4 + 5220\beta^5 + 8505\beta^6)}{-194560 + 315072\beta^2 - 159256\beta^3 + 25515\beta^4}$$

The second order conditions for a maximum in the choice of tariffs requires that $\beta \in (0, 1.21)$ or that $\beta > 1.53$. Furthermore, $t_u^*$ and $t_{wu}^*$ are positive for $\beta \in (0, 1.11)$ and $\beta > 1.69$. Therefore, to establish meaningful comparisons between the two situations we should require $\beta \in (0, 1.11)$ and $\beta > 1.69,$
so that the second order conditions are met before and after the union and equilibrium tariffs are indeed positive. However, there is an upper bound on the parameter $\beta$ which is needed to ensure positive equilibrium quantities and prices. In particular, from $q_h^w$ we must have that $\beta \in (0, 0.47)$. Besides, $q_h^w, q_p^h, q_w^p$ are negative for $\beta$ greater than 1.69. The next result follows by comparing the pre-union and the customs union situations.\footnote{The expressions are fairly long and we do not reproduce them here. They are available from the authors upon request.}

**Proposition 3** For $\beta \in (0, 0.47)$,

i) The tariff $t_u^*$ is lower than $t_h^*$ and $t_p^*$. Furthermore, the tariff $t_{wu}^*$ is also lower than $t_w^*$.

ii) Country $h$ and country $p$ firms earn higher profits with the formation of the customs union. Furthermore, country $w$ firm also earns higher profits for $\beta \in (0.43, 0.47)$.

ii) Consumer surplus in $h$, $p$ and $w$ is higher after the union.

A few comments are in order. Remark that diseconomies of scope affect the output of the home firm in countries $p$ and $w$. Hence, equilibrium in country $h$ follows as if it were an independent market ($\beta$ does not play any role). However, the formation of the customs union has implications for the output choices of the home firm since the fact that $\beta$ is positive is ”bad” for the output mix, but the home firm now does not pay the tariff $t_p$. Thus, trade liberalization between the union members increases intra-industry trade: firm $h$ exports more to $p$, and firm $p$ exports more to $h$, which is a trade creation effect. Given that outputs are strategic substitutes, imports coming from firm $w$ decrease. In technologically related markets, trade diversion has to do with the output reallocation effect by the home firm. Indeed, exports by firm $h$ to
country $w$ decrease. It is worth remarking that profits to firm $w$ increase for sufficiently high cost substitutability. This means that, with the necessary qualifications, consumers and producers in the union and outside the union may gain with customs union formation, which also leads to multilateral tariff reduction even if tariffs are set strategically.

3 Concluding Remarks

We have examined, for a class of examples, the derived effects from customs union formation in a model of imperfect competition where tariffs are chosen in a strategic way. One of our objectives has been to illustrate the various effects at play by alluding to the well-known trade creation and trade diversion effects introduced by Viner (1950). Two interesting results emerge from our analysis. Firstly, if a country liberalizes trade with another one whose firms are less efficient in terms of costs, then firms earn higher profits before the union unless the market is very concentrated. In other words, although consumers are better off with the union, firms might not have any incentives in customs union formation. Secondly, we have assumed away that markets are segmented and that the home firm has a technology with diseconomies of scope to show that there are cases in which all countries gain with the formation of a customs union. Furthermore, tariffs decrease.

References


Proof of Proposition 2: First note that we must ensure that equilibrium quantities, before and after the union, are positive. This occurs if the numerator in $q_h^p$ before is positive, i.e. if $\frac{a-c}{\Delta p} \equiv x > \frac{3+n(8+3n)}{2}$. The difference in profits for a country $h$ firm before and after the union yields the following polynomial (in the numerator):

$$x^2(128n^6 + 192n^5 - 284n^4 - 600n^3 - 379n^2 - 108n - 12)$$

$$+ x(64n^7 - 160n^6 - 1116n^5 - 1574n^4 - 960n^3 - 280n^2 - 32n)$$

$$+ 56n^8 + 144n^7 + 10n^6 - 210n^5 - 211n^4 - 84n^3 - 12n^2,$$

which is decreasing in $x$ and $n$. Plugging $x = \frac{3+n(8+3n)}{2}$ above yields a polynomial in $n$ which, taking into account the integer constraint, is positive for $n > 3$. In fact, for $n > 3$ the coefficient of $x^2$ above is positive so that the difference in profits is positive outside the roots of the polynomial; the upper root is smaller than $\frac{3+n(8+3n)}{2}$. Hence, a country $h$ firm earns higher profits before the union for $n > 3$.

A similar analysis can be applied to the difference in profits for a country $p$ firm before and after the union to obtain that it is positive for $n > 2$. Therefore, we can conclude that firms in countries $h$ and $p$ are better off before the union if $n > 3$.

As for consumer surplus in $h$, the difference before and after results in the following polynomial (in the numerator):

$$-x^2(256n^7 + 1056n^6 + 1400n^5 + 876n^4 + 280n^3 + 36n^2)$$

$$+ x(-64n^8 + 56n^7 + 988n^6 + 1708n^5 + 1208n^4 + 392n^3 + 48n^2)$$

$$+ 28n^8 + 8n^7 - 235n^6 - 434n^5 - 311n^4 - 100n^3 - 12n^2$$

It is positive for values of $x$ between the roots of the polynomial. However, it is easy to check that the upper root is smaller than $\frac{3+n(8+3n)}{2}$. Hence, consumers in $h$ are better off with the union. A similar analysis applies to consumer surplus in country $p$. 

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