DISCUSSION PAPER SERIES

IZA DP No. 1568

# Trade Policy and Illegal Immigration

Subhayu Bandyopadhyay
Ryo Takashima

April 2005

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

# Trade Policy and Illegal Immigration

**Subhayu Bandyopadhyay**
*West Virginia University*
*and IZA Bonn*

**Ryo Takashima**
*West Virginia University*

Discussion Paper No. 1568
April 2005

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
Email: iza@iza.org

IZA Discussion Paper No. 1568
April 2005

# ABSTRACT

## Trade Policy and Illegal Immigration

We use a version of the Meade model to consider the effects of interdependent import tariffs in the presence illegal immigration. First, we consider the small union case and derive the Nash tariff equilibrium for two potential members of a Preferential Trade Agreement (PTA). We analyze conditions under which a movement from the Nash equilibrium to complete intra-bloc tariff elimination (FTA) is likely to be welfare augmenting. The paper also considers how reduction of the external tariff may impact the Nash equilibrium tariffs of the potential bloc members. The analysis is extended to the large union case to consider the conditions under which terms of trade of bloc members improve with respect to the non-member nation(s).

JEL Classification: F11, F22

Keywords: preferential trade agreement, illegal immigration, optimal tariff

Corresponding author:

Subhayu Bandyopadhyay
Department of Economics, P.O. Box 6025
B & E Building, West Virginia University
Morgantown, WV 26506 6025
USA
Email: bandysub@mail.wvu.edu

## 1. Introduction

Regional trading agreements have become very popular in recent times. Some well known trading blocs are NAFTA, EU, SAARC, and MERCOSUR. However, there are several others which are less prominent. While these agreements strive to eliminate trade barriers within blocs, they typically do not achieve complete free trade (see Baldwin and Venables, 1995). Each member tries to pursue their own interests such as the amount of tariff reduction that they are willing to concede in return for better access to their partners' markets. Also, the issues on the negotiation table are not limited to trade policy alone, but cover a variety of related problems. Illegal immigration is one of the important related issues, especially for PTAs that involve bordering nations.

Illegal immigration has been a serious problem in NAFTA, especially along the US-Mexico border. Recent estimates (see Orrenius 2001) suggest that there are about 3 million undocumented Mexican immigrants in the US in 1997. About 202,000 Mexicans immigrated per year between 1987 and 1996. Tariffs change domestic prices, and cause adjustment between different sectors and indirectly affect the labor market. The resulting change in labor market conditions influence immigration flows. On the other hand, immigration flows due to changes in the source nation or due to policy, directly affect the labor market. Clearly, these two issues, tariff and immigration, are interrelated. Thus trade negotiations have to and do consider these issues simultaneously.[1]

The literature on regional trade agreements has explored a variety of issues (see for example, Ethier and Horn, 1984, Baldwin and Venables, 1995, Bhagwati, Krishna,

[1] NAFTA negotiations/documents discuss both tariff liberalization and ways to control illegal labor flows. Former Attorney General Reno called the Free Trade Agreement with Mexico "..our best hope for reducing illegal immigration over the long haul." http://www.clintonfoundation.org/legacy/101293-fact-sheet-on-nafta-notes.htm

and Panagariya, 1999). Ethier and Horn (1984) have shown that (i) marginal reduction of tariff improves joint-welfare of trade bloc when starting from non-discriminatory tariff, and (ii) marginal increase in internal tariff improves joint-welfare of trade bloc when starting from free intra-trade bloc in a tariff-ridden world. These imply the presence of the optimal positive internal tariff. Panagariya (1999) derives the second best optimal tariff within the context of the Meade Model. In addition to the analysis of marginal changes in tariffs, the literature has also explored the welfare implications of complete tariff elimination. Panagariya and Krishna (2002) consider circumstances under which an FTA must improve the joint welfare of the bloc.

While the existing literature has deepened our understanding of the nature of optimal trade taxes and of the welfare implications of regional integration, it has not adequately addressed the issue of illegal immigration. The agenda of this paper is to contribute towards improving our understanding of this issue by complementing the existing literature in four ways. First, we consider how a mutual tariff reduction by bloc members alters the level of illegal immigration. Second, we describe the nature of the non-cooperative equilibrium within the bloc. Third, we analyze the welfare effect of complete intra-bloc tariff elimination (as in an FTA). Finally, the analysis is extended to consider terms of trade effects of tariff changes (within the context of a trade bloc involving large nations) and how these impact the illegal immigration problem.

The rest of the paper is organized in the following way. Section 2 presents the basic model and analyzes the small-union case. Section 3 extends the analysis to consider terms of trade effects. Section 4 concludes.

## 2. The Small Union Case

We use the small-union Meade model used in Panagariya (1999) and Bandyopadhyay (2003). There are three nations, A, B, and C. Nations A and B form a Preferential Trade Agreement (PTA). There are three goods; good-1, 2, and 3. Nations A and B both produce goods 1 and 2. Nation A exports good-1 and imports goods 2 and 3. Nation B exports good-2 and imports goods 1 and 3. Nation C produces and exports good-3 while it imports goods 1 and 2. We assume A and B impose import tariffs while C pursues free trade. Trade liberalization within the bloc takes place as A reduces or eliminates import tariff on good-2 and B does the same for its import tariff on good-1. These tariffs may be denoted as internal tariffs (internal to the bloc) while the tariffs by A and B on good-3 are their respective external tariffs. We abstract from strategic interactions in trade policy between the Bloc and the rest of the world, and focus on intra-bloc strategic tariffs, tariff liberalization and how it affects the illegal immigration problem.[2] Nation A is the host country for illegal immigration, while B is the source country. Illegal immigrants send earnings back to B, thus, A does not retain immigrant's factor rewards (for example, Orrenius (2001) states that: "The out-migration of Mexican citizens brings in $4 billion to $7 billion in remittances each year."). Since prices (without tariffs) are given exogenously to the small countries within the bloc, we

[2] Bandyopadhyay (2003) does address tariffs and illegal immigration. However, unlike this paper he ignores the interdependence in trade policy between the bloc members. The role of the latter and how it affects illegal immigration and national welfare is the central focus of this paper. We should note that interdependence in trade policy is discussed (between a trading bloc and the rest of the world) in Bond, Syropoulos, and Winters (2001) and Bond, Riezman, and Syropoulos (2004). Bond, Syropoulos, and Winters (2001) among others shed light on the mutual negotiation process. They examine how formation of customs union with a certain country affects its trade agreements with other countries (multilateral agreements). Their paper derives external tariff response functions of the customs union and the rest of world, and thus provides the conditions under which both a customs union and multilateral trade agreements are sustainable. Our paper differs from the Bond et al. papers in two respects. First, we focus on interdependence in tariffs (pre-union) between bloc members. Secondly, illegal immigration is a major issue in this paper.

normalize them to be unity.[3] Illegal immigrants earn the wage $W_I$ and the level of illegal immigration itself is *I*. Their total earning is $W_I I$, which is repatriated to B. Thus, this amount must be subtracted from A's revenue and added to B's revenue. The legal wage rate of nations A and B are denoted as $W^A$ and $W^B$, respectively. The legal wage $W^A$ is assumed to exceed $W^B$ (this may be due to technology differences, tariffs or other reasons). This creates incentives for immigrants to illegally cross the border. Nation A uses internal enforcement and border enforcement to control illegal immigration. The enforcement costs are $e_i$ (internal) and $e_b$ (border), respectively. The tariff on good i by nation j is $t_i^j$ where i = good 1,2, and 3, and j = nations A and B. The standard expenditure-revenue equations for the three nations are described below. The partial derivatives of expenditure and revenue functions are denoted by subscripts. For instance, $E_2^A$ is the partial derivative of A's expenditure function with respect to price of good-2.

(1) $E^A(1,1+t_2^A,1+t_3^A,u^A)=R^A(1,1+t_2^A,V^A+I)+t_2^A(E_2^A-R_2^A)+t_3^A E_3^A-W_I I-e_i-e_b$

(2) $E^B(1+t_1^B,1,1+t_3^B,u^B)=R^B(1+t_1^B,1,V^B-I)+t_1^B(E_1^B-R_1^B)+t_3^B E_3^B+W_I I$

(3) $E^C(1,1,1,u^C)=R^C(1,V^C)$

We assume that revenue function is strictly concave in endowment, $V$, such that $R_{VV}^i<0$ for $i=A,B$. Following Ethier (1986) and Bond and Chen (1987), we use the following assumptions. Firms can hire either legal workers and pay $W^A$ or illegal workers and pay $W_I$. However, if firms are detected to be hiring illegal immigrants, they are fined z per unit of illegal labor. There is a probability of detection, which depends on the level of internal enforcement. This is denoted as: $p=p(e_i)$, $p'>0$, $p''<0$. The expected fine

[3] Later, we relax this assumption.

per illegal labor unit hired is $zp$, and on average this is what firms incur above the illegal wage when they hire an illegal immigrant. Competitive firms equate the cost of hiring legal labor to the expected cost of hiring illegal labor.

(4) $W^A = W_I + zp(e_i)$

Potential migrants in B face the risk of being caught by border enforcement. The expected cost may be denoted as $\beta = \beta(e_b)$, $\beta' > 0$. The illegal wage rate, net of this cost is: $W_I - \beta(e_b)$. Assuming risk neutrality, the equilibrium migration condition dictates that the certainty wage in B is equated to the net expected wage from migration:

(5) $W^B = W_I - \beta(e_b)$

### 2.1. The effect of trade liberalization on the level of illegal immigration

This section first shows how tariff policy can affect the level of illegal immigration. Then, we consider a special case where both nations agree to reduce the internal tariffs by the same amount under a Preferential Trade Agreement. With $W^i = R_V^i(.)$ for i = A and B, equations (4) and (5) imply:

(6) $R_V^B(1+t_1^B, 1, V^B - I) - R_V^A(1, 1+t_2^A, V^A + I) + \rho(e_i, e_b) = 0$

where, $\rho(e_i, e_b) \equiv \beta(e_b) + zp(e_i)$.

Relation-(6) implicitly defines the level of illegal immigration as:

(7) $I = I(t_1^B, t_2^A, \rho)$

Let $D \equiv R_{VV}^A + R_{VV}^B$, ($D < 0$). Using (6) and (7), the effects of each policy instrument on immigration are:

(8) $I_1 \equiv \frac{\partial I}{\partial t_1^B} = \frac{R_{V1}^B}{D}, \; I_2 \equiv \frac{\partial I}{\partial t_2^A} = -\frac{R_{V2}^A}{D}, I_\rho \equiv \frac{\partial I}{\partial \rho} = \frac{1}{D}$

Tariffs change the domestic import prices, hence, the wage rates. These in turn affect the incentive for illegal immigration. The precise effect of the tariff on the immigration flow depends on the characteristics of the labor market in the host and source country. That is, how responsive wages are to price changes as well as to changes in the total labor supply. Note that the parameter $\rho$ captures enforcement policy, and we suppress it (for now) to focus on the effect of tariff changes on illegal immigration. Using (7):

(9) $dI = \frac{\partial I}{\partial t_1^B} dt_1^B + \frac{\partial I}{\partial t_2^A} dt_2^A$

In the following Lemma we discuss a special case where both countries reduce the internal tariffs by the same amount.

**Lemma 1.** Suppose under the Preferential Trade Agreement, both A and B reduce the internal tariff by the same amount while A maintains the initial enforcement policy. If the wage rate in the source country (B) responds more than the wage rate in the host country (A) to the change in the tariffs, illegal immigration increases unambiguously.

**Proof.**

(10) $dt_1^B = dt_2^A = dt < 0$

Then, from (8) and (9),

(11) $\frac{dI}{dt} = \frac{R_{V1}^B - R_{V2}^A}{D}$

Note that $\frac{dI}{dt} < 0$ if $R_{V1}^B - R_{V2}^A > 0$, in other word, if $\frac{\partial w^B}{\partial p_1} > \frac{\partial w^A}{\partial p_2}$. *Q.E.D.*

$R_{V1}$ is the response of wage rate in each country when the domestic price of good 1 changes due to tariff. Goods 1 and 2 are the import goods of B and A, respectively. If the change in the protected (import) sector's price affects the wage rate more in B than in A, the equal reduction of tariffs by both countries will increase the level of illegal immigration.[4] This lemma illustrates the importance of incorporating the effects of trade liberalization on illegal immigration in determining overall (trade and enforcement) policy. In the following section, we examine optimal tariff reaction functions in the presence of illegal immigration.

### 2.2. The Pre-Agreement Nash Tariff Equilibrium

This sub-section derives the tariff reaction functions for A and B and describes the Nash tariff equilibrium. By combining (1) and (4), we obtain:

$$(12)\quad E^A(1,1+t_2^A,1+t_3^A,u^A)=R^A(1,1+t_2^A,V^A+I)+t_2^A(E_2^A-R_2^A)+t_3^AE_3^A - IR_V^A(1,1+t_2^A,V^A+I)+Izp(e_i)-e_i-e_b$$

Implicitly, we can write A's utility function as:

$$(13)\quad u^A=u^A(t_2^A,t_3^A,I,e_i,e_b)=u^A(t_2^A,t_3^A,I(t_1^B,t_2^A,\rho),e_i,e_b)$$

B's tariff enters indirectly into A's utility function through *I (.)*. The change in A's utility is:

$$(14)\quad du^A=\frac{\partial u^A}{\partial t_2^A}dt_2^A+\frac{\partial u^A}{\partial I}dI+\frac{\partial u^A}{\partial t_3^A}dt_3^A+\frac{\partial u^A}{\partial e_b}de_b+\frac{\partial u^A}{\partial e_i}de_i$$

Using the expenditure – revenue identity (1), we can show:

[4] If the labor supply is more inelastic in the source country than in the host country, the change in price due to a tariff leads to a greater change in the wage rate in the source country. This may be a reasonable assumption in the US – Mexico context.

(15) $\dfrac{\partial u^A}{\partial I} = \dfrac{zp - t_2^A R_{2V}^A - IR_{VV}^A}{D_u}$, where, $D_u \equiv E_u^A - t_2^A E_{2u}^A - t_3^A E_{3u}^A = E_{1u}^A + E_{2u}^A + E_{3u}^A > 0$,

due to the normality of all goods. The second term in (14) may be interpreted as follows. Nation-A's tariff on good 2 affects *I* which in turn has three effects captured by the numerator of the right hand side of (15). They are the effects of a unit rise in *I*, and are, respectively, (a). the rise in government fine collections; (b). the expansion (or contraction) of domestic production of good 2 through the Rybczynski effect and the resulting effect on import duty collection; and, (c). the reduction in the legal wage in A leading to a lower wage payment to illegal labor. Relations (14) and (15) endogenize the effects of variability of *I* and implicitly define the following Nash optimal tax reaction function for A:

(16) $t_2^A = t_2^A(t_1^B, t_3^A, e_i, e_b)$

A optimally chooses $e_b$ and $e_i$ by setting $\dfrac{\partial u^A}{\partial e_b} = 0$ and $\dfrac{\partial u^A}{\partial e_i} = 0$. This gives us:

(17) $\beta'(e_b)(-t_2^A R_{2V}^A - IR_{VV}^A + zp(e_i)) = D$

(18) $zp'(e_i)[R_{VV}^B I - t_2^A R_{2V}^A + zp(e_i)] = D$

By setting: $\dfrac{\partial u^A}{\partial t_2^A} = 0$, we obtain the reaction function for A.

(19) $t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - \dfrac{R_{VV}^B IR_{V2}^A}{D} + \dfrac{t_2^A R_{2V}^A R_{2V}^A}{D} - \dfrac{zpR_{V2}^A}{D} = 0$

Relation-(19) implicitly defines the Nash tariff reaction function for A. The slope of A's reaction function is:

(20) $\dfrac{\partial t_2^A}{\partial t_1^B}_{|Nash-A} = -\dfrac{-R_{VV}^B R_{V2}^A R_{V1}^B / D^2}{(E_{22}^A - R_{22}^A) + R_{2V}^A R_{2V}^A (R_{VV}^A + 2R_{VV}^B)/D^2} > 0$

Similarly, we obtain B's reaction function:.

$$(21)\quad t_1^B\left[(E_{11}^B - R_{11}^B) - \frac{R_{V1}^B R_{V1}^B}{D}\right] + t_3^B E_{31}^B - \frac{\beta R_{V1}^B}{D} + \frac{R_V^B R_{V1}^B}{D} + \frac{I R_{V1}^B (R_{VV}^A + 2R_{VV}^B)}{D} = 0$$

The (inverse of) slope of B's reaction function is:

$$(22)\quad \frac{\partial t_2^A}{\partial t_1^B}_{|Nash-B} = -\frac{(E_{11}^B - R_{11}^B) + R_{V1}^B R_{V1}^B (R_{VV}^A + 2R_{VV}^B)/D^2}{-R_{V2}^A R_{V1}^B (R_{VV}^A + 2R_{VV}^B)/D^2} > 0$$

Relations (17), (18), (19) and (21) can be simultaneously solved to obtain the Nash equilibrium tariff rates for A and B, as well as the optimal enforcement levels $e_i$ and $e_b$ for nation-A. The Nash tariff equilibrium is demonstrated in figure-1.

**Lemma 2.** If the wage rates in both sectors are positively related to their corresponding output prices, then the reaction functions for both countries are upward sloping.

**Proof.** Shown above in (20) and (22).

In graph 1, a decrease in one nation's tariff is associated with a reduction in the optimal tariff of the other nation. The intersection of the tariff reaction functions gives the second best Nash optimal tariff equilibrium. Due to the presence of the external tariffs and illegal immigration, they are positive as shown in the graph 1.

**[graph 1]**

### 2.3. The effect of a Free Trade Agreement on national welfare

In this section, we analyze how the national welfare levels of A and B are affected if both nations agree to eliminate their tariffs on each other completely (i.e., completely

eliminate import tariffs on goods 1 and 2).[5] The literature on second best tariffs (in the absence of illegal immigration considerations) suggests that complete liberalization may or may not raise welfare in an already distorted economy.[6] We explore how illegal immigration affects this conclusion and identify conditions under which complete liberalization will be welfare improving. The following proposition formally states our findings.

**Proposition 1.** Suppose that the source country's wage rate responds to tariff changes more than the wage rate in the host country, and that goods 2 and 3 (imports for the host country) are complements in consumption. Then, a complete movement to free trade within a bloc consisting of A and B must be welfare improving (if before the FTA they had the same tariff level on their respective intra-bloc imports) while the illegal immigration increases for a given initial enforcement policy.

**Proof.**

Let $dt_2^A = dt_1^B = dt < 0$. From (14),

$$(23) \quad \frac{du^A}{dt} = \frac{\partial u^A}{\partial t_2^A} + \frac{\partial u^A}{\partial I}(I_1 + I_2)$$

Suppose $R_{V1}^B > R_{V2}^A$. Then, as we saw in the previous section, $\frac{dI}{dt} < 0$, i.e. FTA increases the illegal immigration.

[5] Bond, Riezman, and Syropoulos (2004) consider the welfare effect of FTA when the rest of the world also reacts strategically. While illegal immigration is not considered in their study, they find the complete liberalization within the context of an FTA is not optimal. Our analysis assumes that the trading bloc holds the external tariff rates constant (i.e., the rest of the world practices free trade).

[6] The Kemp-Wan proposition discussed in Ethier and Horn (1984) suggests that the adjustment of the external tariff makes the complete elimination of internal tariff under customs unions welfare improving without harming the rest of the world. Panagariya and Krishna (2002) extends this to the case of an FTA. Throughout the analysis we hold the external tariff constant leaving the examination of the Kemp-Wan type of trade liberalization with the presence of illegal immigration to future research.

If we evaluate (15) at the Free Trade Agreement, ($t_1^B = 0, t_2^A = 0$), $\frac{\partial u^A}{\partial I} > 0$. Therefore, if

$\frac{\partial u^A}{\partial t_2^A}_{|t=0} < 0$, then, $\frac{du^A}{dt}_{|t=0} < 0$.

Differentiating (12):

$$(24) \quad \frac{\partial u^A}{\partial t_2^A} = \frac{t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - IR_{V2}^A}{D_u}$$

Evaluated at $t_2^A = 0$,

$$(25) \quad \frac{\partial u^A}{\partial t_2^A}_{|t_2^A=0} = \frac{t_3^A E_{32}^A - IR_{V2}^A}{D_u}$$

Under the conditions of Lemma 2, $IR_{V2}^A > 0$. If $E_{32}^A < 0$ (i.e., goods 2 and 3 are complements in consumption), the right hand side of (25) must be negative. This ensures that the FTA is welfare improving because it implies that the right hand side of (23) is negative.

*Q.E.D.*

If goods 2 and 3 are complements, as the tariff on good 2 is reduced, consumers demand more of it as well as of good 3. This raises the tariff revenue collection from good 3. Secondly, the reduction of tariff on good 2 reduces A's wage rate. This results in lower payments to illegal immigrants and translates to a gain for A. This is the second term in the numerator in (25). Under complementarity, both these effects raise A's real income and its welfare rises due to the liberalization. If goods 2 and 3 are substitutes, the welfare implication of the FTA is in general ambiguous and depends on the balance of the tariff revenue effect and the wage earnings effect.

The second term in (23) is negative. From Lemma 1 we see that mutual trade liberalization raises illegal immigration. This lowers the immigrant wage income, while raising the expected fine collections from firms hiring them. Thus, in the presence of endogenous illegal immigration, an FTA is more likely to be welfare enhancing.[7]

### 2.4. Is multilateral trade liberalization compatible with bilateral trade liberalization?

In this section, we examine whether A would like to reduce the external tariff (i.e., the tariff on good 3) as a credible pre-commitment to multilateral trade liberalization. First, we see how the reaction function of A is affected by the reduction of the tariff on good 3. Second, we examine whether reducing the tariff on good 3 is welfare improving for A.[8] From (20) and (22), the slopes of the reaction functions do not change in response to the change in the tariff on good on 3. Denoting the left hand side of (19) as $\Phi^A$,

$$(26) \quad \frac{\partial t_2^A}{\partial t_3^A} = -\frac{E_{32}^A}{\partial \Phi^A \big/ \partial t_2^A}$$

The denominator of (26) can be assumed negative if the second order condition $\partial^2 u^A \big/ (\partial t_2^A)^2$ is sufficiently large as is shown in the Appendix. Thus, if good 2 and 3 are

[7] It contradicts general public view that an increase in illegal immigration worsens the national welfare of the host country. Here, readers should keep in mind that we focus on the economic analysis of illegal immigration. Associated social and humanitarian issues are important, but they are beyond the scope of this paper.

[8] Bond, Syropoulos, and Winters (2001) discuss how trade liberalization in a customs union affects the multilateral trading process. They find that intra-bloc trade liberalization which requires the reduction of the external tariff is negatively associated with the elasticity of substitution.

substitutes (i.e., $E_{32}^{A} > 0$), the reduction in $t_3^A$ will shift A's reaction function down as described in the graph 2. On the other hand, if $E_{32}^{A} < 0$, A's reaction function shifts up.

**[graph 2]**

Let us consider the case where the goods are substitutes. Given B's reaction function, A knows that if it can pre-commit to a lower $t_3^A$, it would lead to a reduction in $t_1^B$. The effect of $t_1^B$ on A's utility is (from relation-14):

$$(27) \quad \frac{\partial u^A}{\partial t_1^B} = -\frac{t_2^A R_{V2}^A R_{V1}^B}{DD_u^A} - \frac{IR_{VV}^A R_{V1}^B}{DD_u^A} + \frac{zpR_{V1}^B}{DD_u^A}$$

If $\frac{\partial u^A}{\partial t_1^B} < 0$, the reduction of $t_3^A$ is welfare enhancing for A. In other word, multilateral trade liberalization is compatible with PTA if and only if:

$$t_2^A > \frac{zp - IR_{VV}^A}{R_{V2}^A}$$

Intuitively, if the initial internal tariff is high enough to start with, both multilateral trade liberalization and bilateral trade liberalization such as PTA are compatible with each other and lead to a movement in the direction of global free trade.

**Proposition 2.** Reduction of tariff on good-3 leads to lower (higher) Nash equilibrium tariffs for A and B's intra-bloc trade if good 2 and 3 are substitutes (complements). If the initial internal tariff is sufficiently high, reducing the external tariff is also welfare improving for nation-A given good 2 and 3 are substitutes. In this case, the multilateral trade liberalization process is compatible with bilateral trade liberalization. Furthermore, if the size of wage response in the host country is at least as large as that in the source country, illegal immigration decreases due to reduction of tariff on good-3.

**Proof:** Refer to the discussion above.

## 3. Large Open Economy

This section extends the previous analysis to the case of a union of two large nations. The analysis is more complicated because tariffs for A and B affect the world prices, which in turn affect the level of illegal immigration. We start by defining the expenditure-revenue equation for A, B and C and then proceed to analyze how tariffs affect the border prices. We discuss how the second best Nash optimal tariff equilibrium may differ in the context of a large open economy. Using the price of good-3 as the numeraire, the expenditure-revenue functions for the three nations are:

$$(28)\quad E^A(p_1, p_2 + t_2^A, 1 + t_3^A, u^A) = R^A(p_1, p_2 + t_2^A, V^A + I) + t_2^A(E_2^A - R_2^A) + t_3^A E_3^A - W_I I - e_i - e_b$$

$$(29)\quad E^B(p_1 + t_1^B, p_2, 1 + t_3^B, u^B) = R^B(p_1 + t_1^B, p_2, V^B - I) + t_1^B(E_1^B - R_1^B) + t_3^B E_3^B + W_I I$$

$$(30)\quad E^C(p_1, p_2, 1, u^C) = R^C(1, V^C)$$

The goods market equilibrium conditions are:

$$(31)\quad E_1^A(p_1, p_2 + t_2^A, 1 + t_3^A, u^A) + E_1^B(p_1 + t_1^B, p_2, 1 + t_3^B, u^B)$$

$$+ E_1^C(p_1, p_2, 1, u^C) = R_1^A(p_1, p_2 + t_2^A, V^A + I) + R_1^B(p_1 + t_1^B, p_2, V^B - I) + R_1^C(p_1, p_2, 1, V^C)$$

$$(32)\quad E_2^A(p_1, p_2 + t_2^A, 1 + t_3^A, u^A) + E_2^B(p_1 + t_1^B, p_2, 1 + t_3^B, u^B)$$

$$+ E_2^C(p_1, p_2, 1, u^C) = R_2^A(p_1, p_2 + t_2^A, V^A + I) + R_2^B(p_1 + t_1^B, p_2, V^B - I) + R_2^C(p_1, p_2, 1, V^C)$$

Walras' law assures that the market for good 3 is in equilibrium. The illegal immigration level is affected not only by tariffs but also through terms of trade effects. For a given target $I$ (ensured by appropriate adjustments of the enforcement levels), the labor market

equilibrium condition with endogenous prices is

(33) $R_V^B(p_1+t_1^B, p_2, V^B - I) - R_V^A(p_1, p_2+t_2^A, V^A + I) + \rho(e_i, e_b) = 0$

Thus, illegal immigration is defined as:

(34) $I = I(p_1, p_2, t_2^A, t_1^B, \rho)$

The change in illegal immigration is:

(35) $dI = I_1 dp_1 + I_2 dp_2 + I_3 dt_2^A + I_4 dt_1^B + I_\rho d\rho$

In the present context, (12) may be written as:

(36) $E^A(p_1, p_2+t_2^A, 1+t_3^A, u^A) - R^A(p_1, p_2+t_2^A, V^A + I) - t_2^A(E_2^A - R_2^A)$

$-t_3^A E_3^A + IR_V^A(p_1, p_2+t_2^A, V^A + I) + zpI + e_i + e_b = 0$

Relation-(36) implicitly defines A's utility as:

(37) $u^A = u^A(p_1, p_2, t_2^A, t_3^A, I(p_1, p_2, t_2^A, t_1^B, \rho), e_i, e_b)$

The difference from the previous closed economy cases [see relation-(13) earlier] is that we have prices in the utility function. For B:

(38) $E^B(p_1+t_1^B, p_2, 1+t_3^B, u^B) - R^B(p_1+t_1^B, p_2, V^B - I) - t_1^B(E_1^B - R_1^B)$

$-t_3^B E_3^B - R_V^A(p_1, p_2+t_2^A, V^A + I)I + zpI = 0$

Thus, B's utility can be written implicitly as:

(39) $u^B = u^B(p_1, p_2, t_1^B, t_3^B, t_2^A, I(p_1, p_2, t_2^A, t_1^B, \rho), e_b)$

Next, we find how prices are related to the internal tariffs. This is crucial in highlighting the strategic tariff policy of a PTA because members of a trading bloc negotiate over tariffs with a major issue being their intra-bloc and external terms of trade effects.

**Proposition 3.** When the own price effects dominate the cross price effects of tariff changes and the wage rate is more responsive to the change in the price of the import good (compared to the price of the export good), mutual reductions of the intra-bloc tariffs improve both A and B's terms of trade with respect to C. The illegal immigration may increase or decrease depending on how wages respond in each country.

**Proof.** See Appendix at the end.

Now, we briefly describe the Nash tariff equilibrium in the large union case. Using (37):

$$(40)\quad \frac{du^A}{dt_2^A} = (u_1^A + u_5^A I_1)\frac{dp_1}{dt_2^A} + (u_2^A + u_5^A I_2)\frac{dp_2}{dt_2^A} + (u_3 + u_5^A I_4) = 0\,;\ \text{where,}$$

$$u_1^A = \frac{-(E_1^A - R_1^A) + t_2^A(E_{21}^A - R_{21}^A) + t_3^A E_{31}^A - IR_{V1}^A}{D_u^A}$$

$$u_5^A \equiv \frac{\partial u^A}{\partial I} = \frac{-t_2^A R_{V2}^A - IR_{VV}^A - zp}{D_u^A}$$

$$I_1 = -\frac{R_{V1}^A - R_{V1}^B}{D},\ I_2 = -\frac{R_{V2}^A - R_{V2}^B}{D}$$

$$u_2^A = \frac{-(E_2^A - R_2^A) + t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - IR_{V2}^A}{D_u^A}$$

$$(41)\quad \frac{du^B}{dt_1^B} = (u_1^B + u_5^A I_1)\frac{dp_1}{dt_1^B} + (u_2^A + u_5^A I_2)\frac{dp_2}{dt_1^B} + (u_3 + u_5^A I_3) = 0$$

The third term on the right hand side of (40) is the Nash condition in the case of a closed economy, while the first two terms are the additional terms due to endogenous prices. The latter terms capture how A uses strategic tariff policies to manipulate terms of trade to its benefit.

(42) $$u_2^A = -\frac{\partial u^A}{\partial p_2} = \frac{-(E_2^A - R_2^A) + t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - IR_{V2}^A}{D_u},$$

where, $E_2^A - R_2^A > 0$, as A is an importer of good 2.

Thus, $u_2^A < 0$ if $R_{V2}^A > 0$ and $t_3^A E_{32}^A$ is not large and positive. We showed that: $\frac{\partial p_2}{\partial t_2^A} < 0$ if the cross effects on excess demand are smaller than the own effects. Thus, $u_2^A \frac{\partial p_2}{\partial t_2^A} > 0$. This tends to raise the second best tariff of A. If $R_{V2}^B < R_{V2}^A$, the effect is further accentuated. On the other hand, if $R_{V2}^B > R_{V2}^A$:

$$\frac{(R_{V2}^B - R_{V2}^A)}{\beta' D_u} > 0.$$

In this case, the terms $\frac{(R_{V2}^B - R_{V2}^A)}{\beta' D_u}\frac{\partial p_2}{\partial t_2^A} < 0$ and $u_2^A \frac{\partial p_2}{\partial t_2^A} > 0$ pull in opposite directions.

The import tariff on good 2 tends to keep the international price of good 2 low. However, this has adverse effect on the domestic wage rate. Thus, the optimal strategic tariff has to balance the terms of trade benefit and its impact on the wage rate. In the large country case, the slope of the optimal tariff reaction function can either positive or negative, and depends on the relative magnitude of the different terms presented above.

**4. Conclusion**

The paper focuses on the intra-bloc trade negotiation process in the presence of illegal immigration. Our findings comprise largely of three parts. First, we show that when the interaction between tariff policy and illegal immigration is ignored, trade liberalization may lead to an increase in illegal immigration. This establishes the

importance of incorporating both issues simultaneously in the negotiations. Second, we identify conditions under which an FTA (i.e., complete elimination of tariffs within the bloc) is likely to be welfare improving in the presence of illegal immigration. Finally, we consider terms of trade effects of tariff negotiations and how they will in turn affect the immigration problem.

**References:**


Baldwin, R.E. and A. J. Venables, 1995, Regional economic integration, In: Grossman, G., Rogoff, K. (Ed.), Handbook of International Economics, Vol. 3 Noth-Holland, Amsterdam.

Bandyopadhyay, S., 2003, "Illegal immigration and Second Best Import Tariffs", *Review of International Economics*, forthcoming.

Bond, E. W. and T. J. Chen, 1987, "The welfare effects of illegal immigration," *Journal of International Economics*, vol. 23, pp315-328.

Bond, E. W., Syropoulos, C., and L. A. Winters, 2001, "Deepening of regional integration and multilateral trade agreements", *Journal of International Economics*, vol. 53, pp335-361.

Ethier, W. and H. Horn, 1984, "A new look at economic integration", In: Kierzkowski, H., ed., Monopolistic Competition and International Trade, Oxford University Press, Oxford.

Ethier, W. J., 1986, "Illegal Immigration: The Host-Country Problem," *American Economic Review*, vol. 76, no. 1, pp56-71.

Orrenius, P., 2001, "Illegal Immigration and Enforcement Along the U.S.-Mexico Border: An Overview", *Economic & Financial Review*, 1st quarter, Federal Reserve Bank of Dallas.

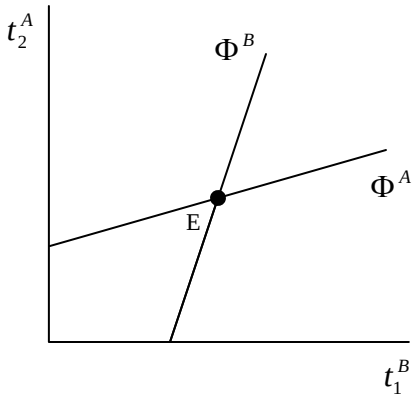
Panagariya, A., 1999, "The Meade Model of Preferential Trading: History, Analytics, and Policy Implications," in Trading Blocs: Alternative Approaches to Analyzing Preferential Trade Agreements, ed. Bhagwati, J., P. Krishna and A. Panagariya, MIT Press.

Panagariya, A. and P. Krishna, 2002, "On necessarily welfare-enhancing free trade areas", *Journal of International Economics*, Vol. 57, pp353-367.

U.S. Immigration and Naturalization Service, 2001, 2001 Statistical Yearbook of the Immigration and Naturalization Service.

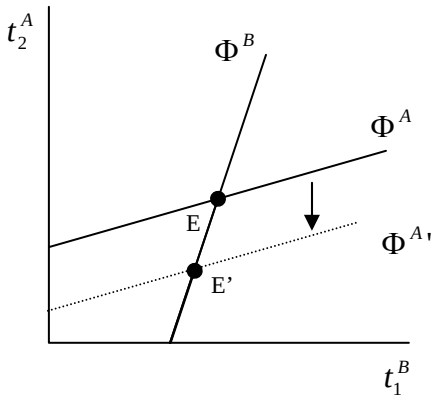
Bond, Riezman, and Syropoulos (2004)

**Graph 1 The internal Nash tariff Equilibrium**




$\Phi^A$ : A's Reaction function
$\Phi^B$ : B's Reaction function
E : Nash Equilibrium

**Graph 2 The effect of the external tariff reduction**




$\Phi^{A'}$ : A's Reaction function after reduction in $t_3^A$
E' : new Nash Equilibrium

## Appendix

1. *Deriving A's Optimal Tariff Reaction Function (Small Union Case):*

Total differential of A's utility function is:

$$(A1)\quad D_u^A du^A = [t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - IR_{V2}^A + \frac{t_2^A R_{2V}^A R_{2V}^A}{D} + \frac{IR_{VV}^A R_{V2}^A}{D} - \frac{zp(e_i)R_{V2}^A}{D}]dt_2^A$$

$$+[t_2^A E_{23}^A + t_3^A E_{33}^A]dt_3^A$$

$$+[-\frac{t_2^A R_{V2}^A R_{V1}^B}{D} - \frac{IR_{VV}^A R_{V1}^B}{D} + \frac{zp(e_i)R_{V1}^B}{D}]dt_1^B$$

$$+[zIp' - 1 - \frac{t_2^A R_{V2}^A zp'}{D} - \frac{IR_{VV}^A zp'}{D} + \frac{zpzp'}{D}]de_i$$

$$+[-\frac{\beta' t_2^A R_{2V}^A}{D} - \frac{IR_{VV}^A \beta'}{D} - \frac{zp\beta'}{D} - 1]de_b$$

*2. Substitutability of good 2 and 3 in Proposition 2:*

From the equation (6), one notes that the illegal immigration is independent of the external tariffs. From the optimal enforcement policy conditions, (17) and (18), we find that the optimal enforcement policy instruments are contingent of the internal tariffs of A and B, yet, independent from their external tariffs. We use the finding to derive the effect of change in the external tariffs on the tariff reaction functions.

Denote $\Phi^A = t_2^A(E_{22}^A - R_{22}^A) + t_3^A E_{32}^A - \frac{R_{VV}^B IR_{V2}^A}{D} + \frac{t_2^A R_{2V}^A R_{2V}^A}{D} - \frac{zpR_{V2}^A}{D}$ in (19).

$$\frac{\partial t_2^A}{\partial t_3^A} = -\frac{\partial \Phi^A / \partial t_3^A}{\partial \Phi^A / \partial t_2^A} = -\frac{E_{32}^A}{(E_{22}^A - R_{22}^A) + R_{2V}^A R_{2V}^A (R_{VV}^A + 2R_{VV}^B)/D^2 - zp'(1/D) R_{V2}^A \partial e_i / \partial t_2^A}$$

$$= -\frac{E_{32}^A}{(E_{22}^A - R_{22}^A) + R_{2V}^A R_{2V}^A (R_{VV}^A + 2R_{VV}^B)/D^2 - zp'(1/D) R_{V2}^A \dfrac{[zp'(-R_{VV}^B R_{V2}^A / D - R_{V2}^A)]}{[zp''(R_{VV}^B I - t_2^A R_{V2}^A + zp) + zp'(R_{VV}^B zp'/D + zp')]}}$$

The first two terms in the denominator is the second order condition of the optimal $t_2^A$ and the sign is unambiguously negative. If this dominate the third term, then the whole denominator will be negative. Thus, the sign of $\frac{\partial t_2^A}{\partial t_3^A}$ becomes the same as the sign of $E_{32}^A$. If good 2 and 3 are substitutes, the sign of $\frac{\partial t_2^A}{\partial t_3^A}$ is positive. In this case, the reduction of $t_3^A$ leads to downward shift of the A's reaction function. The graph 2 depicts this case showing both $t_2^A$ and $t_1^B$ declines with the former decreases more than the later. With the equation (8) and (9), if the size of wage response in the host country is at least as large as that in the source country, i.e. $\frac{\partial w^A}{\partial p_2} > \frac{\partial w^B}{\partial p_1}$, the illegal immigration decreases due to reduction of tariff on good-3.

*3. Proof of Proposition 3:*

Totally differentiating (31) and (32) and assuming quasi-linear utility, we obtain:

$$(A2)\quad \begin{bmatrix} \alpha_1 + \dfrac{(R_{V1}^A - R_{V1}^B)^2}{D} & \beta + \dfrac{(R_{V1}^A - R_{V1}^B)(R_{V2}^A - R_{V2}^B)}{D} \\ \beta + \dfrac{(R_{V1}^A - R_{V1}^B)(R_{V2}^A - R_{V2}^B)}{D} & \alpha_2 + \dfrac{(R_{V2}^A - R_{V2}^B)^2}{D} \end{bmatrix} \begin{bmatrix} dp_1 \\ dp_2 \end{bmatrix}$$

$$= \begin{bmatrix} [(R_{12}^A - E_{12}^A) - \dfrac{(R_{V1}^A - R_{V1}^B)R_{V2}^A}{D}]dt_2^A + [(R_{11}^B - E_{11}^B) + \dfrac{(R_{V1}^A - R_{V1}^B)R_{V1}^B}{D}]dt_1^B \\ [(R_{22}^A - E_{22}^A) - \dfrac{(R_{V2}^A - R_{V2}^B)R_{V2}^A}{D}]dt_2^A + [(R_{21}^B - E_{21}^B) + \dfrac{(R_{V2}^A - R_{V2}^B)R_{V1}^B}{D}]dt_1^B \end{bmatrix}$$

where, $\alpha_1 \equiv E_{11}^A + E_{11}^B + E_{11}^C - R_{11}^A - R_{11}^B - R_{11}^C$, $\alpha_2 \equiv E_{22}^A + E_{22}^B + E_{22}^C - R_{22}^A - R_{22}^B - R_{22}^C$, and $\beta \equiv E_{12}^A + E_{12}^B + E_{12}^C - R_{12}^A - R_{12}^B - R_{12}^C$.

$$(A3)\quad |H| \equiv \begin{vmatrix} \alpha_1 + \dfrac{(R_{V1}^A - R_{V1}^B)^2}{D} & \beta + \dfrac{(R_{V1}^A - R_{V1}^B)(R_{V2}^A - R_{V2}^B)}{D} \\ \beta + \dfrac{(R_{V1}^A - R_{V1}^B)(R_{V2}^A - R_{V2}^B)}{D} & \alpha_2 + \dfrac{(R_{V2}^A - R_{V2}^B)^2}{D} \end{vmatrix}$$

$$= \alpha_1\alpha_2 - \beta^2 + \alpha_2 \frac{(R_{V1}^A - R_{V1}^B)^2}{D} + \alpha_1 \frac{(R_{V2}^A - R_{V2}^B)^2}{D} - 2\beta \frac{(R_{V1}^A - R_{V1}^B)(R_{V2}^A - R_{V2}^B)}{D}$$

$|H| > 0$ if $R_{2V}^A > R_{2V}^B$ and $R_{1V}^B > R_{1V}^A$ , $|\alpha_1| > \beta$, $|\alpha_2| > \beta$, and $|R_{V1}^A - R_{V1}^B| = |R_{V2}^A - R_{V2}^B|$

The first two conditions imply that the rise in the price of export good raises the wage rate more than the rise in the import good price does in general. The third and fourth conditions can be interpreted as the relationship between the own price effect and the cross price effect. By freezing $dt_1^B$ and using the Cramer's rule:

$$(A4)\quad \frac{\partial p_1}{\partial t_2^A}=\left[\begin{array}{l}\alpha_2[(R_{12}^A-E_{12}^A)-\dfrac{(R_{V1}^A-R_{V1}^B)R_{V2}^A}{D}]-\beta[(R_{22}^A-E_{22}^A)-\dfrac{(R_{V2}^A-R_{V2}^B)R_{V2}^A}{D}]\\ \\ +\dfrac{(R_{V2}^A-R_{V2}^B)^2(R_{12}^A-E_{12}^A)}{D}-\dfrac{(R_{22}^A-E_{22}^A)(R_{V1}^A-R_{V1}^B)(R_{V2}^A-R_{V2}^B)}{D}\end{array}\right]/|H|$$

$$(A5)\quad \frac{\partial p_2}{\partial t_2^A}=\left[\begin{array}{l}\alpha_1[(R_{22}^A-E_{22}^A)-\dfrac{(R_{V2}^A-R_{V2}^B)R_{V2}^A}{D}]-\beta[(R_{12}^A-E_{12}^A)-\dfrac{(R_{V1}^A-R_{V1}^B)R_{V2}^A}{D}]\\ \\ +\dfrac{(R_{V1}^A-R_{V1}^B)^2(R_{22}^A-E_{22}^A)}{D}-\dfrac{(R_{12}^A-E_{12}^A)(R_{V1}^A-R_{V1}^B)(R_{V2}^A-R_{V2}^B)}{D}\end{array}\right]/|H|$$

Similarly, by freezing $dt_2^A$:

$$(A6)\quad \frac{\partial p_1}{\partial t_1^B}=\left[\begin{array}{l}\alpha_2[(R_{11}^B-E_{11}^B)-\dfrac{(R_{V1}^A-R_{V1}^B)R_{V1}^A}{D}]-\beta[(R_{21}^A-E_{21}^A)-\dfrac{(R_{V2}^A-R_{V2}^B)R_{V1}^B}{D}]\\ \\ +\dfrac{(R_{V2}^A-R_{V2}^B)^2(R_{11}^B-E_{11}^B)}{D}-\dfrac{(R_{21}^B-E_{21}^B)(R_{V1}^A-R_{V1}^B)(R_{V2}^A-R_{V2}^B)}{D}\end{array}\right]/|H|$$

$$(A7)\quad \frac{\partial p_2}{\partial t_1^B}=\left[\begin{array}{l}\alpha_1[(R_{21}^B-E_{21}^B)-\dfrac{(R_{V2}^A-R_{V2}^B)R_{V1}^B}{D}]-\beta[(R_{11}^B-E_{11}^B)-\dfrac{(R_{V1}^A-R_{V1}^B)R_{V1}^B}{D}]\\ \\ +\dfrac{(R_{V1}^A-R_{V1}^B)^2(R_{21}^B-E_{21}^B)}{D}-\dfrac{(R_{11}^B-E_{11}^B)(R_{V1}^A-R_{V1}^B)(R_{V2}^A-R_{V2}^B)}{D}\end{array}\right]/|H|$$

When $\frac{\partial p_2}{\partial t_2^A}<0$, nation B negotiates with A to reduce A's tariff, $t_2^A$. Similarly, when

$\frac{\partial p_1}{\partial t_1^B}<0$, nation A negotiates with B to obtain a reduction in $t_1^B$. When both nations

mutually reduce the internal tariff by the same amount, its impact on the terms of trade for nation A (in terms of good 3) can be shown as:

$$(A8)\quad |H|\left(\frac{\partial p_1}{\partial t_2^A}+\frac{\partial p_1}{\partial t_1^B}\right)=\alpha_2[(R_{12}^A-E_{12}^A)+(R_{11}^B-E_{11}^B)]+\alpha_2\frac{(R_{V1}^A-R_{V1}^B)(R_{V1}^B-R_{V2}^A)}{D}$$

$$-\beta[(R_{22}^A-E_{22}^A)+(R_{21}^B-E_{21}^B)]-\beta\frac{(R_{V2}^A-R_{V2}^B)(R_{V1}^B-R_{V2}^A)}{D}$$

$$+\frac{(R_{V2}^A-R_{V2}^B)^2}{D}[(R_{11}^B-E_{11}^B)+(R_{12}^A-E_{12}^A)]-\frac{(R_{V1}^A-R_{V1}^B)(R_{V2}^A-R_{V2}^B)}{D}[(R_{21}^B-E_{21}^B)+(R_{22}^A-E_{22}^A)]$$

Relation (A8) implies that if $|H|>0$:

$$\frac{\partial p_1}{\partial t_2^A}+\frac{\partial p_1}{\partial t_1^B}<0;$$

if $[\alpha_2(R_{V1}^A-R_{V1}^B)-\beta(R_{V2}^A-R_{V2}^B)](R_{V1}^B-R_{V2}^A)>0$, $R_{V2}^A-R_{V2}^B>0$, and

$R_{V1}^A-R_{V1}^B<0$.

Similarly, we can show that the mutual tariff reduction improves B's terms of trade

$$\frac{\partial p_2}{\partial t_2^A}+\frac{\partial p_2}{\partial t_1^B}<0 \text{ if } [\alpha_1(R_{V2}^A-R_{V2}^B)-\beta(R_{V1}^A-R_{V1}^B)](R_{V1}^B-R_{V2}^A)>0,\ R_{V2}^A-R_{V2}^B>0,$$

and $R_{V1}^A-R_{V1}^B<0$.

The impact on the illegal immigration can be written as

$$dI=I_1(\frac{\partial p_1}{\partial t_2^A}+\frac{\partial p_1}{\partial t_1^B})dt+I_2(\frac{\partial p_2}{\partial t_2^A}+\frac{\partial p_2}{\partial t_1^B})dt+(I_3+I_4)dt \text{ where } dt=dt_2^A=dt_1^B<0$$

From above discussion, if $I_1>0, I_2>0, I_3+I_4<0$, then, the mutual tariff reduction increases the illegal immigration. The conditions can be rephrased as

$R_{V1}^B>R_{V2}^A, R_{V1}^A>R_{V1}^B, R_{V2}^A>R_{V2}^B$ .

*Q.E.D.*