# The Effects of the FTA on Social Welfare and Urban Employment

**Watcharas Leelawath**
International Institute for Trade and Development, Bangkok, Thailand

## Abstract

A theoretical model concerning the effects of the Free Trade Arrangement (FTA) is developed in this study. The model examines how discriminatory tariff elimination influences social welfare and urban employment rate for the Harris-Todaro type of economy in the presence of variable returns to scale in agricultural and manufacturing sectors. Assume that the home country is the net exporter of agricultural products and the net importer of manufacturing products. Agricultural products are produced in rural areas, while manufacturing products are produced in urban areas. The analysis is based upon the Social-Utility approach to welfare comparison. The results show that the formation of an FTA would cause urban employment to increase regardless of the degrees of returns to scale in both sectors and the occurrence of either trade creation or trade diversion. The findings indicates that the comparison of degrees of returns to scale play a role in determining the effects of trade creation and trade diversion on social welfare. Trade creation is welfare-improving, only if the elasticity of return to scale in manufacturing sector is at most as much as that of agricultural sector. Under the same condition, trade diversion is more likely to cause an increase in social welfare than otherwise would be.

JEL classification: F15, F16

Key words: FTA, variable returns to scale, Harris-Todaro model, urban employment

## I. Introduction

The main objective of this paper is to examine the effects of forming a Free Trade Arrangement (FTA) on social welfare and the urban employment rate for the Harris-Todaro economy in the presence of the degree of variable returns to scale in the rural sector which produces only agricultural goods, and the urban sector which produces only manufactured goods. The paper is developed from the work of Beladi(1989), which adopted Harris-Todaro type of economy assuming that wage rates between urban and rural sectors are not equal. It investigated the effects of a customs union on social welfare and the urban employment rate in the presence of the degree of returns to scale only in the production of manufactured goods in the urban sector. Given that the production of agricultural goods in the rural sector exhibits constant returns to scale, its finding shown that trade creation unambiguously leads to an decrease in the urban employment rate and trade diversion leads to an increase in the urban employment rate. But the effect on social welfare is unclear. It depends on types of trade creation and trade diversion defined in Yu(1981), and the degree of returns to scale in the urban sector.

This paper is organized as follows. Section 2 presents assumptions and the structural equations of the model. The effects of forming an FTA on social welfare and urban employment rate for the Harris-Todaro economy are analyzed in section 3. Finally, the paper is concluded in section 4.

## II. The model and assumptions

Suppose the world consists of three countries, the home country, H, and its trading partner countries, B and C. All three countries produce two types of products, agricultural products ($X_a$), produced in each rural sector, and manufacturing products ($X_m$), produced in each urban sector, using two factors of production, capital (K) and labor (L). Domestic supplies of both factors are fixed. Capital is fully utilized, but labor is fully employed only in the rural sector, where the real wage rate ($w_a$) is flexible. In contrast, the real wage rate ($w_m$) in the urban sector is relatively rigid. As a result of the relative rigidity, there exists the urban unemployment in urban area. Assume that H is the highest-cost and C is the lowest-cost producers of $X_m$. Countries B and C are similar, which means they produce $X_m$ and they do not trade with each other. Moreover, H is a price-taker, and it exports $X_a$ to B and C but imports $X_m$ from either B or C.

The home country's demand side of the model is represented by a strictly quasi-concave utility function:

$$U = U(D_a, D_m) \tag{1}$$

where $D_a$ and $D_m$ are the consumption demands for agricultural and manufacturing products in home country H and $U_i > 0$, $U_{ii} < 0$, i = a, m. For generality, both products are normal goods.

Assume that the balance of payments is always maintained, the economy's budget constraint is

$$Y = X_a + PX_m = D_a + PD_m \tag{2}$$

where P is the relative price of manufacturing products in terms of agricultural products ( i.e. $P = P_m/P_a$). From equation (2), we obtain

$$X_a - D_a = P( D_m - X_m) \tag{3}$$

The left-hand side of equation (3) is the quantity of agricultural exports ($E_a$) and the right-hand side is the value of manufacturing imports ($E_m$). Since

$$E_a = X_a - D_a \tag{4}$$

and

$$E_m = D_m - X_m \tag{5},$$

then the balance of payments condition implies

$$E_a = PE_m \tag{6}$$

The production side of the model is developed from the following production function :

$$X_i = g_i(X_i).F_i( K_i, L_i) \qquad i = a, m \tag{7}$$

where $X_i$ is the output of sector i and $K_i$, $L_i$ are its total employment of capital and labor respectively. $F_{Ki}$ and $F_{Li}$ denote the partial derivatives of $F_i$ with respect to capital and labor, respectively. The function $g_i$ represents scale economies. It is nonnegative and increasing in sector's output. $F_i(.)$ is assumed to be linearly homogeneous.

Output elasticity of returns to scale is written as:

$$e_i = [dg/dX_i]\ F_i = [dg/dX_i].[X_i/g_i] \qquad i = a, m \tag{8}$$

where $-\infty < e_i < 1$. Increasing returns to scale (IRS) is represented by $e_i > 0$; constant returns to scale (CRS) and decreasing returns to scale (DRS) are represented by $e_i = 0$ and $e_i < 0$ respectively.

Totally differentiating (7), we get

$$dX_i = g_i(X_i).[F_{Ki}\, dK_i + F_{Li}\, dL_i] + F_i\ (dg_i/dX_i).dX_i$$

Rewriting (7),

$$F_i = X_i/g(X_i)$$

Thus

$$(1-e_i)dX_i = g_i(X_i).[F_{Ki}\, dK_i + F_{Li}\, dL_i] \tag{9}$$

Assuming that all firms in the urban sector are identical, cost minimization conditions are as follows.

$$P_m g(X_m)F_{Lm} = w_m \tag{10}$$

$$P_m g(X_m)F_{Km} = r_m \tag{11}$$

where $P_m$ stands for the price of manufactured products and $w_m$ and $r_m$ are wage rate and rental rate in the urban sector, respectively.

Similarly, cost minimization conditions in the rural sector are

$$P_a g(X_a)F_{La} = w_a \tag{12}$$

$$P_a g(X_a) F_{Ka} = r_a \tag{13}$$

where $P_a$ denotes the price of the agricultural product, and $w_a$ and $r_a$ are wage rate and rental rate in the rural sector.

Due to the assumption of perfect mobility of capital, equilibrium in the capital market yields

$$r_a = r_m = r \tag{14}$$

In order to simplify, we write $g(X_a)$ and $g(X_m)$ as $g_a$ and $g_m$, respectively. Recall that $P = P_m/P_a$, so

$$g_a F_{Ka} = P g_m F_{Km} \tag{15}$$

In the Harris-Todaro model, it is assumed that the expected wage rate in the urban sector is given by the fixed wage rate times the probability of employment ($\delta$). Equilibrium in the labor market requires

$$w_m \delta = w_a$$

Define the probability of employment in the urban sector as $\delta$, which is equal to the urban employment rate. Then

$$\delta = L_m/L_u < 1 \tag{16}$$

where $L_u$ is the total labor force in the urban sector and thereby $\delta < 1$. Rewrite (16), total labor force ($L^*$) in home country H can be expressed as follows.

$$\begin{aligned} L^* &= L_a + L_u \\ &= L_a + L_m/\delta \end{aligned} \tag{17}$$

Since capital is assumed to be fully utilized, then

$$K^* = K_a + K_m \tag{18}$$

Totally differentiating (17), we obtain

$$dL^* = dL_a + [\delta dL_m - L_m d\delta]/\delta^2$$

So with a fixed total labor supply,

$$dL_m = -\delta dL_a + L_m d\delta/\delta \tag{19}$$

Similarly with a fixed supply of capital,

$$dK_m = -dK_a \tag{20}$$

Total differentiate the economy's budget constraint (2),

$$dY = dX_a + PdX_m \tag{21}$$

Using equation (9), equation (21) can be expressed as follows:

$$dY = dX_a + [Pg_m/(1-e_m)].[F_{Km}\, dK_m + F_{Lm}\, dL_m] \tag{22}$$

Substituting (19) and (20) into (22), then using the cost minimization conditions, the factor supply and factor market equilibrium conditions (9) - (16), we obtain

$$dY = [1- (1-e_a)/(1-e_m)]dX_a + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m) \tag{23}$$

The derivation of equation (23) is shown in Appendix A. Equate (21) and (23), we get

$$dX_a + PdX_m = [1- (1-e_a)/(1-e_m)]dX_a + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m)$$

$$[(1-e_a)/(1-e_m)]dX_a = [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m) - PdX_m$$

This implies

$$dX_a/dX_m = [P/(1-e_a)].[(g_m/\delta)F_{Lm}L_m(d\delta/dX_m) - (1-e_m)] \ < \ 0 \tag{24}$$

The above equation demonstrates the slope of the transformation curve which depends on the sign of $d\delta/dX_m$. The proof in Appendix B illustrates that $d\delta/dP < 0$. In addition, the price-output response is always positive, $dX_m/dP > 0$. Then

$$d\delta/dX_m = (d\delta/dP)/(dX_m/dP) \ < \ 0$$

As a consequence, it is clear that the slope of the transformation curve is negative.

## III. The Analysis

Following the procedure originally developed by Batra (1973) and used in several recent studies, social utility is assumed to depend only on the consumption of agricultural and manufacturing products as expressed in equation (1). Thus, in order to examine the welfare effects of the formation of an FTA, we need to consider the change in social utility. Totally differentiate the social utility function, we obtain

$$dU = U_a dD_a + U_m dD_m \tag{25}$$

This can be rewritten as

$$dU/U_a = dD_a + [U_m/U_a]dD_m \qquad (26)$$

From utility maximizing conditions, the marginal rate of substitution is equal to the relative prices of two products, i.e. $U_m/U_a = P$. Thus

$$dU/U_a = dD_a + PdD_m \qquad (27)$$

The budget constraint in equation (2) with exogenously determined world price $P^*$ implies that

$$dX_a + P^*dX_m = dD_a + P^*dD_m \qquad (28)$$

The relationship between the domestic relative price, the foreign relative price and the tariff t is :

$$P = P^*(1+t) \qquad (29)$$

Totally differentiating equations (4)-(6), we get

$$dD_a = dX_a - dE_a \qquad (30)$$

$$dD_m = dX_m + dE_m \qquad (31)$$

$$dE_a = P^*dE_m + E_m dP^* \qquad (32)$$

Substituting (30)-(32) into equation (27) gives

$$dU/U_a = dX_a + PdX_m + P^*tdE_m - E_m dP^* \qquad (33)$$

Substitute (24) into (33),

$$dU/U_a = [Pg_m/\delta(1-e_a)].F_{Lm}L_m d\delta + [(e_m-e_a)/(1-e_a)]PdX_m + P^*tdE_m - E_m dP^* \qquad (34)$$

The derivations of equation (33) and equation (34) are shown in Appendices C and D, respectively.

According to the fact that the value of imports depends on tariffs and terms of trade, $E_m = E_m(t, P^*)$, totally differentiating this function gives

$$dE_m = (\partial E_m/\partial t).dt + (\partial E_m/\partial P^*).dP^* \qquad (35)$$

Substituting equation (35) into equation (34) yields

$$dU/U_a = [Pg_m/\delta(1-e_a)].F_{Lm}L_m d\delta + [(e_m-e_a)/(1-e_a)]PdX_m + P^*t(\partial E_m/\partial t)dt$$

$$+ [P^{*}t(\partial E_m/\partial P^*) - E_m]dP^{*} \tag{36}$$

Since $X_m$ is a function of t and $P^{*}$, $X_m = X_m(t, P^{*})$, then

$$dX_m = (\partial X_m/\partial t).dt + (\partial X_m/\partial P^{*}).dP^{*} \tag{37}$$

Substitute (37) into (36), we get

$$\begin{aligned} dU/U_a = {} & [Pg_m /\delta(1-e_a)].F_{Lm}L_m d\delta + \{[(e_m-e_a)/(1-e_a)]P(\partial X_m/\partial t) + P^{*}t(\partial E_m/\partial t)\}dt \\ & + \{[(e_m-e_a)/(1-e_a)]P(\partial X_m/\partial P^{*}) + P^{*}t(\partial E_m/\partial P^*) - E_m\}dP^{*} \end{aligned} \tag{38}$$

Again, the change in urban employment rate $\delta$ depends on changes in t and $P^{*}$. Therefore,

$$d\delta = (\partial\delta/\partial t).dt + (\partial\delta/\partial P^{*}).dP^{*} \tag{39}$$

Substitute the above equation into (38), then we obtain

$$\begin{aligned} dU/U_a = {} & \{[Pg_m /\delta(1-e_a)].F_{Lm}L_m(\partial\delta/\partial t) + [(e_m-e_a)/(1-e_a)]P(\partial X_m/\partial t) + P^{*}t(\partial E_m/\partial t)\}dt \\ & + \{[Pg_m/\delta(1-e_a)].F_{Lm}L_m(\partial\delta/\partial P^{*})+[(e_m-e_a)/(1-e_a)]P(\partial X_m/\partial P^{*}) \\ & + P^{*}t(\partial E_m/\partial P^*) - E_m\}dP^{*} \end{aligned} \tag{40}$$

Partially differentiate $P = P^{*}(1+t)$, the results are

$$\partial P/\partial t = P^{*} \tag{41}$$

$$\partial P/\partial P^{*} = (1+t) \tag{42}$$

Substituting these equations into equation (40) gives the key expression for the social welfare effect of the formation of the Free Trade Arrangement.

$$\begin{aligned} dU/U_a = {} & \{[Pg_m/\delta(1-e_a)].F_{Lm}L_m(\partial\delta/\partial P)P^{*} + [(e_m-e_a)/(1-e_a)]PP^{*}(\partial X_m/\partial P) \\ & + P^{*2}t(\partial E_m/\partial P)\}dt + (1+t).\{[Pg_m/\delta(1-e_a)].F_{Lm}L_m(\partial\delta/\partial P) \\ & + [(e_m-e_a)/(1-e_a)]P(\partial X_m/\partial P) + P^{*}t(\partial E_m/\partial P) - E_m/(1+t)\}dP^{*} \end{aligned} \tag{43}$$

Equation (43) illustrate that a discriminatory tariff elimination leads to two crucial effects on social welfare; one through a change in tariffs imposed by the home country and the other through a change in terms of trade that the home country faces. The former is represented by the first braces and the latter is represented by the second braces. The first terms in both braces reflect the change in urban employment rate caused by the change in tariffs and the change in terms of trade, respectively. In order to simplify, let

$$\Omega = [Pg_m/\delta(1-e_a)].F_{Lm}L_m(\partial\delta/\partial P) \quad < \quad 0 \tag{44}$$

Thus $\Omega P^*$ and $\Omega$ become first terms in the first and second braces, respectively. Recall that $\partial\delta/\partial P$ is negative. As a consequence, $\Omega P^*$ and $\Omega$ are negative.

Again, let

$$\Psi = [P/(1-e_a)](\partial X_m/\partial P) \quad > \quad 0 \tag{45}$$

Therefore, the second terms in the first and second braces are $(e_m-e_a)\Psi P^*$ and $(e_m-e_a)\Psi$, respectively. These terms capture the effects on production of importable manufacturing products, in the presence of returns to scale. Given the positive price-output response, i.e. $\partial X_m/\partial P > 0$, the sign of $\Psi$ is positive. However, the signs of second terms cannot be clearly determined. This is because they depend on the values of output elasticity of returns to scale in agricultural and manufacturing sectors. The signs of these terms are negative, when $e_a$ exceeds $e_m$, and vice versa.

The third terms indicate changes in the consumption of importable manufacturing products. Let $\Pi P^*$ and $\Pi$ denote third terms in the first and second braces, respectively, where

$$\Pi = P^* t(\partial E_m/\partial P) \quad < \quad 0 \tag{46}$$

Since $X_m$ is a normal good, then $\partial E_m/\partial P$ must be negative, and thereby $\Pi P^*$ as well as $\Pi$ are negative.

Substitute equations (44)-(46) into (43), the social welfare effects of the formation of an FTA can alternatively be expressed as follows.

$$dU/U_a = \{\Omega P^* + (e_m-e_a)\Psi P^* + \Pi P^*\}dt + (1+t)\{\Omega + (e_m-e_a)\Psi + \Pi - E_m/(1+t)\}dP^* \tag{47}$$

where $\Omega < 0$, $\Psi > 0$ and $\Pi < 0$.

In order to study the effects of discriminatory tariff elimination on social welfare and the urban employment rate, it is important to understand the basic concepts of trade creation and trade diversion. Even though both terms were originated from the theory of customs union, nowadays they are widely applied to any type of preferential tariff arrangement, especially the FTA. Viner(1950) defined trade creation as the substitution in consumption of higher cost, domestically produced goods in favor of lower-cost goods produced by the FTA member country. In contrast, trade diversion represents the shift in imports by the home country from the lowest-cost producers in a country, which is excluded in the FTA formation, to relatively higher-cost producers in a member country due to a discriminatory tariff reduction issued by the home country.

First, let us consider trade creation, which is identified as H's switch of its consumption of $X_m$ from domestic producers to lower-cost producers from country B due to discriminatory tariff elimination in favor of country B. According to this particular scenario, $dt < 0$. However, the terms of trade faced by H remain unchanged, then $dP^* = 0$. The negative change in the tariffs rate causes equation (47) to reduce to

$$dU/U_a = \Omega P^* dt + (e_m - e_a)\Psi P^* dt + \Pi P^* dt \tag{48}$$

Recall that $\Omega < 0$, $\Psi > 0$ and $\Pi < 0$ and $dt < 0$. As a result, it is clear that the first and the third terms in equation (48) are positive. Hence the reduction in tariffs has a positive effect on the urban employment rate. The sign of the second term depends upon the sign of ($e_m$-$e_a$). If $e_m$ is less than or equal to $e_a$, then the second term becomes greater than or equal to zero. As a consequence, $dU/U_a$ is unambiguously positive. Now the following proposition is stated.

Proposition 1: *If the elasticity of returns to scale of manufacturing sector is less than or equal to that of agricultural sector, trade creation leads to the improvement of welfare and an increase in the urban employment rate.*

However, if $e_m$ is greater than $e_a$, then the welfare effect of trade creation I is ambiguous. Hence, we have

Proposition 2: *If the elasticity of returns to scale of the manufacturing sector exceeds that of agricultural sector, trade creation unambiguously leads to an increase in the urban employment rate, but the effect on social welfare is ambiguous.*

Next, consider trade diversion, in which H switches its consumption of $X_m$ from C's lowest cost producers to B's producers in response to the abolition of tariffs only on partner country, B. Hence, $dt < 0$ and $dP^* > 0$. This is because the home country engages in trade with B only, so it faces B's terms of trade, which is greater than before forming an FTA. Accordingly, the change in the urban employment rate is represented by $\Omega P^* dt + (1+t)\Omega dP^*$. Since the sign of $\Omega P^* dt$ is positive and that of $(1+t)\Omega dP^*$ is negative, the direction of the change seems unclear depending upon the relative magnitudes of both terms. Recall that $P = P^*(1+t)$, then

$$dP = P^* dt + (1+t)dP^*$$

Therefore, the change in the urban employment rate will be $\Omega dP$. For trade diversion to occur, a discriminatory tariff elimination in favor of country B have to be large enough to lower domestic price of $X_m$ ($dP < 0$) so as to lure domestic consumers to switch their sources of manufacturing products. Otherwise, there will be no presence of trade diversion. As a consequence, the sign of $\Omega dP$ is positive. Here comes another proposition.

Proposition 3: *Regardless of the degree of returns to scale in agricultural and manufacturing sectors, trade diversion leads to an increase in the urban employment rate.*

Similarly, the welfare effect becomes

$$dU/U_a = \{\Omega + (e_m\text{-}e_a)\Psi + \Pi\}dP - E_m dP^* \quad (49)$$

The sign of equation (49) seems ambiguous. However, if $e_m \leq e_a$, then it is more likely that trade diversion would enhance social welfare of the home country than otherwise would be.

Proposition 4: *If the elasticity of returns to scale of manufacturing sector does not exceed that of the agricultural sector, trade diversion is likely to improve social welfare.*

## IV. Conclusion

The purpose of this paper is to examine the effects of the formation of the Free Trade Arrangement (FTA) on social welfare and urban employment rate for the Harris-Todaro type of economy in the presence of variables returns to scale in both urban and rural sectors. Assume that the urban sector produces manufacturing products and the rural sector produces agricultural products. The analysis has shown that under trade creation, the urban employment rate always increases regardless of the degree of returns to scale in both sectors. However, the change in social welfare depends on the magnitude of the degree of returns to scale of both manufacturing and agricultural sectors. If the elasticity of returns to scale of manufacturing sector does not exceed that of agricultural sector, trade creation is welfare improving. Otherwise, the results will be inconclusive.

Trade diversion will occur when domestic price of manufacturing goods falls due to discriminatory tariff elimination in favor of an FTA partner country. Under this condition, trade diversion leads to an increase in urban employment rate, regardless of the elasticities of returns to scale in agricultural and manufacturing sectors. As for the effect on social welfare, it seems ambiguous. However, if the elasticity of returns to scale of manufacturing sector does not exceed that of agricultural sector, then trade diversion is more likely to be welfare-improving than otherwise would be.

Apparently, this study provides solely theoretical framework for analyzing the FTA impacts. The model closely suits for developing countries, whose services sectors are relatively insignificant in comparison to agricultural and manufacturing sectors. Some extensions of this study can be done by encompassing services sector and differentiated types of labor and capital in the model, so as to make such framework fit for other developing countries with more developed services sectors. Furthermore, it is generally known that the FTA induces both positive and negative effects to workers in partner countries. Due to the proliferation of FTAs has just started within a few years, the problem of insufficient data probably arises in pursuing empirical study with regard to this particular issues for the time being. However, empirical investigations definitely should be conducted in future research.

Appendix A. Derivation of equation (23) in the main text

Substituting (19) and (20) into (22), then using the cost minimization conditions, the factor supply and factor market equilibrium conditions (9) - (16), we obtain

$$
\begin{aligned}
dY &= dX_a - [Pg_mF_{Km}dK_a]\ /(1-e_m) + [Pg_mF_{Lm}/(1-e_m)].[-\delta dL_a + L_m d\delta/\delta] \\
&= dX_a - [g_aF_{Ka}dK_a]\ /(1-e_m) - [\delta Pg_mF_{Lm}dL_a]/(1-e_m) + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m) \\
&= dX_a - [g_aF_{Ka}dK_a + g_aF_{La}dL_a]/(1-e_m) + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m) \\
&= dX_a - dX_a(1-e_a)/(1-e_m) + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m)
\end{aligned}
$$

$$dY = [1- (1-e_a)/(1-e_m)]dX_a + [Pg_mF_{Lm}L_m d\delta]/\delta(1-e_m) \qquad (23)$$

Appendix B. Proof for the condition $d\delta/dP < 0$.

The equilibrium in labor market yields the system of equations as follows:

$$
\begin{aligned}
w_m &= Pg_mF_{Lm} \\
w_a &= g_aF_{La} \\
w_a &= \delta w_m
\end{aligned}
$$

Total differentiation of the above system, we obtain the following matrix system:

$$
\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -\delta & 1 & -w_m \end{bmatrix} . \begin{bmatrix} dw_m \\ dw_a \\ d\delta \end{bmatrix} = \begin{bmatrix} g_mF_{Lm}dP + PF_{Lm}dg_m + Pg_mF_{Lm}d_{Lm} \\ g_aF_{La.a}dL_a + F_{La}dg_a \\ 0 \end{bmatrix}
$$

where $F_{La.a}$ is the second derivative of F(.) with respect to $L_a$.

Denote D as the determinant of this system. Then

$$D \ = \ -w_m \ < \ 0$$

Apply the Cramer's rule to solve this matrix system, we have

$$d\delta = D^{-1}.\{\delta.[g_mF_{Lm}dP + PF_{Lm}dg_m + Pg_mF_{Lm}d_{Lm}] - [g_aF_{La.a}dL_a + F_{La}dg_a]\} \qquad (A.1)$$

Equation (A.1) implies that

$$d\delta/dP \ = \ D^{-1}.(\delta g_mF_{Lm}) \ < \ 0$$

Appendix C. Derivation of equation (33) in the main text

Substituting (30)-(32) into equation (27) gives

$$\begin{aligned} dU/U_a &= dX_a - dE_a + PdX_m + PdE_m \\ &= dX_a - P^* dE_m - E_m dP^* + PdX_m + PdE_m \\ &= dX_a + PdX_m + [P - P^*]dE_m - E_m dP^* \\ &= dX_a + PdX_m + P^* tdE_m - E_m dP^* \qquad (33) \end{aligned}$$

Appendix D. Derivation of equation (34) in the main text

Substitute (24) into (33).

$$\begin{aligned} dU/U_a &= [Pg_m / \delta(1-e_a)].F_{Lm}L_m d\delta - [P(1-e_m)/(1-e_a)]dX_m + PdX_m + P^* tdE_m - E_m dP^* \\ &= [Pg_m / \delta(1-e_a)].F_{Lm}L_m d\delta + [1-(1-e_m)/(1-e_a)]\, PdX_m + P^* tdE_m - E_m dP^* \\ &= [Pg_m / \delta(1-e_a)].F_{Lm}L_m d\delta + [(e_m-e_a)/(1-e_a)]PdX_m + P^* tdE_m - E_m dP^* \qquad (34) \end{aligned}$$

## V. References


Beladi, H. (1989), "Urban unemployment, Economies of scale and the Theory of customs unions," Keio Economic Studies, 26(2), pp.5-15.

Choi, T. Y. and Yu, E. S. H. (1984), "Customs unions under increasing returns to scale," Economica, 51, pp. 1985-2203.

Choi, J.Y., Yu, E.S.H. and Jin, J.C. (2002), "Technical progress, urban unemployment, outputs, and welfare under variable returns to scale," International Review of Economics and Finance, 11, pp. 411-425.

Corden, W.M. (1999), "Economies of scale and Customs union theory" in J. Bhagwati, P. Krishna and A. Panagariya (eds.) Trading blocs: Alterantive approaches to analyzing preferential trade agreements, Cambridge and London: MIT Press, pp. 189-200.

Harrison, G. W., Rutherford, T. F. and Wooton I. (1993), "An alternative welfare decomposition for customs unions," Canadian Journal of Economics, 24(4), pp. 961-968.

Michael, M.S. and Miller, S.M. (1992), "Customs union and the Harris-Todaro model with International capital mobility," Open Economies Review, 3(1), pp. 37-49.

Pomfret, R. ed. (2003), Economic analysis of regional trading arrangements, Northampton, Massachusetts: Elgar.

Yu, E. S. H. (1981), "Trade diversion, trade creation and factor market imperfections," Weltwirtschaftliches Archiv, 117, pp. 546-561.

Yu, E.S.H. and Parai, A.K., (1989), "Endogenous wage differentials, imperfect labor mobility and Customs union theory," Journal of International Economic Integration, 4 (1), pp. 15-26.