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Abstract

This paper analyzes the effect of foreign aid on illegal immigration and host country welfare using a general equilibrium model. We show that foreign aid may worsen the recipient nation's terms of trade. Furthermore, it may also raise illegal immigration, if the terms of trade effect on immigration flows dominates the other effects identified in our analysis. Empirical analysis of the effect of foreign aid on illegal immigration to the United States broadly supports the predictions of our theoretical model. Foreign aid worsens the recipient's terms of trade. While the terms of trade effect tends to reduce illegal immigration, countervailing effects are found to dominate. The paper contributes to the related literature by establishing that there are unintended consequences of foreign aid, and, while some of them are reminiscent of the classical transfer problem, others are new and arise due to endogenous illegal immigration flows.

Keywords: Foreign aid, illegal immigration, terms of trade, transfer problem, tied aid

JEL codes: F1; F35; O1

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Abstract

This paper analyzes the effect of foreign aid on illegal immigration and host country welfare using a general equilibrium model. We show that foreign aid may worsen the recipient nation's terms of trade. Furthermore, it may also raise illegal immigration, if the terms of trade effect on immigration flows dominates the other effects identified in our analysis. Empirical analysis of the effect of foreign aid on illegal immigration to the United States broadly supports the predictions of our theoretical model. Foreign aid worsens the recipient's terms of trade. While the terms of trade effect tends to reduce illegal immigration, countervailing effects are found to dominate. The paper contributes to the related literature by establishing that there are unintended consequences of foreign aid, and, while some of them are reminiscent of the classical transfer problem, others are new and arise due to endogenous illegal immigration flows.

1. Introduction

The United States is increasingly relying on both border and internal enforcement measures to curb the rise of illegal immigrants from Mexico, and Central and South America.[1] Figure 1 chronicles these intensified efforts along the U.S.-Mexico border. As a matter of fact, since the passage of the Immigration Reform and Control Act (IRCA) in 1986, the number of Border Patrol agents has tripled, the use of high-tech equipment such as unmanned spy planes with infra-red cameras has become routine, and a 15 foot high fence spanning 700 miles of the Mexican border is currently under construction. In addition to intensified border enforcement, internal enforcement efforts punish firms that employ illegal workers.

However, tougher enforcement at the border and workplace have, up to this point, failed to control illegal immigration. Numerous studies in the migration literature reach the same conclusion: the most effective way of bringing illegal immigration under control is to promote development in the emigration countries (see for example, Todaro and Maruszko, 1987, and, Faini and Venturini, 1993). In addition, other studies have demonstrated that foreign aid can

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[1] According to Camarota (2007), half of Mexican and Central American immigrants, and one-third of South American immigrants in the United States are illegal. Media outlets such as The Economist (2004) have reported a significant increase in illegal immigrants from Central American countries such as Honduras, Guatemala, Nicaragua, and El Salvador entering the United States.

reduce the incentive to emigrate by raising living standards in sending countries (see for example, Gaytan-Fregoso and Lahiri, 2000, Myers and Papageorgiou, 2000, and Djajic, 2007). However, none of the foregoing studies take into account that aid (and the resulting transfer of purchasing power) also affects the commodity terms of trade of recipient nations, and this in turn effects illegal immigration. In fact, to our knowledge, the commodity terms of trade effect of foreign aid on illegal immigration has not been addressed by the literature. In most studies, the commodity terms of trade are assumed to be exogenous, which implies that they have no effect on immigration (see for example Bond and Chen, 1987, Gaytan-Fregoso and Lahiri, 2000, and, Bandyopadhyay, 2006).

This paper considers the effect of foreign aid on illegal immigration and host country welfare when the commodity terms of trade are endogenous. We build a general equilibrium model with two countries (a donor/host country and a recipient) and two goods (a primary good and a manufactured good). The recipient country exports the primary good and imports the manufactured good (which is subject to a tariff). We show that foreign aid reduces the recipient's commodity terms of trade. The welfare of the host country is affected by three factors. The first is the commodity terms of trade gain due to the transfer. The second is the income loss resulting from the transfer. We know from Ohyama (1974) and Brecher and Bhagwati (1982) that in the presence of a tariff in the recipient country, the commodity terms of trade gain can dominate the income loss leading to a net welfare gain for the host country. Finally, the change in the terms of trade, and the direct effect of foreign aid on the recipient nation's productivity can both affect migration flows by changing the wage differential between the host and source nations of illegal immigration. To the extent that the immigration flows may reduce the wage earned by illegal immigrants, the host nation enjoys a terms of trade gain in the factor market from enhanced

migration flows. This effect complements the standard terms of trade effects discussed in the literature in the context of the classical transfer problem.

To test the findings of our theoretical model, we empirically estimate the effect of foreign aid on illegal immigration flows to the United States. Our results are consistent with the predictions of the theoretical model. We find that the commodity terms of trade effect of foreign aid significantly increases illegal immigration to the United States. The results also support existing studies in the migration literature which find that foreign aid can reduce the incentive to emigrate by raising incomes in sending countries. In addition, we also find that illegal immigration is significantly increased by high unemployment in the sending country.

The rest of this paper is organized as follows: the theoretical model is presented in section 2, while section 3 discusses the empirical model, data, and estimation results, and finally section 4 concludes.

2.   The Model

There are two countries, A (a poor developing country) and B (a rich developed country), and two goods, 1 (a primary good) and 2 (a manufactured good). As is standard in neoclassical trade models, we assume that nations have given factor endowments. To simplify the analysis, we assume that B is specialized in the production of good 2, but consumes both goods. Country B exports good 2 to nation A, and imports good 1 from it. Trade is assumed to be balanced. We assume that labor is of two types, skilled and unskilled. Wage rates of skilled and unskilled labor in nation B are w^{sB} and w^{uB}, respectively. The corresponding wage rates for nation A are w^{sA} and w^{uA}. Nation B's unskilled wage w^{uB} is assumed to exceed w^{uA}.[2] We also assume that

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[2] This may be due to B's superior technology, or because of endowment differences between the two nations, among other potential reasons.

there is no legal immigration in the model, however, the wage difference for unskilled labor leads to illegal immigration of unskilled labor from A to B.[3] Country B relies on border enforcement and internal enforcement to reduce the inflow of illegal immigrants. Let I be the level of illegal immigration, and W_I the illegal wage rate in B. Nation B also makes a transfer of foreign aid to country A of an amount T. Let v^A and v^B be the factor endowment vectors of A and B, respectively. Treating good 1 as the numeraire, denoting the international price of good 2 by p, and the utility of a representative consumer in A by u^A, the expenditure function of A is $E^A\left(1, p+t, u^A\right)$, where t is A's unit import tariff. We assume that B follows free trade. Hence, using notation similar to A, we can express B's expenditure function as $E^B\left(1, p, u^B\right)$.

Under competitive profit maximizing conditions, and assuming that foreign aid may impact A's productivity, national income can be represented by its revenue function $R^A\left(1, p+t, v^A - I, T\right)$, where the argument $\left(v^A - I\right)$ represents the endowment vector net of unskilled emigration from A.[4] Similarly, Country B's national income is represented by its revenue function $R^B\left(1, p, v^B + I\right)$.[5] The partial of nation j's ($j=A,B$) revenue function with respect to the price of good-i ($i=1,2$) yields the general equilibrium supply function for good-i by nation j.[6] Similarly, the corresponding partials of the expenditure functions yield the Hicksian demand functions. In addition, the partials of the revenue functions with respect to the respective endowment vectors yield the respective factor reward vectors. We use the convention

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[3] Following Ethier (1986), among others, we assume that there is no illegal immigration in the skilled category. This is also largely consistent in terms of stylized facts of the US-Mexico illegal immigration problem, where the vast majority of such workers are in the low wage unskilled sector.
[4] We are grateful to an anonymous referee for suggesting an analysis of this potential impact of aid on the revenue function. Of course, it is easy to see that the results are qualitatively unaltered if this effect is absent.
[5] For simplicity, we assume that T does not enter B's revenue function.
[6] See Dixit and Norman (1980) for analysis of trade models using such dual functions.

that for any function $f(x_1, x_2, ..x_n)$, f_i is the partial derivative of the function with respect to argument i, and f_{ij} is the partial derivative of the function f_i with respect to argument j.

Following Ethier (1986) and Bond and Chen (1987) we assume that nation B's government uses both internal enforcement (e_i) and border enforcement (e_b) to control illegal immigration. Internal enforcement leads to a fine of z per illegal immigrant detected to be working for a representative firm. The firm pays this fine, but it also equates its marginal cost of hiring an unskilled native to that of the expected cost of hiring an illegal immigrant. Therefore, denoting the wage paid to an illegal immigrant as w_I, and the probability of internal detection by $\rho(e_i)$, we get:

$$w_I + z\rho(e_i) = w^{uB} \Rightarrow w_I = w^{uB} - z\rho(e_i). \tag{2.1}$$

Let the probability of being caught at the border be $g(e_b)$, and let there be a loss of wages to the tune of k for a potential immigrant who is caught at the border, and returned to nation A.[7] Assuming risk neutrality, the equilibrium migration condition equates the certainty wage for unskilled workers in nation A to the expected wage in nation B. Therefore, along the lines of Ethier (1986), we get:

$$w^{uA} = g(w^{uA} - k) + (1-g)w_I \Rightarrow w^{uA} = w_I - \beta(e_b), \quad \beta(e_b) \equiv \frac{kg(e_b)}{1-g(e_b)}. \tag{2.2}$$

Using (2.1) and (2.2):

$$w^{uA} = w^{uB} - z\rho(e_i) - \beta(e_b). \tag{2.3}$$

Balanced trade requires that A's expenditure equals the sum of its production revenues, foreign aid receipts, income earned by illegal immigrants, and tariff revenue.

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[7] For example, this may take the form of potentially productive time being lost in the process of waiting to be deported.

$$E^A\left(1,p+t,u^A\right)=R^A\left(1,p+t,v^A-I,T\right)+T+\left[w^{uB}-z\rho(e_i)-\beta(e_b)\right]I+t\left(E_2^A-R_2^A\right). \quad (2.4)$$

Equation (2.4) implicitly defines u^A as:

$$u^A=u^A\left(t,p,I,T,e_i,e_b\right). \quad (2.5)$$

There are two things to notice before we present the expenditure-revenue relationship for B.

First, the cost to B of hiring an illegal immigrant is $w_I=w^{uB}-z\rho$, because the fines collected

from the employers are paid back to the natives of B by its government. As noted in Bond and

Chen (1987), $z\rho$ is essentially a tax that is borne by the illegal immigrant, whose benefit accrues

to nation B. Second, the expected cost $\beta(e_b)$ is also borne by the illegal immigrant, and is a loss

to nation A [see Eq.(2.4) above], but unlike $z\rho$ it has no direct impact on B's national income.

Nation B's expenditure-revenue identity is given by

$$E^B\left(1,p,u^B\right)=R^B\left(1,p,v^B+I\right)-T-\left[w^{uB}-z\rho(e_i)\right]I-e_i-e_b. \quad (2.6)$$

Equation (2.6) implicitly defines u^B as

$$u^B=u^B\left(p,I,T,e_i,e_b\right). \quad (2.7)$$

Using the fact that the partial of the revenue function with respect to the endowment vector must

yield the factor reward vector, we can rewrite Eq. (2.3) as:

$$R_v^A\left(1,p+t,v^A-I,T\right)=R_v^B\left(1,p,v^B+I\right)-z\rho(e_i)-\beta(e_b). \quad (2.8)$$

Eq. (2.8) implicitly defines[8]

$$I = I(t, p, T).$$ (2.9)

It is easy to check that $R^B_{vv} < 0$ in our model, where nation B produces a single good through a

constant returns to scale production function. Also, $R^B_{v2} = \dfrac{\partial w^{uB}}{\partial p} > 0$, because in this single good

set-up for B, the rise in the price of the good must raise both factor rewards. Concavity in factor

endowments guarantees that $R^A_{vv} \leq 0$.[9] However, the sign of $R^A_{v2} = \dfrac{\partial w^{uA}}{\partial (p+t)}$ needs some careful

analysis. Good 2 is the manufactured good and is therefore likely to be skill intensive. If A's

production structure follows the Heckscher-Ohlin model, then the Stolper-Samuelson theorem

will predict that a rise in the price of good 2 will reduce the unskilled wage. In other words, it

will predict that $R^A_{v2} = \dfrac{\partial w^{uA}}{\partial (p+t)} < 0$. To reduce the taxonomy of possible cases, we will assume

that $R^A_{v2} < 0$, in the rest of the analysis. The other cases can easily be worked out, as necessary.

Given these assumptions, Eqs. (2.8) and (2.9) can be used to get

$$I_t = \frac{R^A_{v2}}{R^A_{vv} + R^B_{vv}} > 0; \quad I_p = \frac{R^A_{v2} - R^B_{v2}}{R^A_{vv} + R^B_{vv}} > 0; \text{ and } \quad I_T = \frac{R^A_{vT}}{R^A_{vv} + R^B_{vv}} \leq 0,$$ (2.10)

where $R^A_{vT} \geq 0$, because aid is assumed to either be neutral or helpful in terms of A's production

capabilities.

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[8] From this point, we suppress the enforcement vector (e_i, e_b) from the functional forms for ease of exposition. This is innocuous because the analysis assumes the enforcement levels to be given.

[9] For example, strict concavity of the revenue function is satisfied by the specific factors model, but not the standard Heckscher-Ohlin model, where factor returns are independent of factor endowments implying that $R^j_{vv} = 0$.

Using Eqs. (2.5), (2.7) and (2.9) in the expenditure and revenue functions of the two

nations, we get the market clearing equation for good 2 as

$$E_2^A\left[1, p+t, u^A\left\{t, p, I\left(t, p, T\right), T\right\}\right] + E_2^B\left[1, p, u^B\left\{p, I\left(t, p, T\right), T\right\}\right]$$

$$= R_2^A\left[1, p+t, v^A - I\left(t, p, T\right), T\right] + R_2^B\left[1, p, v^B + I\left(t, p, T\right)\right]. \tag{2.11}$$

Suppressing the factor endowment vectors v^A and v^B, Eq. (2.11) implicitly defines the

international price of good 2 (also the terms of trade of nation B) as

$$p = p(t, T). \tag{2.12}$$

Given an import tariff t and a foreign aid level T, and for given enforcement levels, Eq. (2.12)

determines the international price of good 2. In turn, Eq. (2.9) determines the illegal

immigration level. Using this price level and the illegal immigration level we can solve for the

utility levels in the two nations from equations (2.5) and (2.7). The system defined above can

then be used to solve for all the other variables of interest.

2.1.   The effect of foreign aid on terms of trade and illegal immigration

A simple way to understand the effect of foreign aid on the terms of trade is to focus on the case

when aid has no effect on A's revenue function.[10]

$$p_T = \frac{\partial p}{\partial T} = \frac{\left(\dfrac{E_{2u}^A}{E_u^A - tE_{2u}^A} - \dfrac{E_{2u}^B}{E_u^B}\right)}{D}, \tag{2.13a}$$

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where D is the slope of the global excess supply function of good-2, and must be positive for stability of international equilibrium (i.e., the Marshall-Lerner condition requires that $D > 0$). The expression in the numerator of the last term of Eq. (2.13a) is the familiar marginal propensity condition of the transfer problem. If the marginal propensity to consume good-2 of nation A (i.e., the recipient nation) exceeds that of the donor nation B, it raises its demand for good 2 by a larger amount than B's reduction in demand for good 2. In this situation, on balance, the global demand for good-2 must increase. This will lead to a rise in the international price of good-2. A simple case where terms of trade for B must improve is when B is specialized in the consumption of good 1. In that case, the numerator of Eq. (2.13a) must be positive, because it will be independent of any terms involving nation B. For ease of exposition, for the rest of the analysis, we assume that A's demand augmenting effect dominates. Thus,

$$p_T > 0. \tag{2.13b}$$

Case 1: Untied foreign aid

Differentiating (2.9), and using Eqs. (2.10), (2.12) and (2.13b), we get:

$$\frac{dI}{dT} = I_p p_T + I_T \Rightarrow \frac{dI}{dT} > 0 \text{ iff } p_T > \frac{|I_T|}{I_p}. \tag{2.14}$$

This equation suggests that there are two opposing effects that determine the sign of $\frac{dI}{dT}$. From Eq. (2.10) it is clear that if the effect of T on A's revenue function is small, the term $|I_T|$ is likely to be small. In this case, Eq. (2.14) suggests that $\frac{dI}{dT} > 0$. On the other hand, if the productivity enhancing effect dominates, then aid reduces illegal immigration. The intuition is the following.

When the terms of trade effect is strong, the rise in B's unskilled wage and the fall in A's

unskilled wage (due to a rise in p) will tend to encourage migration. On the other hand, if aid

raises productivity in A, it will raise A's unskilled wage, and this will tend to reduce migration.

The net effect depends on the relative strength of these opposing factors. This adds a new twist

to the traditional transfer problem by raising the possibility that foreign aid and the associated

changes in the terms of trade can undermine a nation's efforts to control illegal immigration.

Case 2: Foreign aid is tied to trade liberalization

Suppose foreign aid is given on the condition that country A liberalizes trade by reducing its

tariff on good 2, such that $t = t(T)$, and $t' = \dfrac{dt}{dT} < 0$. Differentiating (2.9), and using Eqs. (2.10),

(2.12) and (2.13b), we get:

$$\frac{dI}{dT} = \left(I_p p_t + I_t \right) t' + I_p p_T + I_T . \tag{2.15}$$

Using Eqs. (2.11) and (2.12) it can be shown that p_t is negative under reasonable assumptions on

tariff induced immigration flows. This is intuitive, because normally one would expect an

import tariff to reduce the world price of the import good. If $I_p p_t + I_t < 0$, then Eq. (2.14) and

Eq. (2.15) jointly imply that $\dfrac{dI}{dT} > 0$. The term $\left(I_p p_t + I_t \right) t'$ captures the induced effect of trade

liberalization, while the remaining terms reflect the terms of trade effects discussed in case 1.

2.2.   The effect of foreign aid on the welfare of the host country

For the welfare analysis we consider case 1 above of untied aid, and also suppress the

enforcement variables from the functional forms. Using Eqs. (2.7), (2.9) and (2.12)

$$u^B = u^B\left(p(t,T), I\{t, p(t,T)\}, T\right).$$ (2.16)

Differentiating (2.16)

$$\frac{du^B}{dT} = \left(u_p^B + u_I^B I_p\right) p_T + u_I^B I_T + u_T^B.$$ (2.17)

Using Eqs. (2.6) and (2.7), we can show that

$$u_p^B = \frac{Exp_2^B - IR_{v2}^B}{E_u^B}, \ u_I^B = \frac{z\rho - IR_{vv}^B}{E_u^B} > 0, \ u_T^B = -\frac{1}{E_u^B} < 0, \ Exp_2^B = R_2^B - E_2^B,$$ (2.18)

where E_u^B is the inverse of the marginal utility of income and is positive, and Exp_2^B is the export of

good 2 by B, and is also positive. As long as IR_{v2}^B is not too large in absolute value, Eq. (2.18)

suggests that u_p^B is positive. This is intuitive, because one would expect that the direct effect of

a rise in the price of B's export good will raise its utility. The term u_I^B is positive because B's

wage falls due to more immigration (i.e., $R_{vv}^B < 0$), and this confers a terms of trade gain to B in

the unskilled labor market, and also because an immigrant works at a lower wage than her/his

marginal product (this gain is reflected in the term $z\rho$). The term u_T^B measures the direct effect

of making a transfer to nation A, which must then reduce B's utility. Using Eqs. (2.14) and

(2.18) in Eq. (2.17) we can infer that while the direct effect of the transfer is to reduce B's utility,

the indirect effects arising out of terms of trade improvement for B tend to improve its welfare

because of the traditional transfer problem type effects, and also because of the induced

immigration flows. Ohyama (1974) and Brecher and Bhagwati (1982) demonstrate that in the

presence of a tariff in the recipient country, the terms of trade gain can dominate the income loss

leading to a net welfare gain for the host country. We complement these results by showing that immigration flows may augment such a welfare enhancing effect for the donor nation.

2.3   A simple model of unemployment[11]

This subsection presents a model along the lines of Ethier (1986) and Palivos (2009) where there is a minimum wage for unskilled labor in nation B. For simplicity, for this subsection we assume that T has no effect on A's revenue function, and also that border enforcement is the only form of enforcement (i.e., $e_i = 0$). These assumptions are not restrictive and do not affect the qualitative nature of the results. Let the constant returns to scale production function of good 2 in B be

$$X_2 = f(L,S), \ f_j > 0, \ f_{jj} < 0, \ j = L,S. \tag{2.19}$$

where L and S are the unskilled and skilled labor employed in producing the good. Let the minimum wage for unskilled labor be $w^{uB} = \overline{w}$. The profit of a representative firm is

$$\pi = pf(L,S) - \overline{w}L - w^{sB}S. \tag{2.20}$$

The first order conditions require that

$$pf_L(L,S) = \overline{w}, \text{ and, } pf_S(L,S) = w^{sB}. \tag{2.21a}$$

Let the skilled labor endowment of nation B be $\overline{S}$. Substituting $S = \overline{S}$ in Eq. (2.21a), we get

$$L = L(p, \overline{w}, \overline{S}), \ L_p = -\frac{\overline{w}}{p^2 f_{LL}} > 0; \text{ and } w^{sB} = pf_S\left[L(p, \overline{w}, \overline{S}), \overline{S}\right] = w^{sB}(p). \tag{2.21b}$$

Let the given stock of B's unskilled natives be $\overline{L}$. The total unskilled labor supply is $\overline{L} + I$. If the minimum wage is binding, there is unemployment, implying that $L < \overline{L} + I$. Let the

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[11] Following the suggestions of an anonymous referee we consider an extension of the framework we describe above by allowing for a minimum wage and unemployment in the unskilled labor market of nation B.

employment rate be denoted by m. Then, using Eq. (2.21b) and suppressing $\bar{w}$, $\bar{L}$ and $\bar{S}$ from the functional forms, we get

$$m = \frac{L(p)}{\bar{L}+I} \equiv m(p,I) < 1.$$ (2.22)

Notice that in the presence of unemployment, and assuming that there is no internal enforcement, the expected wage that a potential migrant faces if she/he successfully crosses the border is $m\bar{w}$. The migration condition [along the lines of Eq. (2.2) above] is:

$$w^{uA} = g\left(w^{uA} - k\right) + \left(1-g\right)m\bar{w} \Rightarrow w^{uA} = m\bar{w} - \beta\left(e_b\right), \quad \beta\left(e_b\right) \equiv \frac{kg\left(e_b\right)}{1-g\left(e_b\right)}.$$ (2.23a)

Eq. (2.23a) reduces to

$$R_v^A\left(1, p+t, v^A - I\right) = \bar{w}m(p,I) - \beta\left(e_b\right).$$ (2.23b)

Suppressing t and e_b from the functional forms, Eq. (2.23b) implies that

$$I = I(p,m), \text{ where } I_p = \frac{R_{v2}^A}{R_{vv}^A} > 0, \text{ and } I_m = -\frac{\bar{w}}{R_{vv}^A} > 0.$$ (2.23c)

Substituting (2.23c) in (2.22) we get

$$m = \frac{L(p)}{\bar{L}+I(p,m)} \Rightarrow m = m(p),$$

$$\text{where } m'(p) = \frac{dm}{dp} = \frac{L_p - mI_p}{\bar{L}+I+mI_m} > 0 \text{ iff } L_p > mI_p.$$ (2.24)

The balanced trade condition for this economy is:

$$E^B\left(1, p, u^B\right) = pX_2 - \bar{w}mI - e_b - T.$$ (2.25)

Zero profit for good 2 in B dictates:

$$pX_2 = \bar{w}L + w^{sB}\bar{S} = \bar{w}m\left(\bar{L}+I\right) + w^{sB}\bar{S} \Rightarrow pX_2 - \bar{w}mI = \bar{w}\bar{L}m + w^{sB}\bar{S}.$$ (2.26)

Substituting (2.26) in (2.25)

$$E^B\left(1,p,u^B\right)=\overline{w}\overline{L}m+w^{sB}\overline{S}-e_b-T\ . \tag{2.27}$$

Differentiating (2.27) with respect to T we get

$$E_u^B\frac{du^B}{dT}=-E_2^B\frac{dp}{dT}+\overline{w}\overline{L}\frac{dm}{dT}+\overline{S}\frac{dw^{sB}}{dT}-1\ . \tag{2.28}$$

The first term on the right-hand-side of (2.28) is the loss to consumers of B when the price of

good 2 rises due to the transfer. The second term is a gain/loss to unskilled natives of B due to a

rise/fall in the employment rate in B. The third term is the gain/loss to the skilled natives due to

a rise/fall in the skilled wage. The last term is the direct loss to B due to the transfer. Because of

constant returns to scale, we can write the zero profit condition in good 2 in nation B as:

$$C\left(\overline{w},w^{sB}\right)=p\ , \tag{2.29a}$$

where $C(.)$ is the unit-cost function for good-2 in B. Differentiating (2.29a) and using

Sheppard's lemma:

$$\frac{dw^{sB}}{dp}=\frac{X_2}{\overline{S}}\ . \tag{2.29b}$$

Substituting (2.29b) in (2.28), and using (2.21b) and (2.24), we can rewrite (2.28) as:

$$E_u^B\frac{du^B}{dT}=\left[Exp_2^B+\overline{w}\overline{L}m'(p)\right]p_T-1\ , \tag{2.30}$$

where $Exp_2^B=X_2-E_2^B>0$, is the export of good 2 by nation B. Eq. (2.30) is analogous to Eq.

(2.17) above, and suggest that in an unemployment economy a positive terms of trade effect of a

transfer will be reflected in terms of the standard effect (i.e., $Exp_2^B p_T$) and the employment

augmenting effect for unskilled labor (i.e., $\overline{w}\overline{L}m'p_T$). Nation B's welfare will rise because of the

transfer if these effects are larger than direct income loss due to the transfer.

3.   Empirical Model, Data, and Estimation

3.1.   Model specification

The theoretical model developed above predicts that foreign aid to Central and Latin American

nations has countervailing effects on illegal immigration to the U.S. Consistent with the

conventional beliefs of the profession, the model does hold that increased aid (*all else equal*)

reduces illegal immigration by boosting the income and material wellbeing of those living in the

recipient nations. However, the model also predicts that aid distorts a recipient nation's terms of

trade, thereby harming that nation's export sector and catalyzing greater migration flows. To

determine the net effect of foreign aid on illegal immigration to the U.S. in practice, we

empirically estimate the following system of equations (3.1):

$$immigration_{it} = \beta_1 trade_{it-1} + \beta_2 tariff1_{it} + \beta_3 tariff2_{it} + \beta_4 unemployment_{it}$$

$$\beta_5 income_{it-1} + \beta_5 aid_{it-1} + \alpha_i + \eta_t + \varepsilon_{it}. \qquad (3.1a)$$

$$trade_{it} = \gamma_1 aid_{it-1} + a_i + \delta_t + u_{it}. \qquad (3.1b)$$

Starting with the first equation above (3.1a) *immigration_{it}* is the natural log of illegal immigrants

from nation *i* apprehended by U.S. authorities in year *t*. The first explanatory variable is

trade_{it-1}, which measures the natural log of the terms of trade from the prior period. The U.S.

tariff applied to foreign imports is measured by *tariff1_{it}*, while *tariff2_{it}* captures the average

foreign tariff levied on U.S. exports. Foreign labor market conditions are measured by the

corresponding unemployment rate (*unemployment_{it}*), and living standards are in-turn reflected

by the natural log of real per capita income in the prior period. The parameters α_i and η_t capture

nation and period fixed effects respectively, while ε_{it} is an independently and identically

distributed mean-zero shock. Turning to the second equation (3.1b), the definitions of trade and

aid are identical to those given in first equation, while the parameters a_i and δ_t are the respective

nation and period fixed effects, and u_{it} is a mean zero shock.

While equation (3.1a) is a straightforward extension of Hanson and Spilimbergo (1999),

equation (3.1b) warrants further discussion.[12] We assume that aid is an exogenous variable,

determined by U.S. geopolitical considerations, and independent of any other factors that

influence the terms of trade. This assumption is advantageous as it implies that aid is

uncorrelated with any omitted explanatory variables, thus allowing for the unbiased estimation of

γ_1 in equation (3.1b).

3.2. Data

A major empirical challenge is that the number of people attempting to enter the U.S. illegally is

not directly observable. Following Hanson and Spilimbergo (1999), we instead use data on

apprehensions from the Department of Homeland Security as our measure of illegal immigration.

However, to make the migration flows comparable across nations, we normalize by the

populations of the sending nations, and multiply by one million (thus expressing illegal

immigration per one million home residents). The data include both apprehensions by U.S.

Border Patrol agents of individuals attempting to cross U.S. borders illegally and apprehensions

of individuals residing within the U.S. who either entered the U.S. illegally or entered legally but

subsequently lost their legal status.[13] Foreign aid is measured by net Official Development

Assistance (ODA) normalized by each nation's total exports plus income transfers, and

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[12] Hanson and Spilimbergo (1999) consider the effects of Mexican and U.S. wages and enforcement on illegal immigration (measured using apprehensions). We expand their analysis to consider a broader panel of countries, we add foreign aid to the analysis, and we endogenize the terms of trade. We use unemployment rates as a proxy for foreign labor market conditions (as we do not have reliable wage data), and fixed nation effects capture invariant idiosyncratic determinants of migration flows. Finally, our inclusion of time period effects captures changes in U.S. enforcement policy over the sample period.

[13] Over 90% of all apprehensions occur at U.S. borders.

expressed on a 100-point scale. The ODA data are from the OECD-DAC database, while the

export and income values are from the World Bank's World Development Indicators (WDI)

database. We measure the price of exports of good 1 using the export unit value of a major non-

oil product exported to the U.S. by each sending country. The price of imports of good 2 is

measured by the import unit value of metal working machinery (SITC 737 rev.2).[14] Terms of

trade equal the ratio of export unit values to import unit values. Unit values are calculated using

data from COMTRADE. Income per capita is expressed in PPP adjusted (constant 2000) dollars,

and is from the World Bank's World Development Indicators (WDI) database. Data on

unemployment rates were obtained from World Economic Outlook (WEO), and tariff data are

from the TRAINS database. Our sample consists of 162 observations, covering 18 countries (see

Table 1), with annual observations over the period 1996 to 2004. Variable definitions and

summary statistics of the data are provided in Table 2.

3.3.　　Estimation

Although one of the key implications of the theoretical model is that the receipt of foreign aid

affects the recipient nation's terms of trade with the U.S., and that this eventually stimulates the

flow of illegal immigration, we assume that this process operates with a lag – i.e. time must

elapse between the receipt of the aid and the eventual migration of displaced workers. This is

important because it implies that contemporaneous shocks to a nation's terms of trade are

uncorrelated with contemporaneous shocks to immigration, or more precisely $cov(\varepsilon_{it}, u_{it}) = 0$.

As such, separate equation-by-equation estimation of (3.1a) and (3.1b) is both unbiased and

efficient.

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[14] Like many other developing countries, the share of capital goods imports (such as metal working machinery) in total imports is very high. Imports of metal working machinery are therefore important for analyzing terms of trade.

Estimation results for equation (3.1a) are provided in Table 3. To ensure the robustness of the results, several alternative specifications are also reported, whereby various explanatory variables are removed. Consistent with our theoretical model, the estimated trade coefficient is universally negative and statistically significant, averaging -0.378 in value. This implies that a ten percent increase in the prior-period terms of trade leads to a -3.78 percent decline in the rate of illegal immigration or alternatively a 10 percent *decline* in the prior-period terms of trade leads to a 3.78 percent increase in illegal immigration. Turning to U.S. tariff rates, the estimated coefficients are both negative and statistically significant in all but one specification, which is consistent with the hypothesis that tariffs affect illegal immigration through their effect on domestic prices. The average coefficient value on U.S. tariffs is -0.0075, implying that a ten percentage-point increase in the applied tariff rate leads to a -7.5% reduction in illegal immigration. By contrast, the applied foreign tariff rates on U.S. exports are statistically insignificant in every model specification. Not surprisingly, the estimated coefficient on the unemployment rate is positive and statistically significant in each specification of equation 3.1a. Specifically, the coefficient on unemployment averages 0.061, implying that a 1 percentage-point increase in a nation's current unemployment rate leads to a 6.1% increase in illegal immigration. Clearly, illegal immigration flows are *extremely* sensitive to foreign labor market conditions. Also consistent with our *a priori* expectations, the coefficient on the lag of log per capita income is negative and statistically significant. The average coefficient value is -2.529, meaning that a one percent increase in the level of income in Central and Latin American nations leads to just over a 2.5% decline in illegal immigration. This result clearly comports well with the prior findings of Faini and Venturini (1993) and Todaro and Maruszko (1987). Finally, turning to the log of lagged aid, the point estimates are all negative and remarkably similar in

magnitude across all five specifications. The aid coefficient is statistically significant in three of the five regressions, just failing to achieve the 10% significance threshold in the other two regressions [i.e. a p-value of 10.8% in specification (1), and a p-value of 13.6% in specification (4)]. The average coefficient value among the statistically significant aid coefficients is -0.135, meaning that a ten percent increase in a nation's aid to export ratio will reduce illegal immigration by 1.35% in the following period. This captures the well documented income effect from the migration literature, whereby foreign aid reduces migration by raising living standards in recipient nations.

To ascertain the extent to which aid indirectly affects immigration by way of distorting the terms of trade, we examine estimates of equation (3.1b). Specification (1) in Table 4 assumes both fixed country and period effects, and the resulting coefficient on lagged aid equals -0.155, with a corresponding p-value of 3.6%. Specification (2) includes country fixed effects, but no period effects. The coefficient on aid in this alternative model equals -0.098, with a corresponding p-value of 2%. The average coefficient value across these two specifications is -0.126, implying that a ten percent increase in aid (expressed as a fraction of a nation's export sector) reduces the recipient nation's terms of trade by 1.26%. From the estimates of equation (3.1a), we have established that a reduction in a nation's terms of trade results in an increase in illegal immigration activity. Combining these two findings, the magnitude of the indirect effect of aid on immigration vis-à-vis trade equals 0.017:

$$\frac{\partial immigration_{it}}{\partial aid_{it-2}} = \frac{\partial trade_{it-1}}{\partial aid_{it-2}} \times \frac{\partial immigration_{it}}{\partial trade_{it-1}} = \gamma_1 \times \beta_5 \,. \tag{3.2}$$

In words, a ten percent increase in aid leads to a 0.17% indirect increase in illegal immigration two periods in the future. Clearly, the direct income effect of aid on immigration dominates the indirect effect of aid-induced changes in the terms of trade on immigration. The policy implications are quite clear: aid reduces illegal immigration, but there are unintended consequences which blunt the effectiveness of such a strategy. To date, we are unaware of any other empirical study which estimates the relative magnitude of this neglected aid-immigration channel.

4.   Conclusion

This paper analyzes the effect of foreign aid on terms of trade within the context of a general equilibrium immigration model. Along the lines of the well-known transfer problem in the presence of distortionary trade taxes, we show that foreign aid may improve the donor's terms of trade and partially (or fully) offset the donor's loss from granting the aid. In addition, we consider the effect of such terms of trade changes on the wages of the donor and the recipient nations. If the wage difference between the nations is magnified by the change in the terms of trade, illegal immigration increases. We consider the welfare implication of such factor flows, taking into account their effect on factor prices.

Our empirical analysis of the effect of foreign aid on illegal immigration supports the predictions of the theoretical model. We find that the terms of trade effect of foreign aid significantly increases illegal immigration to the U.S. However, the direct income effect of aid on immigration dominates the indirect effect of aid-induced changes in the terms of trade on immigration. Overall, aid reduces illegal immigration, but there are unintended consequences which attenuate the effectiveness of such a strategy.

References

Bandyopadhyay, S. (2006) "Illegal Immigration and Second Best Import Tariffs" *Review of International Economics 14*, 93-103.

Bond, E.W., and Chen, T.J. (1987) "The Welfare Effects of Illegal Immigration" *Journal of International Economics 23*, 315-328.

Brecher, R., and Bhagwati, J. (1982) "Immizerising Transfers from Abroad" *Journal of International Economics 13*, 353-364.

Camarota, S. (2007) "Immigrants in the United States, 2007: A Profile of America's Foreign-Born Population" Center for Immigration Studies, Washington, D.C.

Djajic, S. (2007) "Foreign Aid, International Migration and Welfare" in Sajal Lahiri (ed): *Theory and Practice of Foreign Aid*, Vol. 1, Elsevier.

Dixit, A., and Norman, V. (1980) *Theory of International Trade*. Cambridge University Press.

Ethier, W. (1986) "Illegal Immigration: The Host Country Problem" *American Economic Review 76*, 56-71.

Faini, R., and Venturini, A. (1993) "Trade, Aid, and Migrations: Some Basic Policy Issues" *European Economic Review 37*, 435-442.

Gaytan-Fregoso, H., and Lahiri, S. (2000) "Foreign Aid and Illegal Immigration" *Journal of Development Economics 63*, 515-527.

Hanson, G., and Spilimbergo, A. (1999) "Illegal Immigration, Border Enforcement, and Relative Wages: Evidence from Apprehensions at the U.S.-Mexico Border" *American Economic Review 89*, 1337-1357.

Myers, G., and Papageorgiou Y. (2000) "Immigration Control and the Welfare State" *Journal of Public Economics 75*, 183-207.

Ohyama, M. (1974) "Tariffs and the Transfer Problem" *KEIO Economic Studies 11*, 29-45.

"The Kamikazes of Poverty" *The Economist*, 2004, vol. 370, issue 8360, pp. 33-34.

Palivos, T. (2009) "Welfare Effects of Illegal Immigration", *Journal of Population Economics*, 22, 131-44.

Todaro, P., and Maruszko, L. (1987) "Illegal Migration and U.S. Immigration Reform: A Conceptual Framework" *Population and Development Review 13*, 101-114.

Table 1: Sample of Countries used in the Estimation

Region/Country

North America
Mexico*

Central America
Belize
Costa Rica
El Salvador*
Guatemala*
Honduras*
Nicaragua*
Panama

South America
Argentina
Bolivia
Brazil
Chile
Colombia*
Ecuador*
Paraguay
Peru*
Uruguay
Venezuela

* Country is among the top 20 countries with the highest illegal immigrant population in the U.S.

(Source: 1997 Yearbook)

Table 2: Variable Definitions and Summary Statistics

Variable	Definition	Mean (Standard Deviation)
Apprehensions	Apprehensions by the U.S. Border Patrol agents of individuals attempting to cross the U.S. borders illegally, and apprehensions by investigations agents of individuals who entered the U.S. illegally and those who entered legally but subsequently lost legal status, divided by home population and multiplied by one million.	1,122.82 (3,281.11)
Foreign aid	Net Official Development Assistance normalized by total exports plus income transfers, and expressed as a percentage (%).	9.96 (21.05)
Per-capita income	GDP per capita (PPP based, constant 2000 dollars)	5,885.07 (2,528.85)
Terms of trade	Export unit value /import unit value	0.05 (0.29)
Unemployment	Unemployment rate of country i, expressed as a percentage (%)	9.66 (4.25)
Tariff 1	U.S. average applied tariff on imports good 1 (trade weighted)	4.46 (20.48)
Tariff 2	Average applied tariff on good 2 by country i (trade weighted)	7.70 (3.97)

Note: illegal immigrants' countries of origin are indexed by i.

Table 3 – Estimates of Equation 3.1a

Fixed Effect Panel Regressions: Various Model Specifications
(dependent variable: immigration)

Variable	Alternative Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
terms of trade	-0.0380	-0.0420	---	-0.0300	-0.0400	-0.0390
	(0.017)**	(0.021)*		(0.017)*	(0.018)**	(0.018)**
tariff on good 1	-0.0060	-0.0070	-0.0060	-0.0110	---	-0.0020
	(0.003)**	(0.003)**	(0.003)**	(0.004)***		(0.002)
tariff on good 2	-0.0110	-0.0110	-0.0110	0.0090	---	-0.0150
	(0.022)	(0.019)	(0.024)	(0.022)		(0.021)
unemployment rate	0.0570	0.0610	0.0580	0.0860	0.0410	---
	(0.022)***	(0.018)***	(0.021)***	(0.018)***	(0.014)***	
income	-2.4020	-1.8460	-2.3250	---	-2.8050	-3.2660
	(0.368)***	(0.333)***	(0.431)***		(0.278)***	(0.397)***
aid	-0.132	---	-0.135	-0.1000	-0.1380	-0.1330
	(0.081)		(0.08)*	(0.067)	(0.077)*	(0.08)*
Goodness of fit (R^2)	0.98	0.98	0.98	0.98	0.98	0.98
Observations	140	144	140	140	140	140

White robust standard errors in parenthesis

***,**,** - statistically significant at the one, five, and ten percent levels respectively

Specifications (1) to (6) contain both fixed nation and period effects

Table 4 – Estimates of Equation 3.1b

Fixed Effect Panel Regressions: Various Model Specifications
(dependent variable: trade)

Variable	Alternative Specifications	
	(1)	(2)
aid	-0.155	-0.098
	(0.071)**	(0.041)**
Goodness of fit (R^2)	0.78	0.76
Observations	140	140

White robust standard errors in parenthesis

***,**,** - statistically significant at the one, five, and ten
  percent levels respectively

Specification (1) contains both fixed period and nation effects

Specification (2) contains just fixed nation effects

Figure 1: Enforcement of U.S.-Mexico Border