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Is There Too Little Immigration? An Analysis of Temporary Skilled Migration

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Abstract

This paper presents a model of legal migration of temporary skilled workers from one source country to two host countries, both of which can control their levels of such immigration. Because of complementarities between capital and labor, the return on capital is positively related to the level of immigration. Consequently, when capital is immobile, host nations' optimal levels of immigration are positively related to their capital endowments. Further, when capital is mobile between the host nations, the common return on capital is a function of the levels of immigration in both countries, meaning that immigration is a public good. As a result, when immigration imposes costs on host countries, the Nash equilibrium results in free riding and less immigration than would occur in the cooperative equilibrium. These results are qualitatively unaltered when capital mobility extends to the source nation.

Keywords: Skilled Immigration; Optimal Immigration; Capital Mobility; Externalities; Public Goods; Assimilation Costs.

JEL Codes: F22, O24

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1. Introduction

Immigration policy occupies a central place in policy discussions for most developed nations. Increasing globalization has also meant increased movement of skilled labor from developing to developed nations. For example, nations like China and India have abundant skilled labor, but lack infrastructure and complementary inputs. This has kept wages much lower than in developed nations and has led to employers in labor-scarce nations to pressure for the relaxation of immigration restrictions. It is well known, for example, that major U.S. firms like Microsoft lobby the government to relax the quota imposed by H1 type visas for temporary workers. A quote from Bhagwati (2003) summarizes the situation aptly:

> "…developed countries' appetite for skilled migrants has grown – just look at Silicon Valley's large supply of successful Indian and Taiwanese computer scientists and venture capitalists. The enhanced appetite for such professionals reflects the shift to a globalized economy in which countries compete for markets by creating and attracting technically skilled talent. Governments also perceive these workers to be more likely to assimilate quickly into their new societies."

Borjas (2000) mirrors this view in his analysis of the effects of skilled immigration through complementary effects on native capital and knowledge externalities to native workers.[1]

This paper addresses this interdependence in immigration policy, especially in the context of skilled immigrants who are perceived to be temporary workers. While immigration policy in the United States is largely considered to be a bilateral issue between the source nation (say India) and the host nation (U.S.), it is clear that immigration of skilled labor to the United States has spillover effects on other potential host nations and *vice versa*. If immigration raises the return on capital, capital will flow into that nation. The capital outflow from the other developed nations will affect both their wages and national income. Thus, the immigration level chosen by one host nation affects another. Although this is recognized in the literature, its analysis has not developed at a sufficient level.[2]

We address the issue of interdependence between host nations with a three-nation model where immigrants from a source developing nation (say *S*) migrate to two developed host nations (*H* and *F*). *H* and *F* are developed nations with superior technology (relative to *S*) associated with higher marginal product of labor and consequently higher wages. Immigration policy is determined through a government quota and, as a result, there is a wedge between wages in the host and source nations.

Host nations incur assimilation costs in making an immigrant suitable for the domestic workplace and to be responsible residents. Part of these costs may be internal to the firm – like work related training etc. The rest are social costs that pertain to cultural assimilation of the immigrants. It is well documented in the literature that assimilation entails real resource costs for an economy. Consider, for example, proficiency in the host nation's official language. Dustmann and van Soest (2002) write:

> "…one question relevant to that issue is how strongly language proficiency influences economic assimilation. If good knowledge of the dominant language increases productivity by a sufficient amount, governments may find it advantageous to provide an appropriate infrastructure for language acquisition to support this process, and to encourage the immigrant population to learn the dominant language. It is therefore important to obtain an accurate estimate of the effect of language on earnings."

Using German data, they find significant effects of acquisition of the German language on the earnings of immigrants. Along similar lines, Meng and Gregory (2005) look at the effect of inter-marriage between immigrants and natives to look for assimilation effects. They find that intermarried immigrants earn significantly higher incomes compared to nonintermarried ones.

They control for other mitigating factors and conclude that this premium derives from better assimilation that intermarriage facilitates.

In the benchmark case in which capital is immobile, the immigration policies of the two host nations *H* and *F* are independent of each other. Each host nation chooses immigration levels that equate the marginal gains for domestic capitalists to the marginal social (or assimilation) costs of immigration. A rise in immigration to nation *j* reduces the capital-to-labor ratio and the wage rate. The loss to native labor is a transfer that accrues to domestic capital, so the transfer makes no difference in terms of national income.[3] As the wage rate falls, however, immigrants are paid less, leading to an effective terms-of-trade gain in the factor market. This gain accrues as higher return for domestic capital, resulting in a net marginal benefit from immigration for a host nation.

In the presence of capital mobility, there are two scenarios. First, capital may be mobile between the host nations but immobile between the host nations and the source nation. This might be due, for example, to significant barriers to international capital mobility in developing nations (like a lack of currency convertibility, restrictions on the participation of foreign holders in equity markets, etc.). The alternative scenario has freely mobile capital between the developed and developing nations. Section 3 of the paper analyzes the first scenario, while section 4 extends it to the second. Some ambiguities do arise in the latter case, but the main thrust of the results from section 3 is unaffected.

When capital is mobile between *H* and *F* only, a rise in the immigration quota by *H* will raise the demand for capital as more of it will be required to complement immigrant labor at the prevailing capital intensity. This will raise the demand for capital in the global capital market and raise its price, leading to two effects. The first is a terms-of-trade benefit from a reduction in payment to immigrants (similar to the immobility case). The second effect comes into play through the capital market. If *H* is a net exporter (importer) of capital, it will gain from a rise (fall) in the rental rate. At the optimal immigration level, the marginal gains from these two effects are equated to the marginal cost of immigration that is external to the firm (say marginal external cost). The relaxation of the immigration quota by *H* affects the other host nation *F* through the effect on the global capital market. Nation *F*'s capitalists gain, prompting *F* to adjust its optimal immigration level. In other words, *H* and *F*'s immigration policies have positive spillover effects on each other. In the Nash equilibrium, immigration levels are too low from a cooperative point of view. Because the positive externalities created by one nation on the other are not internalized in the process of unilateral optimization, there is a coordination failure that is quite similar to the problems that have been noted in the tax competition or multi-country trade taxation literatures.[4]

If the production functions of the two nations are identical, the international rate of return on capital is a function of the joint immigration levels of *H* and *F*. In other words, global immigration becomes a public good. In turn, this means that the marginal benefit of *H* (or *F*) is a function of global immigration and is independent of its location. The marginal external cost is, however, location-specific and, hence, private. The result is a typical free rider equilibrium in which only one nation allows immigration.

The remainder of the paper contains four sections. Section 2 presents the optimal choice of immigration in the absence of capital mobility. Section 3 considers capital mobility between the two host nations. Section 4 discusses the implications for capital mobility between the host and source nations. Section 5 concludes.

2. The Model with Immobile Capital

We present a standard single-good model that is used often to analyze factor mobility.[5] This section analyzes the home nation alone because *H* and *F* are independent in terms of their policy decisions in the absence of capital mobility, and the analysis for *F* simply mirrors that of *H*. Country *H* produces a single good *X* using labor (*L*) and capital (*K*), and a constant returns to scale (CRS) technology:

$$X = X(L, K). \tag{1}$$

Let firms in *H* be perfectly competitive, w be the wage rate of natives, and w_I the wage rate of an immigrant worker.[6] The training (or assimilation) costs internal to the firm bis c_f per immigrant worker, and r is the rental on capital. The first order conditions for profit maximization are:

$$X_1(1,k) = w \Rightarrow w = w(k), k = \frac{K}{L}, \text{and, } w = w_I + c_f. \tag{2}$$

$$X_2 - r = 0 \Rightarrow r = X_2(1,k) \Rightarrow r = r(k). \tag{3}$$

Using CRS properties we get

$$w(k) = X(1,k) - kr(k). \tag{4}$$

Let I be the level of immigration, while $\overline{L}$ and $\overline{K}$ are *H*'s endowments of labor and capital, respectively. Therefore,

$$L = \overline{L} + I \Rightarrow k = \frac{\overline{K}}{\overline{L} + I} \Rightarrow k = k(I), k' < 0. \tag{5}$$

Using (1) through (5) and assuming that the government does not include immigrant income in national income (*NI*), we have the following expression:[7]

$$NI = (\overline{L} + I)X\{1, k(I)\} - (w_I + c_f)I - cI, \tag{6a}$$

where c is the constant marginal assimilation cost of immigrants that is external to the firm. Alternately, (6a) can be written as:

$$NI = (\bar{L} + I)X\{1, k(I)\} - wI - cI \,. \tag{6b}$$

Using (6b), the first-order condition for the maximization of national income (through the choice of an optimal immigration level) is

$$\frac{dNI}{dI} = -I\left(\frac{dw}{dI}\right) - c = Ik\left(\frac{dr}{dI}\right) - c = 0 \Rightarrow Ikr_I = c \text{, where } r_I = \frac{dr}{dI},$$

$$\text{and, } \frac{dw}{dI} = \frac{dw_I}{dI} \tag{7}$$

A marginal increase in *I* reduces *w* (and w_I) and, therefore, the payment to labor. The fall in the wage rate implies a rise in the return on capital. The loss in income for native labor is offset completely by the gains to capital. In addition, domestic capital gains because of the loss in payments to the immigrants, which is a terms-of-trade gain in the factor market and shows up as a net marginal benefit from immigration in (7).[8] At the optimum, this benefit equals the marginal external cost of immigration. Relation (7) defines the optimal immigration level implicitly as

$$I = I(c, \bar{L}, \bar{K}) \,. \tag{8}$$

Using (7) and (8),

$$\frac{dI}{dc} = \frac{1}{SOC} < 0 \Rightarrow \frac{dk}{dc} > 0 \Rightarrow \frac{dr}{dc} < 0 \,, \tag{9a}$$

where SOC<0 is the second-order condition for the optimal immigration problem. Thus, a rise in the marginal external cost of immigration will reduce its level and also reduce the return on capital. Furthermore,

$$\frac{dI}{d\bar{K}} = -\frac{I\left\{r_I\left(\frac{\partial k}{\partial \bar{K}}\right) + k\left(\frac{\partial r_I}{\partial \bar{K}}\right)\right\}}{SOC} > 0 \tag{9b}$$

because, using (3) and (5) and ignoring the third derivative of the production function,

$$\frac{\partial k}{\partial \bar{K}} = \frac{1}{\bar{L}+I} > 0, \text{ and } r_I = -k\frac{X_{22}}{\bar{L}+I} \Rightarrow \frac{\partial r_I}{\partial \bar{K}} = -\frac{X_{22}}{(\bar{L}+I)^2} > 0.$$

Therefore, a rise in the capital endowment will raise the optimal immigration level. Using (3) and (5), notice that

$$r = r\left(\frac{\bar{K}}{\bar{L}+I}\right) \Rightarrow \frac{dr}{d\bar{K}} = X_{22}\frac{dk}{d\bar{K}}. \tag{10a}$$

It can be shown that[9]

$$\frac{dk}{d\bar{K}} = \frac{1-k(dI/d\bar{K})}{\bar{L}+I} < 0 \Rightarrow \frac{dr}{d\bar{K}} > 0. \tag{10b}$$

This finding is interesting because it suggests that in a two-host-country setup, *ceteris-paribus*, the nation having the larger endowment of capital has the higher return on capital. Thus, if *H* is capital-abundant it will have the incentive to import capital. This is counter-intuitive at first glance, but makes sense when one considers the complementarity between immigration and capital.[10] From (9b) we see that a capital-abundant nation will have a higher optimal immigration level, which in turn raises the marginal product of capital and the rate of return on capital.

3. Capital Mobility between Host Nations

This section explores the consequences of capital mobility between *H* and *F* and assumes that *S* is not connected to the global capital market (an assumption that is relaxed in the next section). It is useful to look at the current context for two reasons. The first is the analytical simplicity it offers and therefore the clarity of the results that we can obtain. The second is that for many developing nations capital mobility suffers from several barriers, so the abstraction from universal capital mobility has an element of realism.[11] All F-nation variables are marked by an asterisk.

The capital market equilibrium condition is

$$K + K^* = \bar{K} + \bar{K}^* = \bar{K}^W \Rightarrow (\bar{L} + I)k(r) + (\bar{L}^* + I^*)k^*(r) = \bar{K}^W \Rightarrow r = r(I, I^*), \tag{11}$$

where

$$\frac{\partial r}{\partial I} = r_I = -\frac{k}{(\bar{L} + I)k'(r) + (\bar{L}^* + I^*)k^{*\prime}(r)} > 0$$

because $k'(r) = dk/dr < 0$ and $k^{*\prime} = dk^*/dr < 0$ (since X_{22}<0 and X_{22}^*<0). Similarly,

$$\frac{\partial r}{\partial I^*} = r_{I^*} = -\frac{k^*}{(\bar{L} + I)k'(r) + (\bar{L}^* + I^*)k^{*\prime}(r)} > 0 .$$

Under capital mobility H's national income is

$$NI = (\bar{L} + I)X[1, k\{r(I, I^*)\}] - w[k\{r(I, I^*)\}]I - cI + rK_E , \tag{12}$$

where $K_E = \bar{K} - K = \bar{K} - (\bar{L} + I)k$ is the net exports of capital by H to F. We assume that I and I^* are chosen simultaneously by H and F under the Nash assumption that I^* is given when choosing its optimal I. Assuming an interior solution, national income in H is maximized when

$$(Ik + K_E)r_I - c = 0 . \tag{13a}$$

A rise in immigration raises the return on capital, which benefits H on two counts: As in the previous section, a rise in the rental rate is beneficial because it lowers the wage bill going to the immigrants, an effect measured by the term Ikr_I. In addition, there is a gain (or loss) from capital exports (or imports), which is measured by $K_E r_I$. This occurs through the effect of immigration on the international rental rate. If immigration raises r, it must benefit H's capital in F (i.e., K_E). This occurs because under constant returns to scale, the wage rate in F must fall, benefiting both its capitalists and the foreign capital that was exported by *H*. In equilibrium, the sum of these two effects is balanced against *c*. Relation (13a) defines *H*'s Nash reaction function implicitly:

$$I = I(I^*; c, \bar{K}, \bar{L}). \tag{13b}$$

Analogously, *F*'s first-order condition and Nash reaction function are, respectively,

$$(I^* k^* + K_E^*) r_{I^*} - c^* = 0 \text{ and} \tag{14a}$$

$$I^* = I^*(I; c^*, \bar{K}^*, \bar{L}^*). \tag{14b}$$

Simultaneous solution of (13a) and (14a) yields the Nash equilibrium (I_N, I_N^*). Note that

$$\frac{\partial I}{\partial I^*} = -\frac{\dfrac{\partial^2 NI}{\partial I^* \partial I}}{\dfrac{\partial^2 NI}{\partial I^2}} \Rightarrow sign\left(\frac{\partial I}{\partial I^*}\right) = sign\left(\frac{\partial^2 NI}{\partial I^* \partial I}\right) \text{ and} \tag{15a}$$

$$\frac{\partial I^*}{\partial I} = -\frac{\dfrac{\partial^2 NI^*}{\partial I \partial I^*}}{\dfrac{\partial^2 NI^*}{\partial I^{*2}}} \Rightarrow sign\left(\frac{\partial I^*}{\partial I}\right) = sign\left(\frac{\partial^2 NI^*}{\partial I \partial I^*}\right). \tag{15b}$$

Further, it can be shown that

$$\frac{\partial^2 NI}{\partial I^* \partial I} = (Ik + K_E) r_{II^*} - r_I r_{I^*} \bar{L} k' \text{ and} \tag{16a}$$

$$\frac{\partial^2 NI^*}{\partial I \partial I^*} = (I^* k^* + K_E^*) r_{II^*} - r_I r_{I^*} \bar{L}^* k^{*\prime}. \tag{16b}$$

Using (11), we know that r_I and r_{I^*} are both positive. Thus, because k' and $k^{*\prime}$ are both negative, the second terms on the right-hand sides of (16a) and (16b) are positive. It can be shown that

$$r_{II^*} = r_I r_{I^*} \left(\frac{k'}{k} + \frac{k^{*\prime}}{k^*}\right) < 0. \tag{17}$$

The first-order conditions imply that $(Ik + K_E)$ and $(I^* k^* + K_E^*)$ are both positive. Using (16a), (16b), and (17), it is clear that the slopes of the reaction functions can be positive or negative.

Let us now explore the incentives for H to pre-commit. Using (12) and (14b),

$$NI = NI\{I, I^*(I)\} \Rightarrow \frac{dNI}{dI} = \frac{\partial NI}{\partial I} + \left(\frac{\partial NI}{\partial I^*}\right)\left(\frac{\partial I^*}{\partial I}\right). \tag{18a}$$

Evaluating (18a) at the Nash equilibrium [i.e., where $\partial NI / \partial I = 0$],

$$\frac{dNI}{dI} = \left(\frac{\partial NI}{\partial I^*}\right)\left(\frac{\partial I^*}{\partial I}\right). \tag{18b}$$

It can be shown that

$$\frac{\partial NI}{\partial I^*} = (Ik + K_E) r_{I^*} > 0\,, \tag{19}$$

so, using (18b) and (19), it is clear that at the Nash equilibrium

$$\frac{dNI}{dI} = \left(\frac{\partial NI}{\partial I^*}\right)\left(\frac{\partial I^*}{\partial I}\right) > 0 (< 0) \text{ as } \frac{\partial I^*}{\partial I} > 0 (< 0)\,. \tag{20}$$

From (20), in the Nash equilibrium H has a local incentive to pre-commit to a higher (lower) immigration level if F views I as a strategic complement (substitute) for I^*. Using (16b) and (17), I is a strategic complement for I^* if and only if

$$(I^* k^* + K_E^*)\left(\frac{k'}{k} + \frac{k^{*\prime}}{k^*}\right) > \bar{L}^* k^{*\prime}\,. \tag{21}$$

Finally, it is worth noting that because of positive spillovers, Nash-equilibrium immigration levels are likely to be too low compared to the cooperative levels. Consider, for example, the joint national income of H and F:

$$NI^W(I, I^*) = NI(I, I^*) + NI^*(I, I^*)\,. \tag{22}$$

Partials of the joint national income are

$$\frac{\partial NI^W(I,I^*)}{\partial I} = \frac{\partial NI(I,I^*)}{\partial I} + \frac{\partial NI^*(I,I^*)}{\partial I} \text{ and} \tag{23a}$$

$$\frac{\partial NI^W(I,I^*)}{\partial I^*} = \frac{\partial NI(I,I^*)}{\partial I^*} + \frac{\partial NI^*(I,I^*)}{\partial I^*}. \tag{23b}$$

Evaluated at the Nash equilibrium, these reduce to

$$\frac{\partial NI^W(I,I^*)}{\partial I} = \frac{\partial NI^*(I,I^*)}{\partial I} = (I^*k^* + K_E^*)r_I > 0 \text{ and} \tag{24a}$$

$$\frac{\partial NI^W(I,I^*)}{\partial I^*} = \frac{\partial NI(I,I^*)}{\partial I^*} = (Ik + K_E)r_{I^*} > 0. \tag{24b}$$

From (24a) and (24b), it is clear that, starting from the Nash equilibrium, there is a local incentive to raise both I and I^* to achieve a cooperative equilibrium. Consider (24a), a rise in I will raise the rental r and benefit F's capital to the tune of $(I^*k^* + K_E^*)r_I$. This is a positive externality of H's immigration policy on F, and is not internalized in the unilateral choice of H's national income maximizing immigration level. Consequently from a joint national income maximization perspective, the level of immigration chosen by H is too low. Similar logic applies to (24b), which reflects F's choice of Nash immigration level. Therefore, both nations choose immigration levels that are too low because they ignore the effect of their choice on the other nation. The result is a Nash immigration equilibrium with levels that are too low relative to a cooperative outcome.

Turning our attention to the special case of identical production functions in H and F, (11) can be written as

$$k(r)(\bar{L} + \bar{L}^* + I + I^*) = \bar{K}^W \Rightarrow r = r(I + I^*) \Rightarrow r_I = r_I(I + I^*) = r_{I^*}. \tag{25}$$

For H, the marginal benefit from immigration is

$$MB^H = (Ik + K_E)r_I = [\bar{K} - \bar{L}k\{r(I + I^*)\}]r_I(I + I^*) \Rightarrow MB^H = MB^H(I + I^*). \tag{26a}$$

Similarly, for F,

$$MB^F = [\bar{K}^* - \bar{L}^* k\{r(I + I^*)\}]r_I(I + I^*) \Rightarrow MB^F = MB^F(I + I^*)\,. \tag{26b}$$

In this case we have the possibility of a corner solution. Suppose that H and F have identical marginal external costs of immigration (i.e., $c = c^*$). Also assume that H has larger endowments of both labor and capital compared to F. In this case, H will have an interior solution and F will have a corner solution (i.e., $I^* = 0$) if and only if

$$MB^H > MB^F \Rightarrow \bar{K} - \bar{L}k > \bar{K}^* - \bar{L}^* k \Rightarrow k < \frac{\bar{K} - \bar{K}^*}{\bar{L} - \bar{L}^*}\,. \tag{27}$$

[Figure 1 around here]

This is a Nash equilibrium where the optimal immigration for F is zero.[12] Notice, however, that if F added a unit of immigration at the margin, the sum of the benefit from it for H and F would have exceeded the marginal external cost to F. Thus, we have a free rider problem (as in the case of a public good). Because r is a function of the sum of the two nations' immigration levels, global immigration is a pure pubic good and is underprovided. Figure 1 illustrates this free-riding equilibrium for $c = c^*$. At I_{Nash}, H is at an interior optimum, but F's marginal benefit from immigration is lower than its marginal cost. There is no reason for F to choose a positive immigration level of its own, although the resulting immigration level is sub-optimal from a cooperative perspective.

Notice from (25) that

$$k(r) = \frac{\bar{K}^W}{\bar{L}^W + I^W}\text{, where, } \bar{L}^W = \bar{L} + \bar{L}^*\text{, and, } I^W = I + I^*\,. \tag{28}$$

Using (27) and (28), the condition for $MB^H > MB^F$ boils down to

$$I^W > 2(\bar{K}^*\bar{L} - \bar{K}\bar{L}^*)/(\bar{K} - \bar{K}^*)\,. \tag{29}$$

If global immigration is positive, then a sufficient condition for (29) to be satisfied is

$$\overline{K}^*\overline{L}-\overline{K}\overline{L}^*<0 \Rightarrow \frac{\overline{K}}{\overline{L}}>\frac{\overline{K}^*}{\overline{L}^*}\text{, assuming } \overline{K}>\overline{K}^*. \tag{30}$$

Therefore, (30) suggests that if *H* is larger than *F* in terms of their endowments, then a sufficient condition for *H* to provide for global immigration while *F* free rides is that *H* is capital-abundant relative to *F*. In the general case in which the marginal external costs might differ, *H* will provide immigration and *F* will free ride if and only if

$$MB^H-MB^F>c-c^* \Rightarrow k<\frac{\overline{K}-\overline{K}^*+\dfrac{(c^*-c)}{r_I}}{\overline{L}-\overline{L}^*}. \tag{31}$$

4. Capital Mobility between Host and Source Nations

It is useful to see how capital mobility among *H, F*, and *S* affects our findings. In what follows, all variables are denoted as in the previous sections and the superscript *S* refers to nation *S*. Let the production function in *S* be CRS in labor and capital and be of the following form:

$$X^S=X^S(L^S,K^S)\text{, where, } L^S=\overline{L}^S-(I+I^*) \text{ and } K^S=\overline{K}^S-K_E^S. \tag{32}$$

Using (32) the capital market equilibrium is

$$K+K^*+K^S=\overline{K}+\overline{K}^*+\overline{K}^S=\overline{K}^W \Rightarrow$$

$$(\overline{L}+I)k(r)+(\overline{L}^*+I^*)k^*(r)+\{\overline{L}^S-(I+I^*)\}k^S=\overline{K}^W \Rightarrow r=r(I,I^*). \tag{33}$$

Using (33),

$$r_I=-\frac{k-k^S}{(\overline{L}+I)k'(r)+(\overline{L}^*+I^*)k^{*\prime}(r)+\{\overline{L}^S-(I+I^*)\}k^{S'}}>(or<)0 \text{ as } k>(or<)k^S. \tag{34a}$$

Similarly,

$$r_{I^*} = -\frac{k^* - k^S}{(\overline{L}+I)k'(r) + (\overline{L}^* + I^*)k^{*\prime}(r) + \{\overline{L}^S - (I+I^*)\}k^{S\prime}} > (or <) 0 \text{ as } k^* > (or <) k^S. \quad (34b)$$

From (34a) and (34b), we can see that there is an ambiguity about the effect of a rise in the immigration quotas on the international rate of return on capital. If capital intensity in *S* is higher than that in *H* and *F*, then the effect of the immigration quotas on the return on capital is reversed. It is probably more realistic, however, to concentrate on the case where the developed host nations have a higher capital intensity compared to *S*. In that case, the effect of immigration on *r* is as in the previous analysis, and the thrust of the results is unaffected. Finally, let us note that if the host nations have identical technology, then (33) may be written as

$$k(r)\{\overline{L} + \overline{L}^* + (I + I^*)\} + \{\overline{L}^S - (I + I^*)\}k^S = \overline{K}^W \Rightarrow r = r(I + I^*). \quad (35)$$

Expression (35) is similar to (25) in that the rental function is additive in its arguments. This implies that the public good nature of global immigration obtains even in this case. This results in a free riding and globally sub-optimal immigration equilibrium.

5. Concluding Remarks

This paper considered optimal immigration policy as it pertains to skilled temporary immigrants. Mobility of capital and capital-labor complementarities mean that host countries' policies are interdependent. As a result, market failures associated with externality and public good problems arise when host nations do not coordinate their immigration policies. While our context is somewhat distinct from Zimmermann's (2005) discussion on the coordination problems within the European Union, the analysis should shed light on the European context. For example, it would be interesting to explore potential harmonization of policies toward illegal immigrants. Zimmermann discusses this issue, but we have not seen a formal analysis of it. ■

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[1] The importance of immigration in terms of its impact on the host economy is highlighted in Freeman (2004). He suggests that for several reasons immigration may have more significant effects than trade flows. One reason is the presence of non-traded goods in the product mix. Another is that a large volume of trade occurs between developed nations with similar factor endowments and thereby not contributing to factor price equalization as predicted by neo-classical trade theory. On the other hand, immigration happens more from developing to developed nations, significantly affecting the mix of skilled to unskilled labor in the host nation. This issue is not the focus of this paper, but it does go to show the importance of immigration in framing economic policy.

[2] For example, see Fuess (2003) for a discussion about the favorable sentiment in Japan in the 1990s towards skilled immigration to help the nation regain international competitiveness at a time when Japan was suffering from an economic slump. Also, although the context is different, Zimmermann's (2005) focus on the necessity of EU-wide harmonization of immigration policies (for non-EU source nations) is related. For example, he aptly summarizes the interdependence of immigration polices as follows: "There is a need to harmonize the single-country migration policies across Europe…. An inflow of non-EU labour immigrants in one country may affect the economies in all European Union partner countries through externalities in immigration like illegal flows, forced mobility of the natives, or adjustments through the capital and goods markets."

[3] Note that this is completely consistent with the findings of Borjas (2003), among others, suggesting that immigration has a negative effect on the wages/employment opportunities of native workers. The point of departure here is that we consider the aggregate effect on the nation, and, therefore, a loss to the workers is washed out by a gain to employers. We should also note that, in the presence of complementarities between different types of workers, the effect of immigration on native workers need not be negative. In our model the immigrants and native workers are perfect substitutes as far as the production function goes. If one allows for imperfect substitutability in the production function, then, of course, the negative impact might be mitigated. In a recent contribution, Ottaviano and Peri (2005) take this approach and find large positive effects of immigration on the wages of U.S.-born workers. It is the complementarities between immigrants and natives that drive their findings.

[4] See for example Wilson (1999) for the tax competition issue. Regions set taxes too low in a competition to attract capital. The taxes are too low in the sense that each region ignores the negative (positive) externality of lowering

(raising) taxes on a rival region. If this externality is internalized taxes are higher. In a different context, Panagariya and Schiff (1994), Rodrik (1995), and Bandyopadhyay (1996) note that taxation of primary commodity exports by one exporting nation drives up its price for others. In that sense, there are positive terms-of-trade externalities that are not internalized by Nash taxes. The resulting taxes are sub-optimal.

[5] See for example Ethier (1986), Bond and Chen (1987), etc. for single-good models with a focus on the general equilibrium linkages between the goods and factor markets. Borjas (2001) also uses a one-good model to look at the effects of immigration when there are regional differences in wages. While it is not difficult to use a multi-good, multi-factor model, it complicates the analysis needlessly. Since our focus is on factor mobility, we abstract from that issue.

[6] This formulation allows for the possibility that immigrant workers may earn a different wage compared to natives. If we drop this distinction the qualitative conclusions of the paper do not change.

[7] There is a well-established literature debating whether immigrant incomes should be included in economic analyses of national income. We assume that it is not included in national income. As far as the policy decision regarding immigration goes, this makes sense. This is because *ex-ante*, there is no reason why the government should care about immigrant incomes when it is trying to decide whether to let in another immigrant. At that stage, the immigrant is not yet part of the economy. However, *ex-post*, inclusion or exclusion may both be justified depending on the context.

[8] What is necessary for this marginal benefit to be positive is that the host countries are large in the factor markets, so that immigration can affect factor rewards. This requirement continues to hold in the future sections where we consider capital mobility. However, immigration is not unlimited because there is a positive marginal external cost that society bears.

[9] The proof is available from the authors on request.

[10] This is consistent with Freeman (2004) who writes: "In theory, global capital markets send capital from advanced countries to poor countries…the major importer of foreign capital has been the US, whose stability and technological progress has attracted foreign investment…."

[11] Consider the case of India, which, for a long time had quite closed trade and capital markets. With recent liberalization, that is changing, but there are still a lot of restrictions in the capital market. Foreign equity

participation is limited, currency convertibility in the capital account is pending, and direct foreign investment is carefully monitored. Many other developing nations share such restrictions.

[12] The corner solution in which one country will allow zero immigration in equilibrium is rather implausible and follows from our assumption of constant marginal assimilation costs. If we instead had increasing marginal assimilation costs, we could obtain interior solutions for both host countries. Immigration levels would still be sub-optimal because of the public good aspect of the model.