Temporary Migration Policies and Welfare of the Host and Source Countries: A Game-Theoretic Approach

by

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Abstract

This paper examines the interaction between migration policies of the host and source countries in the context of a model of guest-worker migration. For the host, the objective is to provide low-cost labor for its employers while avoiding illegal immigration. It optimizes over these objectives by setting the time limit of a guest-worker permit. The source country seeks remittance flows and return migration by offering fiscal benefits and other advantages to returnees. Within this framework, we solve for the Nash equilibrium values of the migration policy instruments and compare them with the ones that emerge in a cooperative setting.

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1 Introduction

The wide international wage differentials for labor of similar skill and quality are indicative of the large potential gains that can be enjoyed by the world economy from an increase in the volume of international migration. While the host countries recognize the potential benefits, past experience suggests that international migration does not only involve the import of labor, but a more complex transaction that can potentially result in a transfer of entire extended families from the source to the host country. Given the elaborate welfare state that exists in the advanced countries and various considerations related to the possible negative externalities from hosting permanent unskilled immigrants, many of the labor-importing countries have shown a strong preference for guest-worker programs.[1] The objective of such programs is to address labor-market shortages, while avoiding the unwanted consequences of permanent immigration of unskilled workers.

From the perspective of the source countries, there is also a keen interest in benefiting from international migration. One key benefit is the flow of remittances from emigrants employed abroad. Worker remittances from the advanced to the developing countries are an important source of income and capital for millions of households[2]. For all the developing countries combined, officially recorded flows are significantly in excess of two hundred billion dollars per year. These transfers affect not only the direct recipients, but also other members of the community that transact with them in the same markets.[3] Remittances, however, are more likely to come from temporary migrants who leave their families behind, than from permanent migrants who have weaker ties with the source country. From the perspective of the

[1] Prominent among the high-income countries that recruit temporary foreign workers are the USA, Canada, UK, Germany, Australia, New Zealand, Spain, the Netherlands, Belguim, Ireland, Austria, Poland, Portugal, Cyprus, Israel, Singapore, to name just a few. For a description of temporary foreign-worker programs in the major labor-importing countries, see GAO (2006).

[2] There is a very large literature on remittance flows and how they affect the families left behind and investment in small businesses in the source country. See for example, Adams (1991), Ammasari (2003), Brauwand Rozelle (2003), Durand et al.(1996), Escobar-Patapi and Martinez-Castellanos (1991), Lianos (1997), Lucas (1987), Massey and Parrado (1998), Nega et al.(2004), Penny (1986), Puri and Ritzema (1999), Woodruff and Zenteno (2001).

[3] See Djajić (1986, 1998), Kirwan and Holden (1986), Quibria (1997), and Rivera-Batiz (1986), among others.

policymakers of both the labor-exporting and labor-importing countries, the benefits of migration of low-skilled labor are therefore likely to be higher in a system of temporary rather than permanent migration.

Within this setting, a number of important questions emerge. What are the characteristics of an optimal immigration policy governing inflows of low-skilled temporary foreign workers? What should a source country do to maximize its own welfare, given the immigration policies of the host? How would these policies differ, depending on whether or not both countries cooperate to maximize joint welfare? As temporary migration of low-skilled workers is likely to grow in importance in the decades to come, these and other related questions should be high on the research agenda. Surprisingly, very little theoretical work has been conducted so far on these crucial issues.[4]

The present study attempts to examine some of the characteristics of optimal policies with respect to temporary migration of unskilled workers in the context of a two-country model. In order to keep the analysis simple and tractable, we limit our focus on just a few key aspects of guest-worker migration. One of these is the problem of ensuring that the guest-workers return to their country of origin at the moment their work permit expires. It is often the case that temporary workers wish to convert their status to that of a permanent immigrant. When lawful possibilities are limited or very costly, it is not unusual for them to extend their stay as illegal aliens. This is obviously undesirable from the perspective of the host country, but also from that of the source country. Permanent migrants are less likely to

[4]There is a vast literature on policy issues related to migration of *skilled* workers as well as *illegal immigration* of unskilled workers. Concerning legal migartion of unskilled labor, the literature on the choice between labor and capital mobility does address a range of important policy issues (see Bhagwati and Srinivasan (1983), Calvo and Wellisz (1983), Jones, Coelho and Easton (1986) and other contributions on this topic). More recently, Martin (2003) and Ruhs (2002) analyse various guest-worker programs and offer policy recommendations. Schiff (2007) looks at optimal immigration policy with a focus on the distinctions between permanent migration, guest-worker migration and Mode IV under the GATS. Winters et al (2003) discuss issues related to liberalizing Mode IV, while Hatton (2007) raises the question of whether the potential gains from international migration could be realized through international cooperation along the lines similar to what the WTO has done for trade. Jensen et al (2007) examine the implications of immigration-policy coordination among host countries in a model where immigrants are heterogeneous with respect to their performance in the labor market.

send remittances or contribute to growth and development of their country of origin by bringing back human and physical capital.

Another feature that we focus on are the benefits enjoyed by the employers. The possibility of hiring a guest worker to perform tasks that native workers are not willing to undertake at the going wage is a source of large rents. The longer the foreign worker remains in the host county, however, the greater is the worker's awareness of its labor-market opportunities and compensation structures. To the extent possible, a guest worker can be expected to take advantage of such opportunities and thereby achieve gradual assimilation in terms of earnings in relation to native workers. This reduces the rents enjoyed by the employers, diminishing to some extents the benefits of employing a foreign worker. In addition, the longer a guest worker stays in the host country, the easier it is to transit from temporary to permanent status, whether legal or illegal. This reflects the possibility of acquiring relevant information over time and developing networks in the host country that can serve to reduce the cost of status adjustment.

The authorities of the host and source countries can also influence return-migration decisions. Very tough enforcement policies of the host can guarantee that a vast majority of temporary foreign workers do in fact return at the end of their contract. Tough enforcement measures, however, can absorb a large amount of public resources as well as tarnish a country's international reputation in relation to humanitarian and human-rights issues. Cooperation with the source countries in the form of repatriation agreements, preferential guest-worker arrangements, and other modes of cooperation (related to visas, travel documents, border controls, development cooperation, foreign direct investment, etc.) can also lower the chances that a guest worker would seek to remain in the host country as an illegal alien. Other measures taken by a source country can have a similar effect. Special tax treatment for household goods and capital brought from abroad can go a long way to encourage migrants to return. So can other policies that offer preferential rates of return on repatriated savings and favorable exchange rates when foreign currency is converted into local currency[5]. While these measures impose costs on the

[5] A number of source countries have initiated special programs that provide returnees rates of interest on savings in excess of those available abroad. For example, India and Pakistan have pursued a policy of enabling return migrants to deposit their savings into special foreign currency accounts on which they earn a premium over world financial

treasuries (and hence taxpayers) of the source countries, they can prove to be beneficial in the long run by stimulating development.

Our two-country model, presented in Section 2, tries to capture some of the features noted above. From the perspective of the host country, we focus on one key dimension of a temporary immigration policy which has not been adequately treated in the theoretical literature: Namely, the optimal duration of a guest-worker permit. We also examines the implications of that policy for the source country and the objectives that its authorities may try to achieve. This is followed in Section 3 by an analysis of the interaction between the migration-policy instruments of both countries within a game-theoretic framework. A non-cooperative setting is considered first, where each country tries to maximize its own welfare, given the policy of the other. In Section 4, we examine the possibility of both countries cooperating on migration issues to maximize joint welfare and compare the policies that emerge with those in the absence of cooperation. Section 5 concludes the paper.

2 The Analytic Framework

Consider the host country, H, that allows its employers to import foreign workers temporarily from the source country, S, in order to meet any labor-market shortages that may push the wage paid to native workers above some constant level W^H. The overriding objective of the host country's immigration policy is, therefore, to stabilize the wage enjoyed by the native workers. It achieves this objective by continuously adjusting the number of temporary work permits issued to foreign labor. This leaves open the interesting question of how long should any one guest worker be allowed to stay.

market rates. Puri and Ritzema (1999) report that in 1991, the margin over Eurodollar deposit rates ranged from .75% to 1.62%, depending on the maturity of the deposit. Special accounts, exchange rates, fiscal incentives, and other programs designed to channel remittances into productive investments and small business activities have also emerged in Egypt, Jordan, Bangladesh, Sudan, Turkey, and the Philippines [see Nega *et al* (2004) and Puri and Ritzema (1999)].

Let us assume for simplicity that temporary immigrants are granted non-renewable work permits of the duration τ. As a condition for being granted a permit, they are required to have a job contract from an eligible local employer that sets the initial wage at the level $w_0 < W^H$. The employer, in turn, incurs the cost C for the privilege of being able to hire a guest worker. This cost includes the travel and recruitment expenses as well as any other initial costs of participation in the guest-worker program.[6]

The hiring of low-cost foreign labor generates a rent for an employer. This implies that there is an excess demand for imports of labor. For simplicity, we assume that employers are invited to participate in the program after being chosen at random by the authorities of country H.

As part of their employment contract, migrants are given food and housing by their employers in addition to the starting wage, w_0.[7] Let us assume that the cost of food and housing amounts to K per unit of time and that the entire cash portion of the migrant's wage is saved and repatriated to the source country at the point of return.

The Question of Rents

While their initial, guest-worker wage is set by the authorities at w_0, migrants slowly learn about labor-market opportunities in the host country. They observe that native workers are receiving a considerably higher wage W^H. Over time, therefore, an employer of a guest worker is increasingly in competition with other employers for the services of his migrant worker and the implied rent. We shall assume that this enables migrants to obtain wage increases that bring them closer to the level of earnings of the native workers[8]. More specifically, we assume that the money wage received by a migrant is simply given by

[6] In countries such as Switzerland, Austria, Cyprus, Singapore, Australia, Netherlands, and Germany, employers must pay a fee for the work permits of their foreign workers. See GAO (2006). Although we do not explicitly account for such fees in this paper, they can easily be included in the analysis.

[7] Many of the seasonal guest-worker programs impose the free-housing requirement on the employers. Examples include Canada's Seasonal Agricultural Workers Program, UK's Seasonal Agricultural Workers Scheme, the H-2A program for foreign agricultural workers in the US, as well as similar programs in Germany, France and Switzerland [see Martin (2006)].

[8] See Hillman, Epstein and Weiss (1999) for a more detailed description of a competitive

$$(1) \qquad W^M = inf\{w_0 + \alpha t, W^H - K\}$$

where the constant $\alpha > 0$ reflects the migrant's rate of earnings assimilation and t represents the amount of time since arrival in the host country. It follows that for each migrant worker brought into the host country on a work permit of duration τ, his employer enjoys a rent amounting to the difference between the marginal productivity of labor, which is constant at the level W^H, and the cost of recruiting and transporting (C), housing and feeding (K), and paying (W^M) an immigrant worker. Considering the range of τ for which $W^M < W^H - K$, this rent amounts to

$$(2) \qquad \rho = \int_0^\tau (W^H - K - w_0 - \alpha t)dt - C,$$

which we assume to be positive in the relevant range of analysis.

For a given employment position that is filled by foreign labor over a time horizon of the length T, an employer will have a total of T/τ migrants if each of them is allowed to work in H on a permit of duration τ. The total employer rent, R, per employment position over the interval T is therefore

$$(3) \qquad R = (T/\tau)\{(W^H - K - w_0)\tau - \alpha\tau^2/2 - C\}.$$

Let us suppose that the immigration authorities set τ to maximize R. From eq. (3), the rent-maximizing value of τ is

$$(4) \qquad \tau = \sqrt{2C/\alpha}.$$

mechanism that can generate this type of earnings assimilation of guest workers in relation to the natives. Schiff (2007) makes use of a similar mechanism in his analysis of an optimal immigration policy. Also note that in some countries, the employment contracts contain provisions that require the employer to raise the wage paid to the immigrant every year (e.g., Cyprus). Whether the guest-worker program does or does not allow a worker to change employers, employment-switching often occurs, as it did during the Bracero program [see Martin (2006)], allowing migrants to improve their earnings and working conditions.

Thus the lower the fixed cost of recruiting and transporting foreign labor and the higher the rate of earnings assimilation of guest workers, the shorter the optimal duration of a guest-worker permit if the sole objective of the immigration authorities is to maximize the rents enjoyed by the employers. In reality, the authorities are likely to have a number of additional arguments in their objective function. The following subsection extends the model by assuming that the authorities are also concerned about the possibility that some of the guest workers might become illegal immigrants.

The Possibility of Overstaying

Experience of advanced countries that have had guest-worker programs in the past, shows that temporary migrants do not always return to their country of origin when their work permit expires. Some manage to remain legally in the host country by adjusting their status, while others may stay without authorization. To keep the analysis simple, let us suppose that there are no legal options for overstaying and that the welfare of the host country is negatively affected when a guest worker remains on its territory as an illegal alien. Since the number of guest workers that rotate in a given employment position over a time horizon of the length T is T/τ, the stock of illegal aliens, A, generated per position that is filled by guest workers over that interval is

$$(5) \qquad A = (T/\tau)\pi(\tau),$$

where $\pi(\tau)$ is the probability that any given guest worker will remain in the host country illegally after the expiration of his work permit. We shall assume that the function $\pi(\tau) < 1$ for all τ, is continuously twice differentiable with $\pi'(\tau) > 0$, $\pi''(\tau) \gtrless 0$, and $lim_{\ \tau \to 0}\ \pi(\tau) = 0$. This reflects the notion that guest workers learn over time about the possibilities of successfully remaining in the host country as illegal aliens, while simultaneously developing networks that can help reduce the expected lifetime cost of transiting to illegal alien status. It is therefore more likely that a guest worker stays illegally, the larger the value of τ. The second derivative of $\pi(\tau)$ is likely to be negative in reality, although we shall also devote some attention

to the case of $\pi''(\tau) > 0$ later in the paper[9].

The optimal value of τ

If in addition to the employer rents we introduce the disutility of hosting illegal aliens into the objective function, V, of the host country, we obtain a more general function that the authorities will seek to maximize.

$$(6) \qquad V = R - \lambda A = \frac{T}{\tau}[(w^H - w_0 - K)\tau - \frac{\alpha\tau^2}{2} - C - \lambda\pi(\tau)],$$

where the constant $\lambda > 0$ is the weight attached by the authorities to the cost of hosting an additional illegal immigrant relative to the benefit of generating an additional unit of employer rents through the guest-worker program. Maximizing V with respect to τ yields

$$(7) \qquad \frac{\partial V}{\partial \tau} = 0 \Rightarrow C - \frac{\alpha\tau^2}{2} + \lambda\pi(\tau)[1 - \eta_\tau] = 0$$

where $\eta_\tau = (\partial\pi/\partial\tau)(\tau/\pi) > 0$. We shall assume in what follows that η_τ is constant. Thus, for the case $\pi''(\tau) < 0$, $\eta_\tau < 1$, while for $\pi''(\tau) > 0$, $\eta_\tau > 1$. Eq. (7) provides an implicit solution for the optimal value of τ from the perspective of country H.[10]

When $\eta_\tau = 1$, the optimal τ is exactly the same as if the authorities were simply maximizing employer rents (see eq.(4)). For $\eta_\tau > 1$ any increase in τ generates a proportionately larger increase in $\pi(\tau)$, which implies that a larger number of illegal aliens is generated per employment position filled

[9] Our analysis focuses on employer rents and illegal immigration generated per employment position that is filled by guest workers over any given time horizon. Alternatively, one may wish to consider the consequences of a guest-worker policy designed to meet a labor-market shortage amounting to N units of unskilled labor over a time horizon of the length T. The total number of illegal aliens generated is then given by N{1-[1-$\pi(\tau)$]$^{T/\tau}$} and the total undiscounted rents enjoyed by all the employers participating in the program are N$\rho(\tau)${1-[1-$\pi(\tau)$]$^{T/\tau}$}/$\pi(\tau)$, where ρ is defined in eq.(2). With the use of this specification, the algebra quickly becomes very tedious, without offering much in terms of additional insights. We therefore retain our assumption that the authorities of H are concerned about the employer rents and illegal immigration generated *per employment position* filled by a guest worker.

[10] It can be easily verified with the aid of eqs.(6) and (7) that the second order condition is satisfied.

by a guest worker over any given time horizon.[11] Accordingly, when illegal immigration is a problem for the host country, the immigration authorities have an incentive to reduce the duration of the work permit if $\pi(\tau)$ is elastic with respect to τ. Alternatively, if $\eta_\tau < 1$, an increase in τ reduces the number of illegal immigrants per employment position over a given time horizon. The optimal τ is then larger than its rent-maximizing value.

The Source-Country Perspective

The source country also has a stake when it comes to temporary migration. Let us suppose that it is interested in maximizing the flow of worker remittances from H. Since we assumed that guest workers repatriate at the point of return all of their money income earned abroad, the total amount of repatriated savings per employment position filled by a guest worker in H over T units of time is given by

$$(8) \qquad F = \frac{T}{\tau}[w_0\tau + (\alpha\tau^2/2)][1 - \pi(\tau)],$$

where $[1 - \pi(\tau)]$ is the probability that a guest worker does in fact return to S with accumulated savings at the moment the work permit expires.

The source country obviously does not have the power to set the duration τ of the work permit enjoyed by its citizens in H, but it may have policies available that enhance the probability of return for any given τ. To the extent that such policies come into play, we need to generalize the function $\pi(.)$ to reflect the measures employed by the authorities of S.

As noted in the Introduction, various fiscal benefits and one-time advantages, as well as bureaucratic simplifications have been offered by source countries to induce emigrants to return with accumulated savings. These benefits are costly to the taxpayers. Moreover, they are sometimes seen as contributing to greater income inequality, because they assist returning migrants who are in many cases relatively better off than the average source-country resident. On the other hand, to the extent that such programs

[11] Differentiating eq. (5) with respect to τ we obtain $\partial A/\partial\tau = (\eta_\tau\text{-}1)T\pi(\tau)/\tau^2$. It follows that the number of illegal aliens, A, generated per employment position filled by a guest worker increases with τ when $\eta_\tau > 1$ (i.e., π is elastic with respect to τ) and diminishes with τ when $\eta_\tau < 1$.

attract migrants to come back with their savings, they also attract critically needed capital (and, in a more general setting, human capital) that has a positive effect on job creation, growth and development.

Let us therefore assume that the objective function, V^*, of the policy-makers of S has two arguments: The repatriated savings, F, brought back by the returning migrants, and the cost of fiscal and other benefits, B, offered to returnees, which has a negative weight of λ^*.

$$(9) \qquad V^* = (T/\tau)[w_0\tau + (\alpha\tau^2/2) - \lambda^* B][1 - \pi(\tau, B)],$$

where T/τ is the total number of migrants per employment position in H over a time horizon T. Only a fraction $1 - \pi(\tau, B)$ of them will return, each receiving a package of benefits B, which in addition to τ, affect the probability of return to S. For simplicity, let us assume that $\pi_\tau > 0$, $\pi_B < 0$, $\pi_{\tau\tau} \gtrless 0$, $\pi_{BB} > 0$, and $\pi_{\tau B} = 0$

In our two-country framework of analysis, the policy of H concerning τ has an impact not only on its own welfare, but also on that of country S. Similarly, return-related policies of S, summarized by B, have an impact on the welfare of both countries. This is an environment in which there may be scope for both countries to improve world welfare through international cooperation on issues related to temporary migration. We begin, however, by characterizing a non-cooperative equilibrium, where each country sets the level of its migration-policy instrument to maximize its own welfare, given the policy of the other country.

3 Nash Equilibrium

Maximization of the objective function, V, of the host country with respect to τ yielded eq.(7). We now rewrite this expression to take into account the migration policy of the source country and obtain the reaction function of H.

$$(10) \qquad \frac{\partial V}{\partial \tau} = 0 \Rightarrow \frac{T}{\tau^2}\left[C - \frac{\alpha\tau^2}{2} + \lambda\pi(\tau, B)\,(1-\eta_\tau)\right] = 0, \qquad \text{(RF)}$$

The partial derivatives of (10) with respect to τ and B are given by

$$(11) \qquad V_{\tau\tau} = \frac{T}{\tau^2}\left[\lambda(1-\eta_\tau)\eta_\tau\frac{\pi}{\tau} - \alpha\tau\right] < \ 0.$$

$$(12) \qquad V_{\tau B} = -\frac{T}{\tau^2}\left[\lambda(1-\eta_\tau)\eta_B\frac{1-\pi}{B}\right] \gtrless 0, \qquad \text{as } \eta_\tau \gtrless 1,$$

where $\eta_B = \frac{\partial(1-\pi)}{\partial B}\frac{B}{1-\pi} > 0$ is assumed to be constant and the arguments of the function π have been suppressed for notational simplicity.

With the aid of eqs.(6) and (7), it can be easily shown that $V_{\tau\tau}$ is unambiguously negative regardless of whether η_τ is greater or smaller than unity. This guarantees that the second-order condition for maximization of V with respect to τ is satisfied.

Similarly, S will set B at a value that maximizes its objective function (9)

$$(13) \qquad \frac{\partial V^*}{\partial B} = 0 \Rightarrow \frac{T(1-\pi)}{B\tau}\left[(\tau w_0 + \frac{\alpha\tau^2}{2})\eta_B - \lambda^* B(1+\eta_B)\right] = 0. \qquad \text{(RF}^*\text{)}$$

The partial derivatives of (13) with respect to τ and B are

$$(14) \qquad V^*_{B\tau} = \frac{T(1-\pi)}{B\tau}(w_0 + \alpha\tau)\eta_B > 0,$$

$$(15) \qquad V^*_{BB} = -\frac{T(1-\pi)}{B\tau}\lambda^*(1+\eta_B) < 0,$$

where we used (13) to simplify the expression in (14). With $V^*_{BB} < 0$, the second-order condition for the maximization of V^* with respect to B is satisfied. Eqs.(14) and (15) imply that the slope of the reaction function of S is simply $\frac{dB}{d\tau}|_{V^*_B=0} = (w_0 + \alpha\tau)\eta_B/\lambda^*(1+\eta_B) > 0$. In figures 1a

and 1b, RF* is therefore depicted as a positively sloped schedule, convex to the origin. Similarly, on the basis of (11) and (12), the slope of RF is $\frac{dB}{d\tau}|_{V_\tau=0} = \left[\lambda(1-\eta_\tau)\eta_\tau\frac{\pi}{\tau} - \alpha\tau\right] / \left[\lambda(1-\eta_\tau)\eta_B\frac{1-\pi}{B}\right]$. Since the numerator of this expression is negative [see eq. (11)] RF can be either negatively or positively sloped, depending on whether η_τ is smaller or greater than unity. This is illustrated in figures 1a and 1b, respectively. In the latter case, RF* is shown to be flatter than RF, as required for stability.

Comparative Statics

Total differentiation of the system of equations (10) and (13) yields

$$(17) \qquad \begin{bmatrix} \lambda(1-\eta_\tau)\frac{\pi}{\tau}\eta_\tau - \alpha\tau & -\lambda(1-\eta_\tau)\frac{1-\pi}{B}\eta_B \\ (w_0+\alpha\tau)\eta_B & -\lambda^*(1+\eta_B) \end{bmatrix} \begin{bmatrix} d\tau \\ dB \end{bmatrix} = \begin{bmatrix} \frac{\tau^2}{2}d\alpha - dC - \pi(1-\eta_\tau)d\lambda \\ -\frac{\tau^2}{2}\eta_B d\alpha - \tau\eta_B^* dw_0 + B(1+\eta_B)d\lambda^* \end{bmatrix}$$

where the determinant of the coefficient matrix $\Delta = -(\lambda(1-\eta_\tau)\frac{\pi}{\tau}\eta_\tau - \alpha\tau)\lambda^*(1+\eta_B) + (w_0+\alpha\tau)\eta_B\lambda(1-\eta_\tau)\frac{1-\pi}{B}\eta_B$ is assumed to be positive, as required for stability. It can be easily seen that $\Delta > 0$ for $\eta_\tau < 1$ but it can also be shown to be positive for $\eta_\tau > 1$, provided that $\eta_\tau < \tau^2(\alpha\tau + w_0 - \alpha)/\pi(\alpha\tau^2/2 - C)$.

From (17) we are able to solve for the effects of changes in the exogenous variables, including C, α, w_0, λ, and λ^* on the optimal values of migration policy instruments τ and B in a non-cooperative equilibrium.

Increase in the cost of recruiting and transporting guest workers

If there is an increase in C, the host country prefers a higher value of τ for any given B to economize on the cost of importing labor. This shifts RF to the right, while leaving RF* unaffected in figures 1a and 1b. Thus, an

increase in C results in an unambiguous increase in both τ and B in the new equilibrium. From (17), we obtain

$$(18) \qquad \Delta\frac{d\tau}{dC} = \lambda^*(1+\eta_B) > 0,$$

$$(19) \qquad \Delta\frac{dB}{dC} = (w_0 + \alpha\tau)\eta_B > 0,$$

where the increase in the equilibrium value of B reflects the source country's heightened interest in attracting migrants to return with their accumulated assets, which are greater when country H chooses a larger τ.

Higher rate of earnings assimilation

An increase in α shifts RF to the left in figures 2a and 2b, as more rapid earnings assimilation of guest workers calls for a lower τ at any given B in order to protect employer rents in the host country. At the same time the implied increase in the rate of saving by migrant workers requires that the authorities of S offer a larger B to returnees for any given τ. As a result, the RF* schedule shifts up and to the left. When $\eta_\tau < 1$, it can be shown that the leftward shift of RF is larger than that of RF*, guaranteeing lower values of both τ and B in the new equilibrium.[12] The intuition behind the decline in B following an increase in α is quite simple. There are two conflicting effects on B: A direct one that calls for a higher B, as described above, and an induced one associated with a reduction in τ. A lower τ reduces the amount of accumulated assets that are repatriated by each of the returnees, making it optimal for country S to reduce B. In the case of $\eta < 1$, the induced effect dominates the direct effect so that B is lower in the new Nash equilibrium. This is illustrated in figure 2a as a shift from the initial equilibrium at E_0 to the new one at E_1 and also confirmed by the solutions that emerge from (17).

$$(20) \qquad \Delta\frac{d\tau}{d\alpha} = -\frac{\tau^2}{2}\left[\lambda^*(1+\eta_B) + \lambda\eta_B^2(1-\eta_\tau)\frac{1-\pi}{B}\right] \gtrless 0,$$

[12] The absolute value of the horizontal shift of the RF schedule in response to an increase in α is given by $-\tau^2/2\left[\lambda(1-\eta_\tau)\eta_\tau\frac{\pi}{\tau} - \alpha\tau\right]$, while that of the FR* amounts to $\tau^2/2\left[w_0 + \alpha\tau\right]$. Thus, for $\eta_\tau < 1 + \frac{w_0\tau}{\lambda\eta_\tau\pi}$, the leftward shift of the RF schedule is larger than that of RF*. This is equivalent to the condition that $w_0 > \lambda\left(\eta_\tau - 1\right)\frac{\pi}{\tau}\eta_\tau$.

$$\text{as } \eta_\tau \gtrless 1 + \frac{\lambda^*(1+\eta_B)B}{\lambda(1-\pi)\eta_B^2},$$

$$(21) \qquad \Delta\frac{dB}{d\alpha} = -[\lambda(1-\eta_\tau)\frac{\pi}{\tau}\eta_\tau + w_0]\frac{\tau^2}{2}\eta_B \gtrless 0, \text{ as } w_0 \lessgtr \lambda(\eta_\tau - 1)\frac{\pi}{\tau}\eta_\tau$$

Alternatively, if $\eta_\tau > 1$, the leftward shift of RF may be either larger or smaller than that of RF*, depending on whether w_0 is larger or smaller than $\lambda(\eta_\tau - 1)\frac{\pi}{\tau}\eta_\tau$ (see footnote 12). It follows that for $w_0 > \lambda(\eta_\tau - 1)\frac{\pi}{\tau}\eta_\tau$, both B and τ are once again lower in the new equilibrium, depicted by E_1 in figure 2b. For $w_0 < \lambda(\eta_\tau - 1)\frac{\pi}{\tau}\eta_\tau$, however, the RF* schedule shifts to the left by *more* than RF, giving rise to an increase, rather than a decline in B. The direct effect on B of an increase in α then dominates the induced effect of a reduction in τ. This is illustrated by a new equilibrium at E_2.

Higher initial guest-worker wage

An increase in w_0 results in a higher guest-worker saving rate, which requires S to offer an increase in returnee benefits for any given τ. This shifts the RF* schedule up, while the reaction function of H remains unaffected. In consequence, when $\eta_\tau < 1$ the equilibrium value of B increases and that of τ declines. Alternatively, when $\eta_\tau > 1$ (case depicted in figure 1b) the upward shift of the RF* schedule generates an increase in both B and τ. The intuition behind the opposite direction of change in τ is simple to grasp. With an increase in B, illegal immigration is reduced for any given τ, allowing the host country to pull back on its efforts to combat the problem of unauthorized overstaying. This implies a lower τ when $\eta_\tau < 1$ and a higher τ when $\eta_\tau > 1$. On the basis of (17), we thus have

$$(22) \qquad \Delta\frac{d\tau}{dw_0} = -\tau\eta_B^2\lambda(1-\eta_\tau)\frac{1-\pi}{B} \gtrless 0, \qquad \text{as } \eta_\tau \gtrless 1,$$

$$(23) \qquad \Delta\frac{dB}{dw_0} = -[\lambda(1-\eta_\tau)\frac{\pi}{\tau}\eta_\tau - \alpha\tau]\tau\eta_B > 0.$$

showing an unambiguous increase in B, while τ increases when π is elastic with respect to the length of the work permit and declines when it is inelastic.

Change in preferences of S

An increase in the weight λ^* of fiscal expenditures relative to that of repatriated savings in the objective function of the source country shifts RF* down while leaving RF unaffected. The comparative statics results are therefore the opposite of those reported in the case of an increase in w_0: A rise in λ^* lowers B and either increases or lowers τ, depending on whether η_τ is smaller or larger than unity.

$$(24) \qquad \Delta\frac{d\tau}{d\lambda^*} = B\lambda(1-\eta_\tau)(1+\eta_B)\frac{1-\pi}{B}\eta_B \gtrless 0, \qquad \text{as } \eta_\tau \lessgtr 1,$$

$$(25) \qquad \Delta\frac{dB}{d\lambda^*} = [\lambda(1-\eta_\tau)\frac{\pi}{\tau} - \alpha\tau]B(1+\eta_B) < 0.$$

The result concerning τ reflects the need for the host country to step up its efforts to confront illegal immigration by adjusting τ when the source country lowers the fiscal benefits offered to returnees. A reduction in the stock of illegal immigrants generated per employment position is achieved by increasing τ when $\eta_\tau < 1$ and by lowering τ when $\eta_\tau > 1$.

Change in preferences of H

We finally consider the implications of an increase in the perceived cost of illegal immigration in the host country. With an increase in λ, the host country will try to reduce the number of overstayers over any given time horizon by raising (lowering) τ when $\eta_\tau < 1$ ($\eta_\tau > 1$) for any given B. In the case corresponding to figure 1a, this shifts the RF schedule to the right, while in the case depicted in figure 1b, it shifts it to the left. It follows that both τ and B increase when $\eta_\tau < 1$ and they both decline when $\eta_\tau > 1$.

$$(26) \qquad \Delta\frac{d\tau}{d\lambda} = \pi(1-\eta_\tau)\lambda^*(1+\eta_B) \gtrless 0, \qquad \text{as } \eta_\tau \lessgtr 1,$$

$$(27) \qquad \Delta\frac{dB}{d\lambda} = (w_0+\alpha\tau)\eta_B\pi(1-\eta_\tau) \gtrless 0, \qquad \text{as } \eta_\tau \lessgtr 1.$$

In each case, the change in B reflects the induced effect of policy adjustment in H on the incentive of S to alter the fiscal benefits offered to returnees. The benefits are increased when τ is extended and reduced with a cut in τ.

Our findings can be summarized in the following proposition.

Proposition 1: Assume that country H chooses τ and country S chooses B to maximize, respectively, its own welfare (i.e., Nash behavior).

- The Nash equilibrium level of τ

a) increases with an increase in C;

b) increases with an increase (decrease) in w_0 if $\eta_\tau > 1$ ($\eta_\tau < 1$);

c) increases with an increase (decrease) in λ and λ^* if $\eta_\tau < 1$ ($\eta_\tau > 1$);

d) increases with a decrease in α if $\eta_\tau < 1$ but may decrease if $\eta_\tau > 1$.

- The Nash equilibrium level of B

a) increases with an increase in C, w_0 and with a decrease in λ^*;

b) increases with an increase (decrease) in λ if $\eta_\tau < 1$ ($\eta_\tau > 1$);

c) increases with a decrease in α if $\eta_\tau < 1$ but may decrease if $\eta_\tau > 1$.

For example, if $\eta_\tau < 1$, the Nash equilibrium maximum duration τ of a guest-worker permit increases with an increase in C, λ, λ^*, and with a decrease in ω_0 and α. Under the same condition, the Nash equlibrium benefit B offered to returnees increases with an increase in C, ω_0, λ, λ^* and with a decrease in α.

4 Cooperative Equilibrium

Assume now that both countries are interested in maximizing their joint welfare. That is, the host country chooses the level of τ that maximizes world welfare $W = V + V^*$, while the source country tries to do the same when choosing B. In doing so, the source country sets the value of B such that

$$(28) \qquad W_B = V_B + V_B^* = 0,$$

From eq.(6), and taking into account that π is now a function of both τ and B, we note that the level of welfare of the host country is an increasing function of B.

$$(29) \qquad V_B = -\frac{T}{\tau}\lambda\pi_B > 0.$$

This is because more generous benefits received by returning migrants in S reduce illegal immigration in H. Since V_B is always positive, we conclude on the basis of (28) that at the Nash equilibrium, where $V_B^* = 0$, the value of W_B is also positive. The cooperative level of B, call it B^C, that maximizes the joint level of welfare, is therefore higher than its Nash level, B^N. This can be seen with the help of figure 3. When $B = B^N$, the slope of V^* is zero, while V_B is positive. That means that the slope of W at $B = B^N$ is also positive and the maximum of W is achieved at a higher level of $B = B^C$.

Similarly, the host country chooses the level of τ to maximize its own and the source country's welfare. This requires that

$$(30) \qquad W_\tau = V_\tau + V_\tau^* = 0$$

Differentiating eq.(9) with respect to τ and using the condition that $V_B^* = 0$ at the Nash equilibrium, we get

$$(31) \qquad V_\tau^* = T(1-\pi)\{\frac{\alpha}{2} + \lambda^* \frac{B}{\tau^2}[1 - \frac{\pi\eta_\tau}{(1-\pi)\eta_B}]\}.$$

From eq.(31), we see that a sufficient but not necessary condition for V_τ^* (and thus W_τ) to be positive at the Nash equilibrium is that

$$(32) \qquad (1-\pi)\eta_B > \pi\eta_\tau.$$

If this condition is satisfied, the level of τ that maximizes the joint level of welfare (i.e., the cooperative level of τ) is higher than its Nash value. Condition (32) requires that the ratio of the elasticity of the probability of return with respect to B to the probability of overstaying with respect to τ be higher than $\frac{\pi}{1-\pi}$. The relative magnitudes of these two elasticities is an empirical question which is beyond the scope of the present study. Let us therefore conclude by saying that the cooperative solution for τ is larger, the greater the value of η_B relative to η_τ and the smaller the value of π at the Nash equilibrium. In other words, the greater the effectiveness of B relative to τ in promoting return of guest workers back to the source country, the larger the value of τ in the cooperative equilibrium when compared to Nash. This reflects the tendency of policymakers to rely more heavily on B and less on τ as an instrument aimed at combating illegal immigration in a cooperative setting when the former instrument is relatively more efficient. We summarize our findings in the following proposition.

Proposition 2: Assume that country H chooses τ and country S chooses B to maximize the joint level of welfare (i.e., cooperative behavior).

- The cooperative level of B is higher than the Nash level.

- The cooperative level of τ is higher than the Nash level if $\frac{\eta_B}{\eta_\tau} > \frac{\pi}{1-\pi}$ (sufficient but not necessary).

5 Conclusions

This paper examines the interaction between migration policies of the host and source countries in the context of a model of guest-worker migration. For

the host, the objective is to provide low-cost labor for its employers while also addressing the problem of illegal immigration. It optimizes over these objectives by setting the maximum duration, τ, of a guest-worker permit. As for the source country, we assume that it wants to stimulate the flow of repatriated savings of migrants by offering fiscal benefits and other advantages, B, to returnees. Within this framework, we solve for the Nash equilibrium and analyse the implications of changes in the exogenous variables for the optimal levels of policy instruments of both countries.

The possibility of international cooperation is also examined assuming that the two countries wish to maximize joint welfare. In comparison with the Nash equilibrium, it is found that the fiscal benefits offered to returnees by the source country are unambiguously higher in a cooperative equilibrium. The optimal value of τ in the cooperative equilibrium is also likely to be greater than its Nash level, although a smaller τ cannot be ruled out for certain parameter values. What we can say is that the greater the effectiveness of B relative to τ in encouraging guest workers to return to the source country, the larger the value of τ in a cooperative equilibrium when compared to its Nash level.

The purpose of this paper, however, is not to develop a model that captures all of the key policy considerations related to guest-worker migration from the perspective of the host and source countries. Instead, it is to draw attention to an important policy issue in the area of international migration of low-skilled workers. Immigration policies are often set unilaterally, without adequate consideration given to the interests of the source countries. This has contributed to the rapid growth of illegal immigration and the disorder that it generates in the labor market of the host country as well as in the lives of the migrants. As shown above, it may also result in an inefficient use of policy instruments in both the host and source countries. There is clearly scope for finding superior solutions through international cooperation in those areas where both the sending and receiving countries have key interests. Bilateral agreements on temporary migration of low-skilled labor between Canada and Caribbean states or Spain and Ecuador are steps in the right direction. More are needed. The main objective of this paper is to stimulate interest in and further research on this increasingly important issue.

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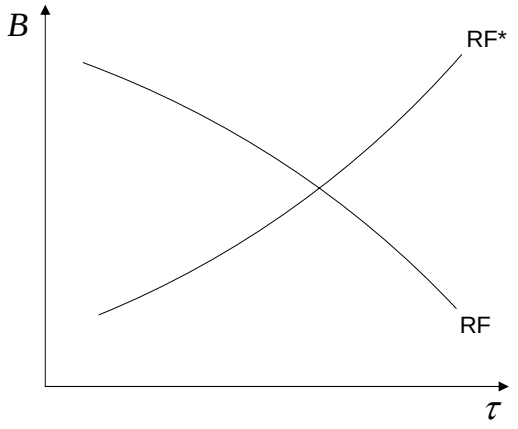

Figure 1a: Nash equilibrium with $\eta_\tau < 1$

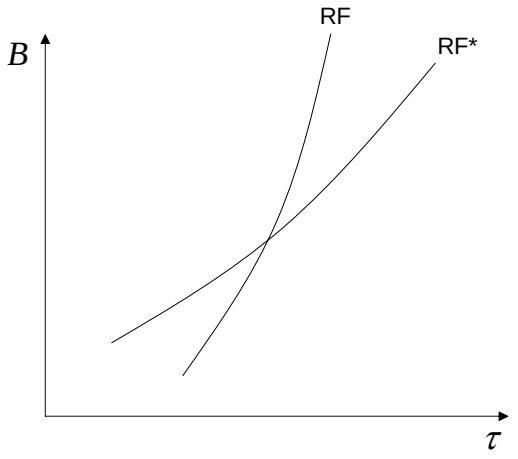

Figure 1b: Nash equilibrium with $\eta_\tau > 1$

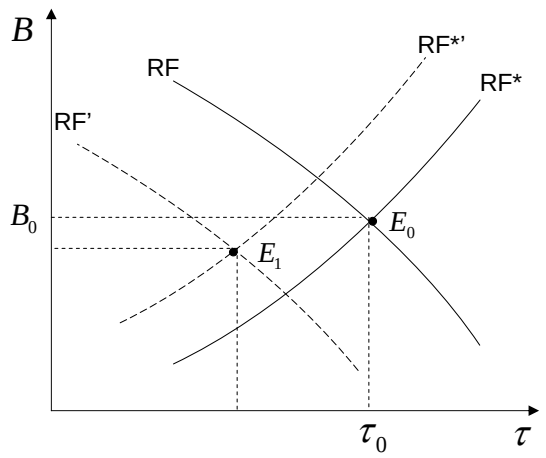

Figure 2a: Effect of an increase in α when $\eta_\tau < 1$

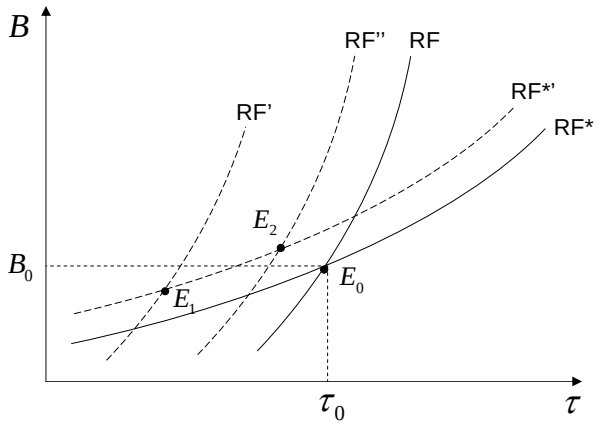

Figure 2b: Effect of an increase in α when $\eta_\tau > 1$

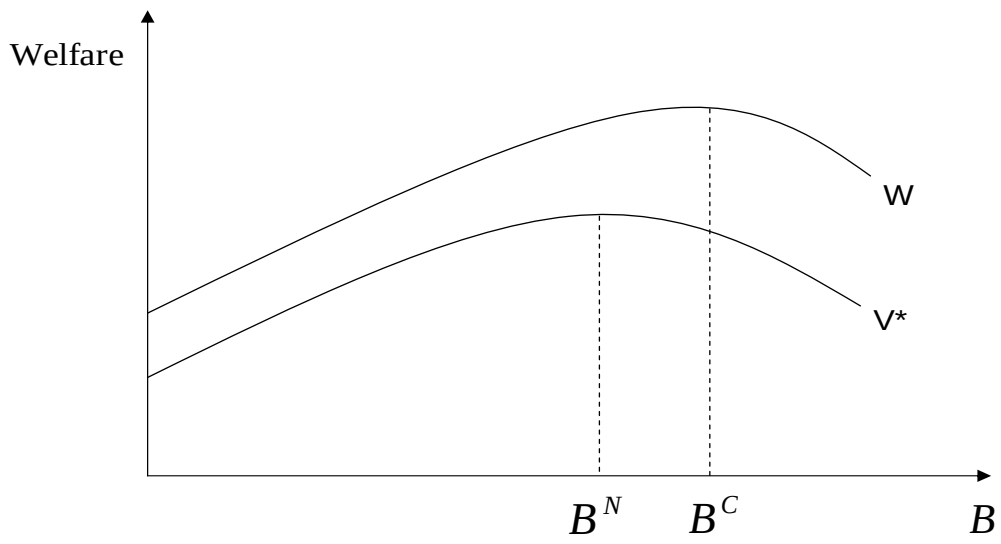

Figure 3: Cooperative and Nash solutions for B