Controlling Illegal Immigration: On the Scope for Cooperation with a Transit Country

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Abstract

We consider the implications of cooperation with respect to immigration control between a final destination country (D) and its poorer neighbor (T). Assuming that the latter serves as a transit country for undocumented immigrants, a key question is how much aid should D provide to T for the purpose of strengthening its immigration controls. The problem for T is to determine what proportion of aid to use strictly for immigration control rather than trying to meet other border-security objectives. We examine the Nash equilibrium values of the policy instruments of both countries and compare them with those which are optimal when international cooperation on immigration-control extends to maximization of joint welfare. We also consider a two-stage game in which D first decides on how much aid to transfer to T, with the latter subsequently choosing how to use it.

1 Introduction

The advanced countries have been rapidly increasing their expenditures on border controls over the last two decades in an effort to address the growing problem of illegal immigration. In the U.S.A., spending on programs to make the country's borders less permeable has expanded rapidly since 1986. As noted by Massey (2007, p.314), the US Border Patrol was devoting eight times more hours to patrolling the border in 2002 than it had in 1986. Over the same period, the agency's budget grew by a factor of ten. A similar upward trend characterizes expenditures on measures to keep undocumented immigrants out of the EU and other advanced countries.

The success of border-control efforts in reducing undocumented inflows depends not only on the actions taken at the border, but also on the internal enforcement policies and practices, as well as the opportunities available to migrants at home and abroad (see Hanson and Spilimbergo (1999)). The vast literature on illegal immigration, starting with the pioneering work of Ethier (1986), illustrates the numerous dimensions and complexity of the problem.[1]

One important element, which has not attracted attention in the literature, is

[1] See, e.g., the works of Auriol and Mesnard (2012), Bandyopadhyay and Bandyopadhyay (1998), Bond and Chen (1987), Borjas et al (1991), Djajić (1987, 1997, 1999), Epstein, Hillman and Weiss (1999), Facchini et al (2006), Friebel and Guriev (2006), Gathmann (2008), Gaytan-Fregoso and Lahiri (2000), Kossoudji (1992), Kossoudji and Cobb-Clark (2002), Orrenius (2001), Rivera-Batiz (1999, 2000), Tamura (2010), Vinogradova (2011), and Woodland and Yoshida (2006). Hanson (2006) provides a very useful survey on illegal immigration between Mexico and the USA.

that the effectiveness of host-country measures to curtail undocumented inflows depends to a significant degree on the policies of its neighbors. Thus the ability of the European Union, for example, to stem the flow of undocumented immigrants is affected by the measures of its North African neighbors aimed at preventing undocumented, third-country nationals from transiting their territory on the way to the EU. Similarly, the ability of the U.S.A. to stem the tide of illegal immigrants depends on the extent to which Mexico is willing and able to control its own borders with respect to inflows of undocumented aliens from other Latin American countries as well as from overseas.[2]

The problem of transit migration and the need for cooperation between transit and final-destination countries is recognized by the policymakers. In the case of Western Europe, the Tunis Declaration in 2001 called for joint management of migration in the region through cooperation between the EU and North African nations. Meetings and consultations between North- and South-Mediterranean countries continued on the island of Malta in February 2003 and in Alexandria, Egypt in June 2003 in an effort to increase the quality and intensity of cooperation on the problem

[2] As noted by Düvell (2010), already in 1994, the International Organization for Migration urged its member states to recognize transit migration as an important phenomenon in relation to irregular and asylum migration. According to the Council of Europe (2008), recent estimates of the number of migrants passing through Libya, Tunisia, Morocco and Mauritania on their way to the EU have risen to at least 100,000 per year. The Mexican National Institute of Migration estimates that some 400,000 people cross Mexico's southern border illegally every year, with 150,000 of them heading for the United States (Gorney (2008)).

of irregular migration across the Mediterranean (Roman (2006)). Cooperation has taken the form of repatriation agreements and projects that enhance border controls in transit countries, usually involving training of personnel and transfers of technical and financial assistance.[3]

In spite of the efforts of policymakers to enhance international cooperation on the problem of undocumented transit migration, the literature on immigration policy does not offer any insights as to what might be the optimal degree of cooperation from the point of view of the final-destination and transit countries, nor does it analyze the role of such cooperation or other forms of policy coordination in reducing the flow of undocumented immigrants. Among the few existing theoretical studies on international cooperation on migration issues, the work of Gaytan-Fregoso and Lahiri (2000) takes an important step of exploring the possibility of using foreign aid as an instrument of immigration control. They examine the effect on illegal immigration of transferring unconditional foreign aid from the destination country to the representative household of the source country. One of the key findings is that such an increase in aid may well raise, rather than reduce, undocumented flows.

[3]The EU has worked to address the problem of transit migration through numerous initiatives over the last two decades, including multilateral and bilateral dialogues and processes such as the EU accession process, the European Neighborhood Policy, the Söderköping Process, the Euro-Mediterranean Partnership, the Barcelona Process, the Mediterranean 5+5 Dialogue, the intergovernmental Dialogue on Transit Migration, the project on Transit and Irregular Migration in Libya and the 2009 agreement between Italy and Libya on joint sea patrols. See Düvall (2010). All of these processes and dialogues offer transit countries various concessions on trade, aid, visa regulations, etc., while exerting pressure on them to clamp down on transit migration.

Similar findings are reported by Bandyopadhyay, Chambers and Munemo (2012) in the context of another model of international trade and illegal immigration. Djajić (2006) also examines the role of foreign aid in reducing migration flows, but in this case aid is conditional on the members of recipient household remaining at home. Myers and Papageorgiou (2000) consider, as well, the possibility of controlling immigration by transferring aid to residents of the source country in the context of a model that studies the implications of illegal immigration for redistributive policies and inequality in the host country. None of these studies, however, looks at the issue of providing aid to a *transit country* in support of its efforts to prevent *third-country nationals* from getting through to the borders of the donor country.

The purpose of this paper is to examine the possibility of using aid as an instrument of immigration control in the context of a two-country model of transit migration. For undocumented migrants from third countries, an advanced country, D, is assumed to be the final destination while its poorer, southern neighbor, T, is the country of transit. Resources that the transit country has available for the purpose of controlling its borders and the interior are assumed to be very limited, resulting in unimpeded flows of undocumented migrants through its territory on the way to D. Ability of D to control its own inflows is assumed to depend on the volume of flows getting through T. This interdependence suggests that cooperation between the two

countries in the form of aid for immigration control can be potentially beneficial to both.

One of the key questions that emerges in this setting is that of determining how much assistance D should offer to T in exchange for taking measures to curb transit migration. From the perspective of T, the problem is to choose the optimal allocation of incoming foreign aid between spending on immigration control, which is primarily of interest to D, and diverting funds to other border-security priorities. Section 2 of the paper defines the problem facing each of the economies and addresses these questions within a game-theoretic framework of analysis. Section 3 studies the implications of changes in the exogenous variables of the model for the Nash-equilibrium values of the policy instruments of both countries. We find that an increase in migration pressures from third countries gives rise to a larger aid flow from D to T, even though this entails a cut in D's spending on the surveillance of its own borders. This is because a surge in illegal immigration increases the effectiveness of aid relative to that of D's own border-control spending in reducing the inflow of illegal aliens, assuming that T prefers not to serve as a host to transit migrants. We also examine the implications of changes in the effectiveness of expenditures on immigration control in both countries, an increase in D's budget for immigration control, and a change in T's perceptions of its welfare loss associated with hosting

transit migrants. Section 4 examines the implications of both countries choosing the policy instruments to maximize joint welfare. In comparison with the Nash-equilibrium values of those instruments, we find that both the flow of aid from D to T and the proportion of aid used strictly for immigration control by T are higher under joint-welfare maximization. Finally, Section 5 summarizes the main findings of the paper.

2 The Model

We describe first the problem facing the transit country in its simplest form. In the following subsection we turn to the advanced, final-destination country.

2.1 Transit Country

Let us assume that T does not have resources to monitor and control entry all along its frontier, but only at official border posts. Nor does it have the capacity to check the status of foreigners on its territory and deport the ones found to be in the process of being smuggled to D. This allows undocumented immigrants to enter and pass through its territory with relative ease. If provided with foreign aid as part of an immigration-control agreement with D, it would be useful for T to spend it on

border and internal controls, not only to help its rich neighbor address the problem of illegal immigration, but also to take steps in achieving its own national security objectives that call for better monitoring and control of its frontiers and territories.

In what follows, reference to border controls should be interpreted in the broad sense of including measures both along the frontier and in the interior of T that serve to deter and prevent transit migrants from getting to the borders of D. With that in mind, the border-control budget of T is, of course, fungible. Equipment, training of personnel, security infrastructure and organization, all have dual uses, making it impossible for D to prevent the authorities of T from diverting a part of the aid flow to meet other border-security objectives rather than strictly using the funds to prevent inflows of undocumented aliens from third countries. T has the possibility, therefore, of choosing the fraction α of the aid flow, F, that is used strictly for immigration control, while diverting the remaining fraction $(1-\alpha)$ to meet other border-security objectives, such as control of tariff evasion activities, arms trafficking, and other trans-national criminal activities.[4] Let us suppose that the diverted resources generate a flow of benefits for T that has the value of $\varepsilon\left((1-\alpha)F\right)$ units of welfare, where $\varepsilon'(.) > 0$ and $\varepsilon''(.) < 0$.

[4]It is interesting to note that on the basis of US data, Gathmann (2008) finds that efforts to curtail drug trafficking and illegal immigration are substitutes, in the sense that an increase in anti drug-trafficking activities tends to divert time and resources away from immigration control. It can be expected that similar considerations play a role in the transit countries.

Welfare of T is also affected by the flow of migrants, L, that *succeeds* in passing through its territory to reach the borders of D. That flow is assumed to depend on N, the number of migrants *attempting* to enter T from third countries, which we take to be exogenous, and the flow of resources, αF, allocated by T for immigration control.[5] We thus have

$$(1) \qquad L = [1 - m(\gamma \alpha F)] N,$$

The fraction of N that is prevented from getting through the territory of T is assumed to be a function $m(\gamma \alpha F)$, where $m'(.) > 0$ and $m''(.) < 0$. The constant $\gamma > 0$ measures the effectiveness of immigration-control spending in deterring and apprehending undocumented immigrants.

The problem for T is thus to choose the value of α that maximizes its welfare V, taking F as given, where

$$(2) \qquad V = \varepsilon((1-\alpha)F) - \lambda[1 - m(\gamma \alpha F)]N,$$

and λ measures the welfare impact on T of allowing an additional migrant to pass through its territory. In principle, the value of λ may be either positive or

[5] Transit migrants passing through Mexico on the way to the US or through Morocco or Turkey on the way to the EU, originate in dozens of different countries. Some are economic migrants looking for a better way of life, others are fleeing from armed conflicts, natural disasters, political oppression, and even family disputes. Modelling explicitly the motives behind their attempts to reach an advanced country or trying to endogenize these flows would take us far from the main topic of this paper, which is on the scope for cooperation between the transit and final-destination countries on the problem of illegal immigration. We therefore treat the number of migrants attempting to transit through T as an exogenous variable.

negative. In countries like Libya, where labor shortages of various degrees existed until 2011, transit migration may have been viewed as desirable at times. It provided local employers with low-cost temporary labor. In other transit countries, such as Morocco, Tunisia, and Mexico, at least on the basis of official pronouncements and legislation, transit migration flows are viewed as undesirable (see Giavitto, 2012). In what follows, we therefore assume that T prefers not to host transit migrants so that $\lambda > 0$.

The optimal choice of α satisfies the following condition.

$$(3) \qquad V_\alpha \equiv \frac{\partial V}{\partial \alpha} = F\left[\lambda\gamma m'(\gamma\alpha F)N - \varepsilon'((1-\alpha)F)\right] = 0,$$

implying that α should be set such that the marginal contribution to welfare of an extra unit of spending on immigration controls is identical to the marginal benefit from diverting aid for other border-security purposes. Note, in addition, that

$$(4) \qquad V_{\alpha\alpha} \equiv \frac{\partial V_\alpha}{\partial \alpha} = F^2[\lambda\gamma^2 m''\left(\gamma\alpha F\right)N + \varepsilon''((1-\alpha)F)] < 0,$$

so that the second order condition is satisfied.

2.2 Final-Destination Country

Let us suppose that the aim of D is to minimize the inflow of undocumented, third-country aliens, given its limited enforcement budget, B, that is available for that

purpose.[6] An amount E^* is spent on controlling its own frontier and the rest is turned over to the transit country in the form of foreign aid, F, as part of an agreement for cooperation on immigration control. The budget constraint facing the authorities of D is therefore given by

$$B = E^* + F. \tag{5}$$

The amount E^*, spent directly on the control of its own borders, helps D deter and prevent entry of undocumented aliens from T. We shall assume that the technology of detection and interdiction of human smuggling activities is such that the proportion of the flow passing through T that can be deterred and prevented from entering D is a function $m^*(\gamma^* E^*)$, where the shift parameter $\gamma^* > 0$ is a measure of the effectiveness of D's spending for the purpose of controlling its own frontier. We assume that $m^{*\prime}(.) > 0$ and $m^{*\prime\prime}(.) < 0$.[7]

[6] Illegal immigration into final-destination countries consists of (1) direct migration of transit-country citizens and (2) indirect migration of third-country nationals transiting through T on their way to D. These are two distinct flows, the analysis of which requires different frameworks. Our focus in this paper is on the latter flow. The problem of direct illegal immigration from a neighboring country has been addressed by the final destination countries with a wide range of policies. Prominent among those with a long-term perspective are steps towards deeper economic integration with their poorer neighbors. Extension of NAFTA to Mexico or the EU expansion and association agreements over the last two decades are examples of such measures. Dealing with illegal immigration of *third-country nationals* by relying on deeper economic integration is perceived by the final destination countries as impractical and it may not even be feasible. They are therefore addressing this problem by enhancing their border enforcement capabilities and strengthening cooperation on illegal immigration with the transit countries.

[7] Hanson and Spilimbergo (1999), Angelucci (2005), and Gathmann (2008) estimate the reduced form causal impact of enforcement along the US-Mexico border and find that enforcement reduces illegal migration. The work of Hanson and Spilimbergo (1999) suggests that a 1% increase in border

The flow of undocumented aliens L^* that gets through to the territory of D is thus given by

$$(6) \qquad L^* = \left[1 - m^*\left(\gamma^* E^*\right)\right] L.$$

The welfare of D is assumed to be decreasing in the magnitude of this flow.[8]

Introducing eqs. (1) and (5) into (6), the problem for D is to minimize L^* or maximize

$$(7) \qquad V^* = -\lambda^*[1 - m^*\left(\gamma^*(B - F)\right)]\left[1 - m\left(\gamma\alpha F\right)\right] N$$

with respect to F, taking α as given, where the constant $\lambda^* > 0$ measures the welfare loss associated with a unit increase in the inflow of illegal immigrants on to its territory.[9] This requires that

enforcement gives rise to at least a 1% increase in apprehension probability. There is, in addition, the deterrent effect of an increase in border patrols, which reduces further the number of migrants arriving at the final destination. Gathmann (2008) finds, however, that the deterrent effect of the US border build-up is rather low.

[8] As noted above, we are ignoring direct migration of country-T nationals to country D, as our focus is on the problem of reducing *transit* migration. In a broader framework, one might argue that the larger the number, L, of transit migrants passing through and possibly working in T, the lower would be the local wage, exerting pressure on country-T nationals to migrate to D. This phenomenon can be captured in our model by replacing L in eq. (6) by $L + \pi(L)$, where $\pi(L)$ is the number of transit-country nationals attempting to migrate to D, with $\pi'(L) > 0$. Modifying our model in this manner would serve to capture the indirect effect of transit migration on direct migration. This extension would make transit-country expenditures on immigration control a relatively more potent instrument from the perspective of country D (see Subsection 3.3 for an analysis of an increase in the effectiveness of immigration control measures in T). Moreover, if transit migrants displace natives in the labor market of country T (as in the state of Chiapas, Mexico), rather than meet shortages in the labor market (as in pre-2011 Libya), transit migration becomes even less desirable for T. In the context of our model, this can be captured by an increase in λ and analyzed along the lines of Subsection 3.2.

[9] If we follow Gathmann (2008) in assuming that λ^* is an increasing function of the number of illegal immigrants entering D, this would not change any of the qualitative findings of the paper.

$$(8) \qquad V_F^* \equiv \frac{\partial V^*}{\partial F} = -\lambda^* N\{\gamma^* m^{*\prime}(\gamma^*(B-F))[1-m(\gamma\alpha F)]$$
$$-\alpha\gamma m'(\gamma\alpha F)[1-m^*(\gamma^*(B-F))]\} = 0,$$

implying that an extra euro (or dollar) spent by D, either on domestic border control or on aid to T, must have the same effect, Z, on the number of illegal immigrants entering its territory:

$$(9) \qquad Z \equiv N\gamma^* m^{*\prime}(.)[1-m(.)] = N\alpha\gamma m'(.)[1-m^*(.)],$$

where arguments of functions are suppressed for notational simplicity.

Turning to the second-order condition for this optimization problem, note that

$$(10)\ V_{FF}^* = \frac{\partial\left(V_F^*\right)}{\partial F} = \lambda^* N\{\alpha^2\gamma^2[1-m^*(.)]m''(.)+\gamma^{*2}[1-m(.)]m^{*\prime\prime}(.)+2\alpha\gamma\gamma^* m'(.)\,m^{*\prime}(.)\}$$
$$= \frac{\lambda^* Z}{F}(2\eta_{L^*} - \theta - \theta^*),$$

where the elasticities $\theta \equiv -\left(\frac{\partial m'(.)}{\partial F}\right)\left(\frac{F}{m'(.)}\right) > 0$ and $\theta^* \equiv \left(\frac{\partial m^{*\prime}(.)}{\partial F}\right)\left(\frac{F}{m^{*\prime}(.)}\right) > 0$, measure the degree of concavity of the functions $m(.)$ and $m^*(.)$, respectively, while η_{L^*} is the elasticity of L^* with respect to F, holding D's expenditures on border controls constant (i.e., $\eta_{L^*} \equiv -\left(\frac{F}{L^*}\right)\left(\frac{\partial L^*}{\partial F}\right)|_{dE^*=0} = \frac{NF\alpha\gamma m'(.)[1-m^*(.)]}{L^*} = \frac{F\alpha\gamma m'(.)}{[1-m(.)]} > 0$). For the second order condition to be satisfied, V_{FF}^* must be negative. This requires that the average degree of concavity of the immigration control functions $m(.)$ and $m^*(.)$ must exceed the elasticity of L^* with respect to F, which we assume to be

the case. Let us take the example of a concave $m(.)$ function of the form $m(.) = \left(X/\bar{X}\right)^{1-\theta}$, where $\theta < 1$ is a measure of the degree of concavity of the function, $X \equiv \gamma\alpha F$, and $\bar{X}$ is some maximum level of effective spending on immigration controls in T that makes it impossible for transit migrants to reach the borders of D. It then follows that $\eta_{L^*} = (1-\theta)\left(X/\bar{X}\right)^{1-\theta}/(1-\left(X/\bar{X}\right)^{1-\theta}) > 0$, which is smaller than θ for any value of $X < \bar{X}\theta^{1/(1-\theta)}$, which we take to be the relevant range of X. We make the analogous assumption with respect to the function $m^*(.)$ so that $\eta_{L^*} < \theta^*$.

3 Nash Equilibrium: Policy Interaction Analysis

Equations (3) and (8) are the reaction functions of T and D, respectively. The simultaneous solution of these two equations determines the Nash-equilibrium level of aid provided by D and the proportion of aid used by T strictly for immigration control. Before analyzing how changes in various exogenous variables affect the Nash-equilibrium, let us examine the slopes of the reaction functions. Starting with the slope of the reaction function of the transit country, TT, we differentiate eq. (3) with respect to aid to obtain

$$(11) \qquad V_{\alpha F} \equiv \frac{\partial V_\alpha}{\partial F} = F[\lambda N\alpha\gamma^2 m''(.) - \varepsilon''(.)(1-\alpha)] = \varepsilon'(.)\left[\eta_\varepsilon - \theta\right],$$

where $\eta_\varepsilon \equiv -\left(\frac{\partial \varepsilon'(.)}{\partial F}\right)\left(\frac{F}{\varepsilon'(.)}\right) > 0$ is a measure of the degree of concavity of $\varepsilon(.)$. A higher F raises V_α (i.e., $V_{\alpha F} > 0$) if the degree of concavity of $\varepsilon(.)$ exceeds that of $m(.)$. In that case, in response to an increase in F, it is optimal for T to allocate a larger proportion of aid for immigration control and divert a smaller proportion to other border-security objectives. This is simply because the marginal benefit of the latter form of spending diminishes relatively more quickly. Since the slope of TT is given by $\frac{d\alpha}{dF}|_{TT} = \frac{-V_{\alpha F}}{V_{\alpha\alpha}}$, in this case TT is positively sloped. Alternatively, if $\eta_\varepsilon < \theta$, TT is negatively sloped.

Differentiating the reaction function of D with respect to α yields

$$(12) \qquad V^*_{F\alpha} = \frac{\partial V^*_F}{\partial \alpha} = \lambda^* \gamma N\{[1 - m^*(.)][\alpha\gamma F m''(.) + m'(.)] + F\gamma^* m'(.)\, m^{*\prime}(.)\}$$

$$\text{or} \qquad V^*_{F\alpha} = \frac{\lambda^* Z}{\alpha}[1 + \eta_{L^*} - \theta] > 0.$$

That $V^*_{F\alpha} > 0$ follows from our assumption that the function $m(.) = \left(X/\bar{X}\right)^{1-\theta}$ is concave (i.e., $\theta < 1$).

The slope of D's reaction function, DD, is given by $\frac{d\alpha}{dF}|_{DD} = \frac{-V^*_{FF}}{V^*_{F\alpha}}$. Noting that $V^*_{FF} < 0$ is required to satisfy the second-order condition with respect to D's choice of F, $\frac{d\alpha}{dF}|_{DD} > 0$. That is, in response to an increase in α, it is optimal for the final destination country to increase F.

To analyze the effects of changes in the various exogenous variables on the Nash

equilibrium value of aid and the proportion of aid that is allocated by T for immigration control, we differentiate the reaction functions of the two countries to obtain

$$(13) \qquad \begin{bmatrix} V_{\alpha\alpha} & V_{\alpha F} \\ \\ V^*_{F\alpha} & V^*_{FF} \end{bmatrix} \begin{bmatrix} d\alpha \\ \\ dF \end{bmatrix} = \begin{bmatrix} -V_{\alpha N}dN - V_{\alpha\lambda}d\lambda - V_{\alpha\gamma}d\gamma \\ \\ -V^*_{F\gamma}d\gamma - V^*_{F\gamma^*}d\gamma^* - V^*_{FB}dB \end{bmatrix},$$

where $\Delta = V_{\alpha\alpha}\ V^*_{FF} - V_{\alpha F}V^*_{F\alpha}$. Stability of the Nash equilibrium requires that $\Delta > 0$. This implies that if the TT schedule is positively sloped, it must be flatter than the DD locus.

The system of equations (13) enables us to solve for the effects of changes in the exogenous variables $N, \lambda, \gamma, \gamma^*$, and B on the Nash-equilibrium values of α and F. Our findings are presented in the following subsections.

3.1 Increase in Migration Pressures

An increase in the number, N, of immigrants from third countries attempting to pass through T has the following implications for the Nash-equilibrium values of α and F.

$$(14) \qquad \Delta\frac{d\alpha}{dN} = -V_{\alpha N}V^*_{FF} > 0,$$

$$(15) \qquad \Delta\frac{dF}{dN} = V_{\alpha N}V^*_{F\alpha} > 0,$$

where $V_{\alpha N} = \lambda\gamma F m'(.) > 0$. A rise in N increases the proportion of aid allocated by T for immigration control, as this becomes a relatively more important priority in comparison with other border-security objectives. The increase in α triggers, in turn, a larger flow of aid from D to T and a corresponding decline in D's expenditure on guarding its own borders in response to the rise in migration pressures. This apparently paradoxical result can be explained by the fact that T's choice of a larger α increases, from the perspective of D, the effectiveness of aid relative to its own border control spending (E^*) in combating illegal immigration. It is therefore optimal for D to raise F at the expense of E^*.

3.2 Increase in λ

An increase in what T perceives to be its welfare cost, λ, of hosting migrants from third countries, as they try to reach D, has the following implications for the Nash-equilibrium values of α and F:

$$\Delta\frac{d\alpha}{d\lambda} = -V_{\alpha\lambda}V^*_{FF} > 0, \tag{16}$$

$$\Delta\frac{dF}{d\lambda} = V_{\alpha\lambda}V^*_{F\alpha} > 0, \tag{17}$$

where $V_{\alpha\lambda} = FN\gamma m'(.) > 0$. An increase in the welfare cost of hosting transit migrants therefore increases the proportion of aid that is spent by T on immigration

control. This triggers a larger flow of aid from D. Thus, as in the previous exercise, greater interest on the part of T in controlling undocumented inflows, increases the effectiveness of the aid program in meeting D's objective, which calls for a higher level of F and lower spending by D on its own border controls.

3.3 Increase in γ

Consider next the implications of an increase in the effectiveness of immigration control spending in T, as measured by γ. This may be due, for example, to improvements in the organizational and command structures or the technology of detection that makes any given amount of spending on immigration control in T more effective in preventing transit migrants from getting through. Using the system of equations (13), we obtain

$$(18) \qquad \Delta \frac{d\alpha}{d\gamma} = V_{\alpha F} V^*_{F\gamma} - V_{\alpha\gamma} V^*_{FF} = \frac{\varepsilon'(.)\lambda^* Z}{\gamma} \left[(\eta_\varepsilon - \theta)\left(1 + \eta_{L^*} - \theta\right) + (1-\theta)(\theta + \theta^* - 2\eta_{L^*}) \right].$$

Note that both $V^*_{F\gamma} = \frac{\lambda^* Z}{\gamma}\left(1 + \eta_{L^*} - \theta\right) > 0$ and $V_{\alpha\gamma} = \lambda F N m'(.)(1-\theta) > 0$, while $V^*_{FF} < 0$. It then follows from (18) that the condition for $V_{\alpha F} > 0$ (i.e., that the degree of concavity of $\varepsilon(.)$ exceeds that of $m(.)$) is sufficient to guarantee that $\frac{d\alpha}{d\gamma} > 0$. On the contrary, if $\eta_\varepsilon < \theta$, it is possible that $\frac{d\alpha}{d\gamma} < 0$.[10]

[10] Consider the extreme case of η_ε=0, such that the marginal benefit of diverting funds to other border-security objectives is a constant. We then have $\frac{d\alpha}{d\gamma} = \frac{\lambda^* Z \varepsilon'(.)}{\gamma}\left[\theta\left(\theta - 1 - \eta_{L^*}\right) + (1-\theta)(\theta + \theta^* - 2\eta_{L^*})\right] = \frac{\lambda^* Z \varepsilon'(.)}{\gamma}\left[\theta^*(1-\theta) + \eta_{L^*}(\theta - 2)\right]$, which

The Nash-equilibrium value of F, however, unambiguously increases.

$$(19) \qquad \Delta \frac{dF}{d\gamma} = V_{\alpha\gamma} V^*_{F\alpha} - V_{\alpha\alpha} V^*_{F\gamma} = \frac{F\varepsilon'(.)\lambda^* Z}{\gamma} \left(1 + \eta_{L^*} - \theta\right) \left[\frac{1}{\alpha} + \frac{\eta_\varepsilon}{1-\alpha}\right] > 0.$$

A rise in the efficiency of expenditures on immigration control in T will thus trigger a larger aid flow from D, although the proportion of aid that is allocated by T to meet immigration-control objectives may possibly decline if the degree of concavity of $\varepsilon(.)$ is sufficiently small.

Proposition 1.

- *An increase in the number of undocumented immigrants attempting to transit T or an increase in T's perceived welfare cost of transit migration, causes an increase in the Nash-equilibrium amount of aid provided by D and the proportion of aid allocated for immigration control by T.*

- *An increase in the effectiveness of T's spending on immigration control increases aid and*

  - *increases the proportion of aid allocated by T for immigration control if* $\eta_\varepsilon > \theta$.

may be either positive or negative, as the first term in the last bracketted expression is positive, while the second term is negative.

– *has an ambiguous effect on the proportion of aid allocated by T for immigration control if* $\eta_{\varepsilon} < \theta$.

3.4 Increase in γ^*

Let us consider next the consequences of an increase in the effectiveness, γ^*, of border-control spending in D. Using the system of eqs. (13), we have the following results:

$$(20) \qquad \Delta \tfrac{d\alpha}{d\gamma^*} = V^*_{F\gamma^*} V_{\alpha F},$$

$$(21) \qquad \Delta \tfrac{dF}{d\gamma^*} = -V^*_{F\gamma^*} V_{\alpha\alpha},$$

where $V^*_{F\gamma^*} = \frac{-\lambda^* Z}{\gamma^*}\left[1 + \frac{E^*}{F}\left(\eta_{L^*} - \theta^*\right)\right]$. If $F/E^* > \theta^* - \eta_{L^*}$, $V^*_{F\gamma^*} < 0$ (i.e., in meeting D's objective of reducing illegal immigration flows, the relative effectiveness of aid declines in comparison with border-control spending in D if there is an increase in γ^*). The possibility of $V^*_{F\gamma^*} > 0$ cannot be ruled out, however, if F/E^* is very small in the initial equilibrium. Thus, as shown in eq. (21), if $V^*_{F\gamma^*}$ is negative (positive), D cuts (expands) its aid transfers to T when the effectiveness of its own border control-spending increases. The reaction of T is to either increase or reduce α in response to a cut (increase) in aid, depending on whether θ is greater or smaller (smaller or greater) than η_{ε}, which determines the sign of $V_{\alpha F}$ in eq. (20).

3.5 Increase in D's Enforcement Budget

An increase in the amount of resources budgeted by D for the purpose of reducing illegal immigration has the following effect on the Nash-equilibrium flow of aid and the proportion of that flow spent by T strictly on immigration control.

$$(22) \qquad \Delta \tfrac{d\alpha}{dB} = V^*_{FB} V_{\alpha F} \gtreqless 0 \text{ as } V_{\alpha F} \gtreqless 0,$$

$$(23) \qquad \Delta \tfrac{dF}{dB} = -V^*_{FB} V_{\alpha\alpha} > 0,$$

where $V^*_{FB} = \frac{\lambda^* Z}{F}(\theta^* - \eta_{L^*}) > 0$. Thus an increase in D's enforcement budget results in an increase in the amount of aid provided to T. The latter may, in turn, either increase or reduce the proportion of aid allocated for immigration control, depending on the relationship between the degree of concavity of $\varepsilon(.)$ relative to that of $m(.)$. If the marginal benefit of diverting aid to meet other border-control objectives diminishes more (less) quickly than that of spending strictly on immigration control, α is higher (lower) in the new equilibrium.

Proposition 2.

- *Assuming that $F/E^* > \theta^* - \eta_{L^*}$, an increase in the effectiveness of D's border-control spending decreases the Nash-equilibrium amount of aid and increases (lowers) the proportion of aid allocated for immigration control by T if η_ε is smaller (larger) than θ.*

- *If $F/E^* < \theta^* - \eta_{L^*}$, an increase in the effectiveness of D's border-control spending increases the Nash-equilibrium amount of aid and increases (lowers) the proportion of aid allocated for immigration control by T if η_ε is larger (smaller) than θ.*

- *An increase in D's enforcement budget increases aid and increases (decreases) the proportion of aid allocated by T to immigration control if η_ε is greater (smaller) than θ.*

4 A Two-Stage Game

The preceding analysis is based on the assumption that both countries set their policy instruments simultaneously. This section considers the case where the process of aid allocation has two stages. In the first stage the donor country decides on the amount of aid it gives to the recipient and in the second stage the recipient decides on how to use the aid. This two stage game works by backward induction. First, we solve for the second stage to determine the share of aid that T spends on immigration control. This is given by equation (3). Next, we solve for the first stage where D decides on the amount of aid it gives to T, taking into account the behavior of the latter. The problem for D is therefore to choose F that maximizes its welfare, anticipating the

reaction of T. The solution requires that

$$(24) \qquad \frac{\partial V^*}{\partial F} + \frac{\partial V^*}{\partial \alpha}\frac{d\alpha}{dF} = 0.$$

Differentiating eq. (7) with respect to α yields $\frac{\partial V^*}{\partial \alpha} = \frac{\lambda^* FZ}{\alpha} > 0$. The value of $(d\alpha/dF)$ is simply the slope of T's reaction function: $\frac{d\alpha}{dF}|_{TT} = \frac{-V_{\alpha F}}{V_{\alpha\alpha}}$. Thus an increase in F induces T to increase (decrease) α if $V_{\alpha F}$ is positive (negative), which is the case if $\eta_\varepsilon > \theta$ ($\eta_\varepsilon < \theta$). The second term in equation (24) is therefore positive if $\eta_\varepsilon > \theta$ and negative otherwise.

Comparing the Nash equilibrium with the equilibrium in a two-stage game, we thus conclude that in the latter case the donor gives more (less) aid to T if $\eta_\varepsilon > (<)$ θ. The intuition is simple. For example, if $\eta_\varepsilon > \theta$, then it is optimal for T to raise α if it receives more aid from D. This behavior is anticipated by D, resulting in more aid being given to T.

Proposition 3. *Assume that D chooses first the magnitude of aid, with T subsequently choosing the proportion of aid that it allocates for immigration control. The amount of aid transferred to T in this two-stage game is higher (lower) if* $\eta_\varepsilon > (<)$ θ *when compared to the Nash equilibrium.*

5 Maximizing Joint Welfare

In this section we consider the possibility of T and D cooperating on the issue of immigration control with the aim of maximizing joint welfare. Country D then chooses F to maximize $V + V^*$. This requires that F satisfies

(25) $\quad V_F + V_F^* = 0.$

Differentiating eq. (2) with respect to aid, we have at the Nash equilibrium

(26) $\quad V_F \equiv \frac{\partial V}{\partial F} = \varepsilon'(.) > 0.$

Noting that $V_F^* = 0$, it follows that the slope of the joint welfare function, $V + V^*$, is positive at the Nash equilibrium value of F. Accordingly, the level of aid that maximizes joint welfare is higher in relation to that which emerges in an equilibrium where the two countries choose F and α non-cooperatively.

Similarly, if T chooses the proportion of aid to be allocated for immigration control so as to maximize joint welfare, α must be such that

(27) $\quad V_\alpha + V_\alpha^* = 0.$

Since $V_\alpha^* = \frac{\lambda^* FZ}{\alpha} > 0$, this implies that the slope of the joint welfare function at the Nash-equilibrium value of α is positive. The proportion of aid spent by T on

immigration control is therefore higher when both countries maximize joint welfare as compared with the case of non-cooperative behavior.

Proposition 3. *Assume that D chooses the magnitude of the aid flow and T chooses the proportion of aid that it allocates for immigration control to maximize joint welfare. The amount of aid transferred to T and the proportion of that aid allocated for immigration control is higher in the case of joint-welfare maximization than it is when both countries behave non-cooperatively.*

6 Conclusions

This paper considers the implications of cooperation between a final-destination (D) and a transit country (T) in their efforts to control illegal immigration. D is assumed to provide aid to T for the purpose of enhancing immigration controls, while T decides how much of this aid to divert for the purpose of meeting other border-security objectives. We solve for the Nash-equilibrium values of the two policy instruments: the flow of aid, F, provided by D to T and the proportion, α, of that flow that T chooses to allocate strictly for the control of illegal immigration. It is found that an expansion of migration pressures from third countries induces T to raise α, while D increases F and cuts down on spending, E^*, for the surveillance of its own borders.

That D cuts E^* in response to an increase in migration pressures reflects the fact that T's tendency to raise α in response to the disturbance makes aid relatively more effective, in comparison with E^*, in terms of reducing the inflow of illegal immigrants into D.

An increase in what T perceives to be its cost of hosting transit migrants raises the Nash-equilibrium values of both α and F. An increase in the effectiveness of expenditures in T on immigration control is found to trigger an increase in the flow of aid from D to T, although the proportion of aid used by T strictly for the purpose of immigration control may not necessarily be higher in the new equilibrium. An increase in the effectiveness of D's own expenditures on border controls entails a cut in the flow of aid to T, while α may either rise or fall. An increase in the amount of resources that D has available to counter illegal immigration results in a larger flow of aid to T, but the proportion of the flow that ends up utilized strictly for immigration control may change in either direction. Finally, if D and T extend their cooperation on border control to the point of agreeing to maximize joint welfare, then the flow of aid, as well as the proportion of it employed by T strictly for immigration control, are higher in comparison with the Nash-equilibrium values.

Our analysis is also extended to an environment in which the donor country first decides on how much aid to give to T, while the latter decides on the optimal use

of aid in the second stage of the game. We find that the optimal amount of aid provided by D to T is larger (smaller) than in the Nash equilibrium if T's marginal benefit of spending on immigration control is less (more) sensitive to a change in expenditure than the marginal benefit of spending for the purpose of meeting other border-security objective.

Our model is admittedly very simple. It nonetheless serves to illustrate for the first time some fundamental aspects of the problem facing final destination and transit countries as they work together in an effort to reduce the flow of illegal immigrants. We hope that this work will stimulate further research on the role of international cooperation in controlling illegal immigration, a problem that is gaining prominence on the policy agendas of an increasingly larger number of countries.

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