

# Illegal Immigration and Fiscal Competition\*

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## Abstract

This paper examines illegal immigration in a spatial context. Consider two countries: a source and a host of illegal immigration. Both countries produce the same good employing labor. There are legal restrictions to the movement of labor across countries. The host country consists of two regions (jurisdictions or states). These two regions share their borders with the source country. The host country controls illegal immigration using two alternative policy instruments: (i) it devotes resources to catch illegal immigrants at the border preventing them from entering the country; and (ii) it can use internal enforcement. Internal and border enforcement may a priori across regions. The paper compares the provision of enforcement, both at the border and internal, chosen by a federal government in the host country to the levels that prevail when each region makes decisions in a decentralized way. Enforcement levels in the decentralized case depart from their efficient levels depending on the effect of two types of externalities. To the extent that targeted regional enforcement reduces the overall pool of illegal immigrants, it would generate an externality on the other region. At the same time, targeted regional enforcement would generate an externality by diverting illegal immigrants from one region to the other.

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# 1 Introduction

This paper examines illegal immigration in a spatial context where regions in a host country strategically determine the levels of illegal immigration enforcement. Recently, several states in the US (Arizona, Alabama, South Carolina) have passed different types of legislation granting state governments a more important role in controlling illegal immigration. There is a big debate going on about the legality of such actions (the Federal Government has been challenging the implementation of such laws). But, regardless of the legal aspects, all this has spurred the discussion about the role of different levels of governments in enforcing immigration laws.

This paper is built on the following assumptions. Consider two countries: a source and a host of illegal immigration. Both countries produce the same good employing labor. There are legal restrictions to the movement of labor across countries. The host country consists of two regions (jurisdictions or states). These two regions share their borders with the source country. The host country controls illegal immigration using two alternative policy instruments. On one hand, the host country can devote resources to catch illegal immigrants at the border preventing them from entering the country. On the other hand, it can choose different levels of internal enforcement to determine if firms employ illegal immigrant workers. If firms are caught employing illegal immigrants, they are subject to penalties and workers are deported. It is assumed that both internal and external enforcement may differ across regions. Illegal workers first decide whether to move to the host country, and next, they decide where (in which region of the host) to locate. Firms operating in each region of the host decide, at the same time, the number of illegal workers to hire.

The paper compares the provision of enforcement, both at the border and internal, chosen by a federal government in the host country to the levels that would be observed when each region makes decisions in a decentralized way. Enforcement levels in the decentralized case depart from their efficient levels depending on the effect of two types of externalities. To the extent that targeted regional border enforcement in the host country reduces the overall pool of illegal immigrants, it would generate a positive externality on

the other region. At the same time, targeted regional internal enforcement would generate a negative externality as it diverts illegal immigrants from one region to the other.

Several papers have addressed the issue of illegal immigration. Ethier (1986) analyzes the the problem of illegal immigration from the host nation perspective in a general equilibrium model of optimal enforcement. The paper assumes that there is target level of illegal immigration which can be sustained with either border or internal enforcement. Bond and Chen (1987) also focus on the host country and examines the effect of allowing capital mobility. Djajic (1987) considers the problem from the source country perspective, and Djajic (1997) examines the resource allocation effects of illegal immigration on the host nation. Bandyopadhyay and Bandyopadhyay (2005) analyzes the effectiveness of enforcement, internal and border, in controlling illegal immigration under both capital mobility and capital immobility. They show that the net enforcement expenditure is higher (lower) in the presence of capital mobility if the host nation is an importer (exporter) of capital at the target immigration level.

Section 2 introduces the model. We consider at this point two alternative institutional settings. First, we assume that the regional governments choose the level of internal enforcement and the federal government decides the level of border enforcement. Second, we assume that the federal government chooses both internal and border enforcement. Then, we compare the results obtained under these two settings.

## 2 The Model

Consider two countries: a source and a host of illegal immigration. Both countries employs labor to produce an homogeneous good.<sup>1</sup> There are legal restrictions to the movement of labor across countries. The host country consists of two regions (jurisdictions or states):  $A$  and  $B$ . These two regions share their borders with the source country. The host country controls illegal immigration using two alternative policy instruments. On one hand, the host country can devote resources to catch illegal immigrants at the border preventing them from entering the country. On the other hand, it can choose different levels of

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<sup>1</sup>As part of the extensions of the model, we will assume that labor and capital are used to produce the goods.

internal enforcement in order to determine if firms employ illegal immigrant workers. If firms are caught employing illegal immigrants, they are subject to penalties and workers are deported. Internal and external enforcement may differ across regions.

Specifically, the model assumes that the probability of detecting an illegal immigrant at the border is  $q^i(c^i)$ , where  $c^i$  is expenditure on enforcement at the border between region  $i$  of the host country and the source country, where  $q^{i'} > 0, q^{i''} < 0, q(0) = 0$ , and  $0 \leq q^i(c^i) \leq 1$  for all  $c^i$ . Concerning internal enforcement, a firm operating in region  $i$  is detected hiring illegal workers with probability  $p^i(e^i)$ , where  $p^{i'} > 0, p^{i''} < 0, p(0) = 0$ , and  $0 \leq p^i(e^i) \leq 1$  for all  $e^i$ . If the firm is caught, it has to pay a penalty of  $z^i$  per illegal worker.

After observing the levels of border and internal enforcement levels, illegal workers first decide whether to move to the host country, and next, they decide where (in which region of the host) to locate. Firms operating in each region of the host decide, at the same time, the number of illegal workers to hire.

## 2.1 Legal residents/workers

There are  $\bar{n}^i$  legal residents in region  $i$ . Individuals derive utility from the consumption of private goods,  $y_L^i$ , and from a publicly provided local good  $g^i$ . Specifically, the utility is given by  $u_L^i = y_L^i + \phi(g^i)$ , with  $\phi' > 0, \phi'' < 0, \phi(0) = 0$ .

## 2.2 Illegal residents/workers

The total number of workers in the source country is  $\bar{n}^*$ .  $M^i$  workers attempt to enter the host country through region  $i$ ; a proportion  $g^i M^i$  are caught at the border with region  $i$ , so only  $(1 - g^i)M^i$  enter the host through that region. Illegal workers that succeed in migrating into region  $i$  can freely move across regions of the host country. The total number of illegal workers in the host country  $\bar{M}$  is

$$\bar{M} = (1 - q^A)M^A + (1 - q^B)M^B. \quad (1)$$

An illegal migrant that works in region  $i$  obtains a utility  $u^i = y^i + \phi(g^i)$ . It is assumed that illegal workers do not pay taxes, so disposable income is equal to the wage received as an illegal worker, i.e.,  $y^i = w^i$ . If the worker stays in the source country, then he is paid the wage at the source country  $w^* \equiv w^*(n^*)$ . The wage depends on the number of workers that remain in the source country  $n^* = \bar{n}^* - \bar{M}$ , with  $w^{*'} < 0$ . The level of the publicly provided good at the source country is fixed and normalized to 0, so the utility of worker in the source country is simply  $u^* = w^*(n^*)$ .

### 2.3 Timing of events

1. The government in the host country decides the level of border enforcement  $c^i$  and internal enforcement  $e^i$ , for  $i = A, B$ .
2. Illegal immigrants decide to enter the county through region  $A$  or region  $B$ . An illegal immigrant entering the country through region  $i$  is stopped at the border and returned to his/her country with probability  $q^i$ .
3. Illegal immigrants present in region  $i$  decide to stay and work in  $i$  or move and work in region  $j$ , with  $i \neq j = A, B$ . A firm in region  $i$  is detected hiring illegal immigrants with probability  $p^i$ . The firm is subject to a penalty of  $z^i$  per illegal worker employed by the firm.

## 3 Complete Discernment Case

In this section, we assume that the firm operating in region  $i$  can distinguish between legal and illegal workers.

### 3.1 Third Stage

A worker from the source country that succeeds in immigrating illegally to region  $i$  of the host country may stay in region  $i$  and work in  $i$ , or move to region  $j$  and work there. The number of illegal workers in region  $i$  is  $m^i = m^{ii} + m^{ji}$ , where  $m^{ii}$  are the illegal workers that entered the country through region  $i$  and stay there, and  $m^{ji}$  those that entered through

region  $j$  and decide to move and work in region  $i$ .

A firm in region  $i$  is detected hiring illegal workers with probability  $p^i(e^i)$ , where  $p^{i'} > 0, p^{i''} < 0, p(0) = 0$ , and  $0 \leq p^i(e^i) \leq 1$  for all  $e^i$ . If the firm is caught, it has to pay a penalty of  $z^i$  per illegal worker.<sup>2</sup> In equilibrium, since legal and illegal residents are perfect substitutes in production,

$$w_L^i = f^{i'}(\bar{n}^i + m^i), \quad (2)$$

$$w^i = w_L^i - p^i(e^i)z^i. \quad (3)$$

Since illegal workers can move across regions of the host country at no cost, in equilibrium their utility should be equalized, i.e.,  $w^A + \phi(g^A) = w^B + \phi(g^B) \equiv u$ . In other words,

$$f^{A'}(\bar{n}^A + m^A) - p^A(e^A)z^A + \phi(g^A) = f^{B'}(\bar{n}^B + m^B) - p^B(e^B)z^B + \phi(g^B), \quad (4)$$

Note that  $\bar{M} = m^A + m^B = (1 - q^A)M^A + (1 - q^B)M^B$ , where  $M^i$  is the number foreign workers that attempt to enter the host country through region  $i = A, B$ , and  $(1 - q^i)M^i$  are those that succeed.

### 3.2 Second Stage

Consider a worker in the source country facing the decision to migrate as an illegal worker. If he migrates, he can enter the host country through region  $A$  or  $B$ . The expected utility of a prospective illegal worker that enters the host country through region  $i$  and

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<sup>2</sup>The firm's profit maximization problem is

$$\max_{\{n^i, m^i\}} \pi = f^i(n^i + m^i) - w_L^i n^i - w^i m^i - p^i z^i m^i.$$

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$$\begin{aligned} m^i : & \quad f^{i'}(n^i + m^i) - w_L^i = 0, \\ n^i : & \quad f^{i'}(n^i + m^i) - w^i - p^i z^i. \end{aligned}$$

This means that:

$$\begin{aligned} w^i &= w_L^i - p^i z^i, \\ &= f^{i'}(n^i + m^i) - p^i z^i. \end{aligned}$$

works in  $j$ , denoted  $u^{ij}$ , is given by

$$u^{ij} \equiv q^i(w^* - k) + (1 - q^i)u^j, \quad (5)$$

where  $w^* = w^*(\bar{n}^* - \bar{M})$ . Since in the third stage  $u^A = u^B \equiv u$ , then  $u^{AA} = u^{AB}$  and  $u^{BA} = u^{BB}$ . Thus, in equilibrium,

$$\max \{q^A(w^* - k) + (1 - q^A)u, q^B(w^* - k) + (1 - q^B)u\} = w^*. \quad (6)$$

In general, the equilibrium values of  $m^A$  and  $M^A$  are implicitly determined by

$$f^{A'} - p^A z^A + \phi(g^A) = f^{B'} - p^B z^B + \phi(g^B) \quad (7)$$

$$\max \{q^A(w^* - k) + (1 - q^A)u, q^B(w^* - k) + (1 - q^B)u\} = w^*. \quad (8)$$

where

$$p^i \equiv p^i(e^i),$$

$$w^* \equiv w^*(\bar{n}^* - \bar{M}),$$

$$f^{A'} \equiv f^{A'}(\bar{n}^A + m^A), \quad f^{B'} \equiv f^{B'}(\bar{n}^B + \bar{M} - m^A), \text{ and}$$

$$\begin{aligned} \bar{M} &= (1 - q^A)M^A + (1 - q^B)M^B \\ &= m^A + m^B. \end{aligned}$$

The system of equations (7) and (8) determine  $m^A \equiv m^A(c^A, c^B, e^A, e^B, g^A, g^B)$ ,  $M^A \equiv M^A(c^A, c^B, e^A, e^B, g^A, g^B)$ .

### 3.3 Equilibria

There are three types of equilibria:

1.  $q = q^A = q^B$ : Illegal immigrants enter the host country through both  $A$  and  $B$ ;
2.  $q^A < q^B$ : Illegal immigrants enter the host country exclusively through  $A$ ;
3.  $q^A > q^B$ : Illegal immigrants enter the host country exclusively through  $B$ .

### 3.3.1 Case 1

Suppose that  $q^A = q^B \equiv q$ . Since in this case

$$q^A(w^* - k) + (1 - q^A)u = q^B(w^* - k) + (1 - q^B)u, \quad (9)$$

then  $M^A = M^B \equiv M$ . The total number of illegal migrants  $\bar{M}$  is determined by

$$w^* = q(w^* - k) + (1 - q)u \Rightarrow w^* = u - \frac{q}{(1 - q)}k. \quad (10)$$

Then, the number of illegal immigrants attempting to enter the host country through region  $i = A, B$  is

$$M = \frac{1}{(1 - q)} \frac{\bar{M}}{2}. \quad (11)$$

### 3.3.2 Case 2

Suppose that  $q^A < q^B$ . Then,

$$w^* = q^A(w^* - k) + (1 - q^A)u > q^B(w^* - k) + (1 - q^B)u, \quad (12)$$

so that  $M^B = 0$ . Note that the equilibrium number of migrants is implicitly defined by

$$w^* = q^A(w^* - k) + (1 - q^A)u \Rightarrow w^* = u - \frac{q^A}{(1 - q^A)}k, \quad (13)$$

and

$$M^A = \frac{\bar{M}}{(1 - q^A)}. \quad (14)$$

### 3.3.3 Case 3

Suppose that  $q^A > q^B$ . Then,

$$w^* = q^B(w^* - k) + (1 - q^B)u > q^A(w^* - k) + (1 - q^A)u, \quad (15)$$



so that  $M^A = 0$ . The equilibrium number of migrants is implicitly defined by

$$w^* = q^B(w^* - k) + (1 - q^B)u \Rightarrow w^* = u - \frac{q^B}{(1 - q^B)}k, \quad (16)$$

and

$$M^B = \frac{\bar{M}}{(1 - q^B)}. \quad (17)$$

## 4 Centralized Border Enforcement and Decentralized Internal Enforcement

In this section, we examine the problem faced by the host country governments, regional and federal. Suppose that while  $\{c^i\}, i = 1, 2$  is determined by the central government authority of the host country,  $\{e^i, g^i\}, i = 1, 2$  are chosen in a decentralized way by the regional governments. The central authority internalizes the fact the minimum of  $\{q^A, q^B\}$  determines the level of illegal immigrants entering the country. When  $q^i > q^j$ , illegal immigrants enter exclusively through region  $j$ , so the amount spent in border protection in region  $i$  becomes ineffective. As a result, to minimize the total costs of providing border protection, the central authority chooses  $c^A = c^B = c$  and  $q^A = q^B = q$ .<sup>3</sup>

The equilibrium values of  $m^A$  and  $M^A$  are defined in this case by

$$f^{A'}(\bar{n}^A + m^A) - p^A(e^A)z^A + \phi(g^A) = f^{B'}(\bar{n}^B + m^B) - p^B(e^B)z^B + \phi(g^B) \quad (18)$$

$$q(c)[w^*(\bar{n}^* - \bar{M}) - k] + [1 - q(c)]u = w^*(\bar{n}^* - \bar{M}). \quad (19)$$

where  $\bar{M} = 2[1 - q(c)]M$ ,  $m^B = \bar{M} - m^A$ , and  $u \equiv f^{i'}(\bar{n}^i + m^i) - p^i(e^i)z^i + \phi(g^i)$ . The system of equations (18) and (19) determine  $m^A \equiv m^A(c, e^A, e^B, g^A, g^B)$ ,  $M^A \equiv M^A(c, e^A, e^B, g^A, g^B)$ .

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<sup>3</sup>This is true when the costs of entering the country through regions  $A$  or  $B$  for the potential migrant are the same.

The appendix shows the derivation of the following comparative static results:

$$\frac{\partial m^A}{\partial e^A} < 0, \frac{\partial M}{\partial e^A} < 0, \frac{\partial m^B}{\partial e^A} = \frac{\partial \bar{M}}{\partial e^A} - \frac{\partial m^A}{\partial e^A} > 0 \Rightarrow \left| \frac{\partial \bar{M}}{\partial e^A} \right| < \left| \frac{\partial m^A}{\partial e^A} \right|, \quad (20)$$

$$\frac{\partial m^A}{\partial g^A} > 0, \frac{\partial M}{\partial g^A} > 0, \frac{\partial m^B}{\partial g^A} = \frac{\partial \bar{M}}{\partial g^A} - \frac{\partial m^A}{\partial g^A} < 0 \Rightarrow \frac{\partial \bar{M}}{\partial g^A} < \frac{\partial m^A}{\partial g^A}, \text{ and} \quad (21)$$

$$\frac{\partial m^A}{\partial c} < 0, \frac{\partial M}{\partial c} \geq 0. \quad (22)$$

Even though the sign of  $\partial M/\partial c$  is undetermined, it is possible to show that  $\partial \bar{M}/\partial c \equiv -2Mq' + 2(1-q)(\partial M/\partial c) < 0$ . Also,

$$\frac{\partial m^B}{\partial c} = \frac{\partial \bar{M}}{\partial c} - \frac{\partial m^A}{\partial c} < 0 \Rightarrow \left| \frac{\partial \bar{M}}{\partial c} \right| > \left| \frac{\partial m^A}{\partial c} \right|. \quad (23)$$

Similar expressions hold for  $e^B$  and  $g^B$ .

Now, consider the determination of  $c^i$ ,  $e^i$ , and  $g^i$  in the first stage. All these policy variables are simultaneously chosen: the regional governments select the levels of  $e^i$  and  $g^i$ , and the central government  $c^i$ . Suppose the regional governments only care about the well-being of legal residents in the region. The central government takes into account the well-being of all legal residents, regardless of where they live.

The utility of a legal resident of region  $i$  is

$$u_L^i = w_L^i + \frac{\pi^i}{\bar{n}^i} - t^i - t + \phi(g^i), \quad (24)$$

where

$$\begin{aligned} T^i &= \sigma^i e^i + (v^i - z^i) p^i m^i + (\bar{n}^i + m^i) \delta^i g^i, & t^i &= T^i / \bar{n}^i, \\ T &= \theta^A c^A + \theta^B c^B, & t &= T / (\bar{n}^A + \bar{n}^B). \end{aligned} \quad (25)$$

The income of a legal resident of region  $i$  is given by the legal wage  $w_L^i$ , and by the share  $1/\bar{n}^i$  of the returns to the fixed factor. A legal resident pays (lump-sum) taxes to the regional government,  $t^i$  and to the central government,  $t$ . Taxes paid to the regional government cover the cost of internal enforcement,  $\sigma^i e^i$ , the cost of deporting immigrants

net of the revenue generated in fees charged to firms that hire illegal immigrants,  $(v^i - z^i)p^i m^i$  (where  $v^i$  is the cost of deporting an illegal immigrant), and the cost of providing the publicly provided regional good,  $\delta^i g^i$ . It is assumed throughout the analysis that the cost of deporting an illegal immigrant is higher than or equal to the fees paid by the firms, i.e,  $v^i \geq z^i$ . The cost of border enforcement,  $\theta^A c^A + \theta^B c^B$ , is shared equally by the country's population,  $\bar{n}^A + \bar{n}^B$ . As a result, a legal resident of the host country pays  $t$  to the central government. Since in this case  $c^A = c^B = c$ , then the total border enforcement cost is  $(\theta^A + \theta^B)c$ . The total utility of legal residents in  $i$  is  $U_L^i = \bar{n}^i u_L^i$ . Then, the regional government's problem is

$$\max_{\{e^i \geq 0, g^i \geq 0\}} U_L^i = f^i(\bar{n}^i + m^i) - f^{i'}(\bar{n}^i + m^i)m^i - T^i - \bar{n}^i t + \bar{n}^i \phi(g^i). \quad (26)$$

taking  $e^j, g^j$  and  $c$  as given. The Kuhn-Tucker conditions are

$$\frac{\partial U_L^i}{\partial e^i} \equiv - [f^{i''} m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial e^i} - [\sigma^i + (v^i - z^i)p^{i'} m^i] \leq 0, \quad (27)$$

$$\frac{\partial U_L^i}{\partial g^i} \equiv - [f^{i''} m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial g^i} + [\bar{n}^i \phi'(g^i) - (\bar{n}^i + m^i)\delta^i] \leq 0, \quad (28)$$

$e^i \geq 0, e^i (\partial U_L^i / \partial e^i) = 0$  and  $g^i \geq 0, g^i (\partial U_L^i / \partial g^i) = 0$ . These two conditions determine  $e^i \equiv e^i(e^j, g^j, c)$  and  $g^i \equiv g^i(e^j, g^j, c)$  for  $i \neq j = 1, 2$ .

Consider the central government's problem. Suppose the central government cares about the well-being of all legal residents, regardless of the region of residence. Then, the problem is

$$\begin{aligned} \max_{\{c \geq 0\}} U &= U_L^A + U_L^B \\ &= f^A(\bar{n}^A + m^A) - f^{A'}(\bar{n}^A + m^A)m^A - T^A - \bar{n}^A t + \bar{n}^A \phi(g^A) \\ &\quad + f^B(\bar{n}^B + m^B) - f^{B'}(\bar{n}^B + m^B)m^B - T^B - \bar{n}^B t + \bar{n}^B \phi(g^B). \end{aligned} \quad (29)$$

When choosing  $c$ , the central government takes  $e^A, e^B, g^A$ , and  $g^B$  as given. The solution

is given by

$$\begin{aligned}
\frac{\partial U}{\partial c} &\equiv \frac{\partial U_L^A}{\partial c} + \frac{\partial U_L^B}{\partial c} = 0 \\
&\equiv -[f^{A''}m^A + (v^A - z^A)p^A + \delta^A g^A] \frac{\partial m^A}{\partial c} \\
&\quad - [f^{B''}m^B + (v^B - z^B)p^B + \delta^B g^B] \frac{\partial m^B}{\partial c} - (\theta^A + \theta^B) \leq 0, \tag{30}
\end{aligned}$$

and  $c \geq 0, c(\partial U_L/\partial c) = 0$ . Equation (30) determines  $c \equiv c(e^i, g^i, e^j, g^j)$ .

The Nash Equilibrium at this stage is denoted  $\{\{e_E^A, g_E^A\}, \{e_E^B, g_E^B\}, \{c_E\}\}$ . At a symmetric (interior) equilibrium, i.e., at an equilibrium where all parameters and functions are the same for both regions, and  $e_E^A = e_E^B > 0, g_E^A = g_E^B > 0$ , and  $c_E > 0$ , the equilibrium conditions are

$$- [f^{i''}m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial e^i} = [\sigma^i + (v^i - z^i)p^{i'}m^i], i = 1, 2, \tag{31}$$

$$- [f^{i''}m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial g^i} = - [\bar{n}^i \phi'(g^i) - (\bar{n}^i + m^i)\delta^i], i = 1, 2, \tag{32}$$

$$- [f^{i''}m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial \bar{M}}{\partial c} = \theta^A + \theta^B. \tag{33}$$

## 5 Centralized Border and Internal Enforcement

In this case, the central government chooses the levels of  $e^i, g^i, i = 1, 2$ , and  $c$  that maximizes

$$\begin{aligned}
U &= U_L^A + U_L^B \\
&= f^A(\bar{n}^A + m^A) - f^{A'}(\bar{n}^A + m^A)m^A - T^A + \bar{n}^A \phi(g^A) \\
&\quad + f^B(\bar{n}^B + m^B) - f^{B'}(\bar{n}^B + m^B)m^B - T^B + \bar{n}^B \phi(g^B). \tag{34}
\end{aligned}$$

subject to the non-negativity constraints. The Kuhn-Tucker conditions are

$$\begin{aligned}
\frac{\partial U}{\partial e^i} &\equiv \frac{\partial U_L^i}{\partial e^i} + \frac{\partial U_L^j}{\partial e^i} \leq 0 \\
&= -[f^{A''}m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial e^i} - [\sigma^i + (v^i - z^i)p^{i'}m^i] \\
&\quad - [f^{j''}m^j + (v^j - z^j)p^j + \delta^j g^j] \frac{\partial m^j}{\partial e^i} \leq 0, \quad i \neq j = 1, 2,
\end{aligned} \tag{35}$$

$$\begin{aligned}
\frac{\partial U}{\partial g^i} &\equiv \frac{\partial U_L^i}{\partial e^i} + \frac{\partial U_L^j}{\partial e^i} \leq 0, \\
&= -[f^{A''}m^i + (v^i - z^i)p^i + \delta^i g^i] \frac{\partial m^i}{\partial g^i} + [\bar{n}^i \phi'(g^i) - (\bar{n}^i + m^i)\delta^i] \\
&\quad - [f^{j''}m^j + (v^j - z^j)p^j + \delta^j g^j] \frac{\partial m^j}{\partial g^i} \leq 0, \quad i \neq j = 1, 2,
\end{aligned} \tag{36}$$

$$\begin{aligned}
\frac{\partial U}{\partial c} &\equiv \frac{\partial U_L^A}{\partial c} + \frac{\partial U_L^B}{\partial c} \leq 0 \\
&\equiv -[f^{A''}m^A + (v^A - z^A)p^A + \delta^A g^A] \frac{\partial m^A}{\partial c} \\
&\quad - [f^{B''}m^B + (v^B - z^B)p^B + \delta^B g^B] \frac{\partial m^B}{\partial c} - (\theta^A + \theta^B) \leq 0,
\end{aligned} \tag{37}$$

and the respective non-negativity and complementarity constraints. The solution is denoted  $\{\{e_O^A, g_O^A\}, \{e_O^B, g_O^B\}, \{c_O\}\}$ .

At a symmetric (interior) equilibrium, the equations can be written

$$- [f^{A''}m^A + (v^A - z^A)p^A + \delta^A g^A] \frac{\partial \bar{M}}{\partial e^A} = \sigma^A + (v^A - z^A)p^{A'}m^A, \tag{38}$$

$$- [f^{A''}m^A + (v^A - z^A)p^A + \delta^A g^A] \frac{\partial \bar{M}}{\partial g^A} = - [\bar{n}^A \phi'(g^A) - (\bar{n}^A + m^A)\delta^A], \tag{39}$$

$$- [f^{A''}m^A + (v^A - z^A)p^A + \delta^A g^A] \frac{\partial \bar{M}}{\partial c} = \theta^A + \theta^B, \tag{40}$$

where  $\partial \bar{M} / \partial e^A < 0$ ,  $\partial \bar{M} / \partial g^A > 0$ , and  $\partial \bar{M} / \partial c < 0$ .

## 6 Comparing the Solutions

Evaluating the centralized solution at the values of  $e^i, g^i$  determined in a decentralized way gives

$$\frac{\partial U_L^j}{\partial e^i} \equiv - [f^{j''} m^j + (v^j - z^j) p^j + \delta^j g^j] \frac{\partial m^j}{\partial e^i} < 0, \quad (41)$$

$$\frac{\partial U_L^j}{\partial g^i} \equiv - [f^{j''} m^j + (v^j - z^j) p^j + \delta^j g^j] \frac{\partial m^j}{\partial g^i} > 0, \quad (42)$$

since  $\partial U_L^i / \partial e^i = \partial U_L^i / \partial g^i = 0$ .

**Proposition 1.** *Relative to the centralized solution,  $e^i$  is overprovided, and  $g^i$  is underprovided in the decentralized case. As a result,  $m^i, M$ , and consequently,  $\bar{M}$ , will be lower than their respective optimal levels.*

In other words, the proposition states that  $e_E^i > e_O^i$ , and  $g_E^i < g_O^i$ . Combining these results and

$$\begin{aligned} \partial m^i / \partial e^i < 0, \partial M / \partial e^i < 0, \partial \bar{M} / \partial e^i < 0, \\ \partial m^i / \partial g^i > 0, \partial M / \partial g^i > 0, \partial \bar{M} / \partial g^i > 0, \end{aligned}$$

it becomes clear that the levels of  $m^i, M$ , and  $\bar{M}$  are unambiguously lower when  $e^i$  and  $g^i$  are decided by the regional governments. As a result, relative to the centralized solution, the levels of  $m^i, M$ , and  $\bar{M}$  are “inefficiently” low.

Now, what about the levels of  $c_E$  and  $c_O$ ? Since  $\partial m^i / \partial c < 0$  and  $\partial \bar{M} / \partial c < 0$ , and in order to compensate for the “inefficient” levels of  $e^i$  and  $g^i$ , border enforcement in the decentralized case has to be lower than the corresponding level of enforcement in the centralized solution, i.e.,  $c_E < c_O$ .

**Proposition 2.** *The level of border protection chosen by the central authority when  $e^i$  and  $g^i$  are determined in a decentralized way,  $c_E$ , is lower than the corresponding level of border enforcement when  $e^i, g^i$  and  $c$  are jointly decided by the central government,  $c_O$ .*

## 7 Numerical Example

In this section, we construct a numerical example to illustrate the conclusions of the theoretical model.

## 8 Conclusions and Extensions

Many states in the USA have recently passed laws that would grant state governments the authority to enforce illegal immigration policies. This paper investigates the economic impact of such initiatives using a theoretical model of border and internal enforcement of illegal immigration. We compare the levels of these two types of enforcement under two institutional arrangements: (i) regional governments choose internal enforcement and the national government chooses the level of border enforcement; and (ii) the federal government chooses both border and internal enforcement.

The paper shows that when internal enforcement is decided in a decentralized way, it tends to be overprovided. As a result, the level of illegal immigration is lower than the “optimal” one. In order to compensate for this, the federal government implements a lower level of border enforcement.

### 8.1 Extensions

The paper will include the following extensions.

1. Factors of production:
  - (a) Skilled/unskilled labor. Host country: unskilled immobile, skilled mobile.
  - (b) Capital: perfect capital mobility across regions of host, and/or across countries.
2. Moving costs:
  - (a) Costly mobility between regions  $i$  and  $j$ .
  - (b) Same entry costs by region.

- (c) Entry costs may depend on the actual number of illegal immigrants entering through region  $i$ ,  $c(M^i)$ ; the costs of moving to the other region may depend on the number of illegal immigrants that decide to work in the other region,  $c(m^i)$ .
3. Decentralized determination of  $c^i$ .
  4. Top up or opt out: central government provides a certain level of enforcement; regional governments may top up or opt out.
  5. Central government sets  $c^i$  uniformly. What are the regional governments' reactions?
  6. Political equilibrium? Who benefits/loses with the policies?



## A Comparative Static Results

$$F \equiv f^{A'} - p^A z^A + \phi(g^A) - f^{B'} + p^B z^B - \phi(g^B), \quad (43)$$

$$G \equiv w^* - [w^A + \phi(g^A)] + \frac{q}{(1-q)} k. \quad (44)$$

$$\begin{aligned} F_{m^A} &\equiv f^{A''} + f^{B''} & F_M &\equiv -2(1-q)f^{B''} \\ G_{m^A} &\equiv -f^{A''} & G_M &\equiv -2(1-q)w^{*'} \end{aligned} \quad (45)$$

$$|H| = \begin{vmatrix} F_{m^A} & F_M \\ G_{m^A} & G_M \end{vmatrix} = -2(1-q) [(f^{A''} + f^{B''})w^{*'} + f^{A''}f^{B''}] < 0. \quad (46)$$

$$\begin{aligned} F_{e^A} &\equiv -p^{A'} z^A & G_{e^A} &\equiv p^{A'} z^A \\ F_{g^A} &\equiv \phi'(g^A) & G_{g^A} &\equiv -\phi'(g^A) \\ F_c &\equiv 2Mq'f^{B''} & G_c &\equiv kq'/(1-q)^2 \end{aligned} \quad (47)$$

### A.1 With respect to $e^A$ :

$$\frac{\partial m^A}{\partial e^A} = \frac{-1}{|H|} 2(1-q)p^{A'} z^A (w^{*'} + f^{B''}) < 0, \quad (48)$$

$$\frac{\partial M}{\partial e^A} = \frac{-1}{|H|} p^{A'} z^A f^{B''} < 0. \quad (49)$$

Note that

$$\frac{\partial \bar{M}}{\partial e^A} = 2(1-q) \frac{\partial M}{\partial e^A} = \frac{-1}{|H|} 2(1-q)p^{A'} z^A f^{B''} > 0, \quad (50)$$

which means that

$$\frac{\partial m^A}{\partial e^A} = \frac{-1}{|H|} 2(1-q)p^{A'} z^A w^{*'} + \frac{\partial \bar{M}}{\partial e^A}, \quad (51)$$

or

$$\frac{\partial m^B}{\partial e^A} \equiv \frac{\partial \bar{M}}{\partial e^A} - \frac{\partial m^A}{\partial e^A} = \frac{1}{|H|} 2(1-q)p^{A'} z^A w^{*'} > 0. \quad (52)$$

Consequently,

$$\left| \frac{\partial \bar{M}}{\partial e^A} \right| < \left| \frac{\partial m^A}{\partial e^A} \right|. \quad (53)$$

**A.2 With respect to  $g^A$ :**

$$\frac{\partial m^A}{\partial g^A} = \frac{1}{|H|} 2(1-q)\phi'(w^{*'} + f^{B''}) > 0, \quad (54)$$

$$\frac{\partial M}{\partial g^A} = \frac{1}{|H|} \phi' f^{B''} > 0. \quad (55)$$

Note that

$$\frac{\partial m^B}{\partial g^A} \equiv \frac{\partial \bar{M}}{\partial g^A} - \frac{\partial m^A}{\partial g^A} = \frac{-1}{|H|} 2(1-q)\phi' w^{*'} < 0, \quad (56)$$

which means that

$$\frac{\partial \bar{M}}{\partial g^A} < \frac{\partial m^A}{\partial g^A}. \quad (57)$$

**A.3 With respect to  $c$ :**

$$\frac{\partial m^A}{\partial c} \equiv \frac{1}{|H|} 2(1-q)q' f^{B''} \left[ 2Mw^{*'} - \frac{k}{(1-q)^2} \right] < 0, \quad (58)$$

$$\frac{\partial M}{\partial c} \equiv \frac{-1}{|H|} \left[ (f^{A''} + f^{B''}) \frac{q'k}{(1-q)^2} + 2Mq' f^{A''} f^{B''} \right] \geq 0. \quad (59)$$

$$(60)$$

Note that even though the sign of  $\partial M/\partial c$  is undetermined, it is possible to unambiguously sign  $\partial \bar{M}/\partial c$ :

$$\begin{aligned}\frac{\partial \bar{M}}{\partial c} &\equiv -2Mq' + 2(1-q)\frac{\partial M}{\partial c} \\ &\equiv \frac{1}{|H|}(f^{A''} + f^{B''})q' \left[ 2Mw^{*'} - \frac{k}{(1-q)^2} \right] < 0.\end{aligned}\quad (61)$$

Also,

$$\frac{\partial m^B}{\partial c} \equiv \frac{\partial \bar{M}}{\partial c} - \frac{\partial m^A}{\partial c} = \frac{1}{|H|}2(1-q)f^{A''}q' \left[ 2Mw^{*'} - \frac{k}{(1-q)^2} \right] < 0,\quad (62)$$

which means that

$$\left| \frac{\partial \bar{M}}{\partial c} \right| > \left| \frac{\partial m^A}{\partial c} \right|.\quad (63)$$

## References

- Bandyopadhyay, Subhayu and Sudeshna Bandyopadhyay, 2006, The Role of Capital Mobility in Illegal Immigration Policy, *Journal of International Trade and Economic Development*, 15(2), 173-89.
- Bond, E. W. and T. J. Chen, 1987, The welfare effects of illegal immigration, *Journal of International Economics*, 23, 35-328.
- Djajic, S., 1987, Illegal aliens, unemployment and immigration policy, *Journal of Development Economics*, 25, 235-249.
- Djajic, S., 1997, Illegal immigration and resource allocation, *International Economic Review*, 38(1), 97-117.
- Ethier, W. J., 1986, Illegal Immigration: The host country problem, *American Economic Review*, 76, 56-71.