BORDER ENFORCEMENT VERSUS INTERNAL ENFORCEMENT:

A STUDY IN THE ECONOMICS OF ILLEGAL MIGRATION

by

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Abstract

This paper focuses on a comparison of the two basic methods through which the government can attempt to control the flow of illegal migrants: border enforcement and internal enforcement. In particular, in the context of a multi-period setting, we demonstrate that internal enforcement has a number of advantages over border enforcement which would not be captured in a static analysis. The conclusion is that the recent move by the U.S. Government towards a policy which relies more heavily on internal enforcement may well be justified for a number of reasons not previously recognized.

I. Introduction

Since 1970, the number of aliens apprehended by U.S. federal agents has grown from 345,000 per year to over 1.2 million.[1] Given this dramatic growth, an important issue arises concerning the mix of border enforcement and internal enforcement the government should use as it attempts to control this flow. The Immigration Reform and Control Act of 1986 marks a historic change in policy – the change being the introduction of an internal enforcement mechanism which penalizes the employers of illegal migrants. In this paper we focus on a comparison of border enforcement and internal enforcement and, in particular, on the advantages associated with internal enforcement when viewed in the context of a multi-period setting.

One previous paper which contains a comparison of these two methods of enforcement is that of Ethier (1985).[2] That paper considers the enforcement question in terms of a variety of issues, but a major drawback of the analysis is that the comparison is fashioned in the context of a one period model. This is a drawback in that the most obvious way in which the two policies differ can only be of significance in a multi-period setting. The logic is straightforward. Border enforcement can be thought of as a one time cost incurred when an illegal migrant attempts to cross the border, while internal enforcement clearly has effects for many periods after an individual attempts to migrate. Obviously, a model which abstracts away from the temporal aspects of the problem cannot capture any differences stemming from this distinction.

To identify the significance of the above distinction, in this paper we construct a simple multi-period model of the illegal migration problem. The first issue we address in this context is how quickly the stock of illegal migrants adjusts to permanent increases in both border and internal enforcement. This is an important issue in that, if the goal of the government is to reduce the stock of illegal migrants, then one should be concerned with which type of enforcement policy achieves that goal more quickly. What we demonstrate is that in most cases the adjustment to the new steady state occurs more quickly when the increase is of the internal enforcement type, i.e, internal enforcement has an advantage over border enforcement which could not be captured in a static analysis. Our results also indicate that this advantage tends to be larger when the increases in enforcement are anticipated rather than unanticipated.

What drives these results is exactly the distinction between border enforcement and internal enforcement discussed earlier. For example, consider what happens when the increases in enforcement are anticipated. For the border enforcement case, there is a slow adjustment to the new steady state partly because the anticipation results in a higher level of migration in the period prior to the increase. The reason this is so is that by migrating in that period an individual can completely avoid the costs associated with the enforcement increase, while at the same time enjoy the benefits the increase will eventually bring in terms of a higher host country wage.[3] On the other hand, for the internal enforcement case there is typically a quick adjustment to the new steady state. One reason this is true is that anticipation now frequently results in a lower level of migration in the period prior to the increase. This lower level of migration occurs because increases in internal enforcement affect individuals who successfully migrated in the past, and hence, an individual <u>cannot</u> avoid the costs of an internal enforcement increase by simply migrating before the increase takes effect.

The second issue we address is the expected length of stay of illegal migrants in the host country. The new immigration bill, as well as a number of past bills, allows illegal migrants to become legal residents if their length of stay is above some minimum duration.[4] It might be of interest, therefore, to consider which type of enforcement policy results in a shorter expected length of stay. Our analysis of this issue again identifies an advantage internal enforcement has over border enforcement, i.e., the expected length of stay under internal enforcement is shorter than that which occurs under border enforcement.

This result is also driven by the distinction between border enforcement and internal enforcement identified above. An increase in border enforcement raises the probability an individual is caught when he attempts to migrate, but has no effect on the probability he is caught after a successful migration takes place. Hence, if one considers the stock of illegal migrants at any point in time, an increase in border enforcement should have no effect on this group's expected length of stay. On the other hand, an increase in internal enforcement does affect the probability an individual is caught after a successful migration takes place, and hence, this type of increase should lower expected length of stay.

In summary, given differences in the time patterns in which costs are borne under border and internal enforcement, one should not be surprised if these two methods of enforcement work much differently in a multi-period setting. In particular, in this paper we have identified two distinct advantages internal enforcement has over border enforcement which can be attributed to these different time patterns. The conclusion is that the recent move by the U.S. Government towards a policy which relies more heavily on internal enforcement may well be justified for a number of reasons not previously recognized.

II. A Study of Dynamic Adjustments

In this section we concentrate on how the stock of illegal migrants adjusts to changes in border enforcement, and to changes in internal enforcement. We demonstrate that, in comparison to what a static analysis would say, border enforcement is a less valuable tool for controlling illegal migration than is internal enforcement.

Because of the difficulty of looking at dynamic adjustment processes, the model we employ has a very simple structure. We consider a discrete time model in which there are two countries – the host country and the sender country. Each country has a fixed stock of capital, where it is assumed that capital is immobile across international borders. Let K_H denote the fixed capital stock of the host country, while K_S denotes the fixed capital stock of the sender country.

For each country there are a fixed number of infinitely lived individuals who are natives of that country. N_H will denote the number of individuals native to the host country, while N_S will denote the number of individuals native to the sender country. To make the model simple it is assumed that all individuals are identical in terms of productive ability, i.e., productive ability does not depend on country of origin or any individual specific factor. Further, it is convenient to assume that the fixed number of individuals in each country consists of a continuum of agents.

Our two countries produce a single homogeneous good, where in each country output is produced by competitively risk neutral firms according to a constant returns to scale production function. In particular, output in country j in time period t is given by

(1) $$Y_{jt}=L_{jt}f(k_{jt}), \quad f'>0, \; f''<0,$$

where L_{jt} is the employment level and k_{jt} is the capital-labor ratio, i.e., $k_{jt}=\frac{K_j}{L_{jt}}$. Let the price of this homogeneous output be the numeraire. If the government of country j imposes no penalties on the firms in its country (possible penalties will be discussed below), then the wage in country j in time period t is given by

(2) $$W_{jt}=f(k_{jt})-k_{jt}f'(k_{jt}).$$

Let $\bar{k}_j=\frac{K_j}{N_j}$. What distinguishes our two countries are the wages which hold in the two countries in the absence of labor migration, i.e., $\bar{W}_H>\bar{W}_S$, where $\bar{W}_j=f(\bar{k}_j)-\bar{k}_jf'(\bar{k}_j)$.

There is clearly no incentive for a native of the host country to migrate to the sender country. Hence, a native of the host country simply works in the host country in each period. On the other hand, a native of the sender country must decide whether or not to attempt to migrate to the host country. This migration decision will obviously depend on whether the cost of migrating is greater or less than the returns from migrating. The cost of migrating in period t is given by cF_t, where F_t is the flow of migrants in period t (the number of agents who attempt to cross the border). This specification captures the idea that there is an upward sloping supply curve for the resources used in migration.[5] Further, to keep the decision of whether or not to migrate a simple one, we assume each native of the sender country is risk neutral, does not discount the future, and faces a zero rate of interest.

It is assumed that any migration from the sender country to the host country is considered illegal by the host country. In turn, the host country has two ways of trying to deter migration. The first method is border enforcement. In particular, if the host country expends B on border enforcement, then a sender country individual who attempts to migrate has a probability p(B) of not being caught, $p'<0$. If he is caught, then he is simply returned to the sender country. The second method is internal enforcement. Internal enforcement takes the form of random inspections of firms at the beginning of the employment period. If the host country expends I on internal enforcement, then a sender country individual who is employed at a host country firm has a probability q(I) of not being caught, $q'<0$. If the individual is caught he is returned to the sender country before he has produced any output, and before he has received any wage payments.[6] Additionally, the employing firm is fined an amount Z, $Z \geq 0$.

Ethier (1985) distinguishes between two cases for internal enforcement: (i) complete discernment; and (ii) no discernment. Complete discernment refers to a situation where firms can perfectly distinguish between illegal migrants and native workers. No discernment refers to a situation where firms cannot at all distinguish between the two types. We will leave this aspect of the model unspecified since the results to be derived do not depend at all on which case is assumed.

This completes the setup of the model. Before proceeding to the question of dynamic adjustment processes, however, some additional notation is needed. In particular, $M^*(B,I,Z)$ will denote the steady state stock of illegal migrants in the host country when the host country expends B on border enforcement in each period, I on internal enforcement, and the fine associated with internal enforcement equals Z.

We can now proceed to the analysis. Our focus is on how illegal migration is affected by a permanent increase in either border or internal enforcement. In analyzing this issue we distinguish between two cases. First, the permanent increase could be unanticipated. An unanticipated increase will be defined as one in which individuals only learn of the increase in the period the increase occurs. Second, the increase could be anticipated. An anticipated increase will be defined as one in which individuals learn of the increase the period before the increase occurs.

We will first consider the unanticipated case. Below when we state that in period x the economy experiences a permanent increase in either border or internal enforcement, we formally mean the following. In period x-1 the economy is in a steady state where $B=\bar{B}$, $I=\bar{I}$, and $Z=\bar{Z}$, $M^*(\bar{B},\bar{I},\bar{Z})>0$. For the border enforcement case there is then an increase in B in period x, where the increase holds for all subsequent periods. On the other hand, for the internal enforcement case there is an increase in I and/or Z, where the increase again holds for all subsequent periods. Note, all proofs are relegated to an Appendix.

Proposition 1: Let $M^U_{t,B}$ denote the sequence of stocks of illegal migrants if in period x there is an unanticipated permanent increase in border enforcement to $\hat{B}$. If $M^*(\hat{B},\bar{I},\bar{Z})>0$, then

i) $M^U_{x-1,B}>M^U_{x,B}>M^U_{x+1,B}>M^U_{x+2,B}>\ldots$

ii) $\lim_{j\to\infty} M^U_{x+j,B}=M^*(\hat{B},\bar{I},\bar{Z})$.

Let $M^U_{t,I}$ denote the sequence of stocks of illegal migrants if in period x there is an unanticipated permanent increase in internal enforcement to $\hat{I}$, $\hat{Z}$.[7] If $M^*(\bar{B},\hat{I},\hat{Z})>0$, then

iii) $M^U_{x-1,I}>M^U_{x,I}>M^U_{x+1,I}>M^U_{x+2,I}>\ldots$

iv) $\lim_{j\to\infty} M^U_{x+j,I}=M^*(\bar{B},\hat{I},\hat{Z})$.

Further, if $M^*(\hat{B},\bar{I},\bar{Z})=M^*(\bar{B},\hat{I},\hat{Z})>0$, then

v) $M^U_{t,I}<M^U_{t,B}$ for all $t\geq x$.

Proposition 1 states the following about the unanticipated case. First, if there is an unanticipated permanent increase in either border or internal enforcement, then the stock of illegal migrants will gradually adjust to the new steady state. Second, if the increases are normalized such that the new steady state is the same across the internal enforcement and border enforcement cases, then the adjustment to the new steady state occurs more quickly in the internal enforcement case than in the border enforcement case.

The latter aspect of Proposition 1 tells us that, in the unanticipated case, internal enforcement has an advantage over border enforcement which would not be captured in a static analysis. This advantage stems from two factors. First, for either type of enforcement policy the adjustment to the new steady state is characterized by a stock which is above the eventual steady state stock, and a flow of migrants (the number of agents who attempt to cross the border) which is below the steady state flow. That is, during the adjustment process the stock is in a relative sense larger than the flow. In turn, since internal enforcement works at least partially by directly reducing the stock while border enforcement works strictly through the flow, the fact that during the adjustment process the stock is larger than the flow suggests there will be a quicker adjustment in the internal enforcement case.

To understand the second factor consider an individual who attempts to migrate in period t. The probability this agent receives the higher host country wage in period t is pq, the probability he receives the higher host country wage in t+1 is pq^2, the probability in t+2 is pq^3, etc. Given this, it is clear an increase in border enforcement (decrease in p) has no effect on how the returns to migrating are distributed across time periods. On the other hand, an increase in internal enforcement (decrease in q) causes the returns to migrating to be more heavily weighted by the period in which the migration occurs. Consider now what happens when there is a permanent increase in either border or internal enforcement. The relative wage in the host country is initially below the final steady state wage, and then gradually adjusts to that wage. Because an increase in internal enforcement more heavily weights the wage in the period the migration occurs, there is a suggestion there will be less incentive to migrate in the internal enforcement case than in the border enforcement case. In other words, we again have that the move to the new steady state should be quicker under internal enforcement than under border enforcement.[8]

We will now consider the anticipated case.

<u>Proposition 2</u>: Let $M^A_{t,B}$ denote the sequence of stocks of illegal migrants if in period x there is an anticipated permanent increase in border enforcement to $\hat{B}$. If $M^*(\hat{B},\bar{I},\bar{Z})>0$, then

i) $M^A_{x,B}>M^A_{x+1,B}>M^A_{x+2,B}>\ldots$

ii) $\lim_{j\to\infty} M^A_{x+j,B}=M^*(\hat{B},\bar{I},\bar{Z})$

iii) $M^A_{x-1,B}>M^U_{x-1,B}=M^*(\bar{B},\bar{I},\bar{Z})$

iv) $M^A_{t,B}>M^U_{t,B}$ for all $t\geq x$.

Let $M^A_{t,I}$ denote the sequence of stocks of illegal migrants if in period x there is an anticipated permanent increase in internal enforcement to $\hat{I}$, $\hat{Z}$. If $M^*(\bar{B},\hat{I},\hat{Z})>0$, then

v) $M^A_{x,I}>M^A_{x+1,I}>M^A_{x+2,I}>\ldots$

vi) $\lim_{j\to\infty} M^A_{x+j,I}=M^*(\bar{B},\hat{I},\hat{Z})$.

Further, if the internal enforcement increase is only in terms of Z, i.e., $\hat{I}=\bar{I}$ and $\hat{Z}>\bar{Z}$, then

vii) $M^A_{x-1,I}<M^U_{x-1,I}=M^*(\bar{B},\bar{I},\bar{Z})$

viii) $M^A_{t,I}<M^U_{t,I}$ for all $t\geq x$.

Proposition 2 tells us the following. First, the adjustment to the new steady state here is similar to the unanticipated case. That is, if there is an anticipated permanent increase in either border or internal enforcement, then the stock of illegal migrants will gradually adjust to the new steady state value. Second, and more interestingly, the movement from the unanticipated case to the anticipated case is quite different under border enforcement than under internal enforcement. Under border enforcement, the adjustment to the new steady state is slower in the anticipated case. On the other hand, the proposition states that at least for one type of internal enforcement increase, the adjustment to the new steady state actually occurs more quickly when the change in enforcement policy is anticipated.

This second aspect of the proposition suggests that, for anticipated increases, internal enforcement has an advantage over border enforcement which is even larger than in the unanticipated case. The intuition behind the result is as follows. Consider what happens when a border enforcement increase is anticipated. Potential migrants realize that this increase will result in a lower stock of illegal migrants in the future, and thus in a higher wage in the host country. This increases the incentive to migrate prior to the actual change in enforcement – the result being that the anticipation of the border enforcement increase slows down the adjustment to the new steady state.

Now consider what happens when there is an anticipated increase in Z. Potential migrants again realize that the future increase will result in less future migration. However, there is now a second factor which is more important. As opposed to a border enforcement increase, an increase of this type has a direct negative impact on illegal migrants who enter the host country in the period prior to the increase. That is, starting with the period in which the increase occurs, the rise in Z has a direct negative effect on the host country wage. This factor lowers the incentive to migrate in the period before the increase. As indicated, of the two factors the second is more important, with the result being that for this special case the anticipation of an internal enforcement increase actually speeds up the adjustment to the new steady state.

One question which might be asked is what happens when an internal enforcement increase consists partly or wholly of an increase in I. Consider again an illegal migrant who enters the host country in the period prior to the increase. Now the increase in internal enforcement has an additional effect. That is, starting with the period in which the increase occurs, there is a rise in the probability such an agent will be caught and returned to the sender country. Because of the introduction of this third factor, it is now possible that the dominant factor is the first one mentioned, i.e., the increase in the wage due to the future reduction in the stock of illegal migrants. Hence, for the general case of an internal enforcement increase, it is at least possible that the anticipation of the increase slows down the adjustment to the new steady state.

Even for the general case of an internal enforcement increase, however, the more likely result is that anticipation speeds up the adjustment process. To see this consider the following. Suppose that in period x there is an unanticipated increase in internal enforcement which consists partly or wholly of an increase in I. If the result of the increase is a reduction in the number of agents who attempt to cross the border in period x, then the movement to the anticipated case will speed up the adjustment process. That is, for anticipation to slow down the adjustment process, we must be dealing with an internal enforcement increase which has a counter-intuitive property, i.e., the increase must actually result in a larger number of agents attempting to cross the border.[9]

This completes our formal analysis of the dynamic adjustment process. What we have found is that, for a variety of reasons, internal enforcement has an advantage over border enforcement which would not be captured in a static analysis. This advantage exists when the analysis is in terms of unanticipated permanent increases in border and internal enforcement, and there is a suggestion it becomes even larger when we move to a comparison of anticipated changes.

III. Expected Length of Stay

The new immigration bill, as well as a number of past bills, have allowed illegal migrants to become legal residents if their length of stay was above some minimum duration. In this section we compare border and internal enforcement in relation to this aspect of the law. That is, in the context of the steady state of the model analyzed in the previous section, we consider which type of enforcement policy results in a shorter expected length of stay.

To consider this issue we must first define a measure of expected length of stay. Expected length of stay is of interest to the extent it indicates the proportion of a current stock of illegal migrants whose length of stay is above some minimum duration. Hence, the steady state expected length of stay, denoted $L^*(B,I,Z)$, will be defined in terms of the current stock of illegal migrants at a point in time and their average stay as of that date, rather than as the expected length of stay of an agent who attempts to cross the border.

<u>Proposition 3</u>: If $M^*(\bar{B},\bar{I},\bar{Z})>0$, $M^*(\hat{B},\hat{I},\hat{Z})>0$ and $\bar{I}<\hat{I}$, then $L^*(\bar{B},\bar{I},\bar{Z})>L^*(\hat{B},\hat{I},\hat{Z})$.

Proposition 3 states that the expected length of stay is shorter the larger is the expenditure on internal enforcement, i.e., internal enforcement again has an advantage over border inforcement which would not be captured in a static analysis. The intuition for this result is straightforward. The stock of illegal migrants is composed solely of individuals who successfully cross the border. In turn, once one successfully crosses the border, it is clear the expected length of stay will simply be a function of the probability of being caught due to expenditures on internal enforcement.

Although not captured in our analysis, we feel there is a second reason why internal enforcement will typically result in a shorter expected length of stay. Consider an environment in which illegal migrants sometimes voluntarily return to the sender country, where they do this with the knowledge they might return to the host country at some later date.[10] In such an environment, the expected length of stay will be shorter the more likely is an illegal migrant to return in this voluntary fashion. Further, since border enforcement can be interpreted simply as a fixed cost of crossing the border, increases in border enforcement should work to deter this type of voluntary return. Or overall, we again have the result that internal enforcement should result in a shorter expected length of stay than border enforcement.

IV. Conclusion

The present paper has focused on a comparison of the two basic methods through which the government can attempt to control the flow of illegal migrants: border enforcement and internal enforcement. In particular, in the context of a multi-period setting we addressed the following two issues. First, how quickly does the stock of illegal migrants adjust to permanent increases in both border and internal enforcement? Second, which type of enforcement policy results in a shorter expected length of stay?

In terms of both issues, our findings indicate that internal enforcement has an advantage over border enforcement which would not be captured in a static analysis. That is, the adjustment to the new steady state tends to occur more quickly given an increase in enforcement of the internal enforcement type, while the expected length of stay is shorter under internal enforcement than under border enforcement. Overall, then, our results suggest that the recent move by the U.S. Government towards a policy which relies more heavily on internal enforcement may well be justified for a number of reasons not previously recognized.

Appendix

Proof of Proposition 1: For the proofs we need some additional notation. Let B_t denote the expenditure on border enforcement in period t, I_t the expenditure on internal enforcement, and Z_t the fine associated with internal enforcement. Let $F^*(B,I,Z)$ denote the steady state flow of illegal migrants as a function of border and internal enforcement. Let $\delta_t = W_{Ht} - W_{St}$, where W_{St} is the sender country wage in period t and W_{Ht} is the host country wage paid to illegal migrants. Let $\delta^*(B,I,Z)$ denote the steady state value for δ as a function of border and internal enforcement. The returns to migrating in period t, denoted $\Delta_t = p(B_t)\left\{q(I_t)\delta_t + q(I_{t+1})\delta_{t+1} + \ldots\right\}$. Further, let $\Delta^*(B,I,Z)$ denote the steady state value for Δ as a function of border and internal enforcement.

Before proceeding it is helpful to note that in each period t, if $F_t > 0$, then individuals attempting to migrate must be indifferent between migrating and not migrating. In other words, in any such period t, $\Delta_t = cF_t$.

Demonstrating that after a permanent increase in enforcement the stock of illegal migrants gradually adjusts to the new steady state stock is straightforward – but somewhat tedious – so we will just outline it here. We begin by considering i).

The first step is to show there does not exist a period t, $t \geq x$, for which $M^U_{t,B} \leq M^*(\hat{B},\bar{I},\bar{Z})$. Suppose there does and let t now denote the first such period. For this period the flow is less than the steady state flow $(F^*(\hat{B},\bar{I},\bar{Z}))$, and hence, this can only occur if there exists some subsequent t′ where $M^U_{t',B} > M^*(\hat{B},\bar{I},\bar{Z})$. Let t′ now denote the first period of this type. We know

(A1) $$\Delta_{t'}>\Delta^*(\hat{B},\bar{I},\bar{Z})$$

and

(A2) $$\Delta_t<\Delta^*(\hat{B},\bar{I},\bar{Z}).$$

We also know

(A3) $$\Delta_t=\hat{p}\bar{q}\delta_t+\ldots\hat{p}\bar{q}^{(t'-t)}\delta_{t'-1}+\bar{q}^{(t'-t)}\Delta_{t'}$$

or

(A4) $$\Delta_t>\hat{p}\bar{q}\delta_t+\ldots\hat{p}\bar{q}^{(t'-t)}\delta_{t'-1}+\bar{q}^{(t'-t)}\Delta^*(\hat{B},\bar{I},\bar{Z}).$$

Since $\delta_j>\delta^*(\hat{B},\bar{I},\bar{Z})$ for all $\delta_t\leq\delta_j\leq\delta_{t'-1}$, (A4) tells us $\Delta_t>\Delta^*(\hat{B},\bar{I},\bar{Z})$ which contradicts (A2). Hence, there exists no value t, t≥x, such that $M^U_{t,B}\leq M^*(\hat{B},\bar{I},\bar{Z})$.

The next step is to show there does not exist a period t, t≥x, for which $M^U_{t,B}\geq M^U_{t-1,B}$. Suppose there does. For this period the flow is greater than the steady state flow, and hence, this can only occur if there exists some subsequent period t′ for which $M^U_{t',B}<M^*(\hat{B},\bar{I},\bar{Z})$. However, we previously demonstrated this cannot be the case. Hence, there does not exist a period t, t≥x, for which $M^U_{t,B}\geq M^U_{t-1,B}$. Together with the previous result, this proves i). Further, iii) follows from a similar argument.

Using the same logic as above, an increase in border enforcement means that beginning in period x the flow in each period must be less than the steady state flow. Given our previous demonstration that $M^U_{t,B}>M^*(\hat{B},\bar{I},\bar{Z})$ for all, t≥x, this guarantees ii). Further, iv) follows similarly.

We can now consider v). Let $M^*=M^*(\hat{B},\bar{I},\bar{Z})=M^*(\bar{B},\hat{I},\hat{Z})$, $F^*_B=(\hat{B},\bar{I},\bar{Z})$, $F^*_I=F^*(\bar{B},\hat{I},\hat{Z})$, $\delta^*_B=\delta^*(\hat{B},\bar{I},\bar{Z})$, and $\delta^*_I=\delta^*(\bar{B},\hat{I},\hat{Z})$. By definition we have

(A5) $$cF^*_B=(\hat{p}\bar{q}+\hat{p}\bar{q}^2+\ldots)\delta^*_B$$

and

(A6) $$cF_I^*=(\bar{p}\hat{q}+\bar{p}\hat{q}^2+\ldots)\delta_I^*.$$

Let W'_{Ht} be the host country wage in period t paid to workers if Z=0. Under complete discernment we have

(A7) $$W_{Ht}=W'_{Ht}-(1-q)Z,$$

while no discernment implies

(A8) $$W_{Ht}=W'_{Ht}-(1-q)Z\,\frac{M_t}{M_t+N_H}\,.$$

Notice that both cases yield $\delta_B^*>\delta_I^*$.[11] If $\hat{p}\bar{q}+\hat{p}\bar{q}^2+\ldots\geq\bar{p}\hat{q}+\bar{p}\hat{q}^2+\ldots$, then given the steady state stocks are the same it must be that $F_B^*\leq F_I^*$. However, this contradicts (A5) and (A6). Hence, $\hat{p}\bar{q}+\hat{p}\bar{q}^2+\ldots<\bar{p}\hat{q}+\bar{p}\hat{q}^2+\ldots$, which implies $F_B^*>F_I^*$. Further, we also have

(A9) $$cF_B^*-cF_I^*=\hat{p}\bar{q}(\delta_B^*-\delta_I^*)+\hat{p}\bar{q}^2(\delta_B^*-\delta_I^*)+\ldots$$
$$+(\hat{p}\bar{q}-\bar{p}\hat{q})\delta_I^*+(\hat{p}\bar{q}^2-\bar{p}\hat{q}^2)\delta_I^*+\ldots$$

Given the steady state stocks are the same, the "net flows" in the two steady states must be the same, i.e.,

(A10) $$\hat{p}\bar{q}F_B^*-(1-\bar{q})M^*=\bar{p}\hat{q}F_I^*-(1-\hat{q})M^*$$

or

(A11) $$F_B^*-F_I^*=\frac{(\hat{q}-\bar{q})M^*}{\hat{p}\bar{q}}+\frac{(\bar{p}\hat{q}-\hat{p}\bar{q})}{\hat{p}\bar{q}}\,F_I^*.$$

Let $F_{t,B}^U$ ($F_{t,I}^U$) denote the flow of migrants in period t given the border (internal) enforcement increase. Using the same logic as earlier we know $F_{t,B}^U<F_B^*$ and $F_{t,I}^U<F_I^*$ for all $t\geq x$.

Suppose $M_{t,I}^U\geq M_{t,B}^U$ for all $t\geq x$. This implies

(A12) $$\hat{p}\bar{q}F^U_{x,B}-(1-\bar{q})M^*(\bar{B},\bar{I},\bar{Z})\le\bar{p}\hat{q}F^U_{x,I}-(1-\hat{q})M^*(\bar{B},\bar{I},\bar{Z})$$

or

(A13) $$F^U_{x,B}-F^U_{x,I}\le\frac{(\hat{q}-\bar{q})M^*(\bar{B},\bar{I},\bar{Z})}{\hat{p}\bar{q}}+\frac{(\bar{p}\hat{q}-\hat{p}\bar{q})}{\hat{p}\bar{q}}F^U_{x,I}.$$

Comparing (A11) and (A13) yields

(A14) $$F^U_{x,B}-F^U_{x,I}<F^*_B-F^*_I.$$

We also have

(A15) $$cF^U_{x,B}=\hat{p}\bar{q}\delta^U_{x,B}+\hat{p}\bar{q}^2\delta^U_{x+1,B}+\dots$$

and

(A16) $$cF^U_{x,I}=\bar{p}\hat{q}\delta^U_{x,I}+\bar{p}\hat{q}^2\delta^U_{x+1,I}+\dots$$

Rearranging yields

(A17) $$\begin{aligned}cF^U_{x,B}-cF^U_{x,I}&=\hat{p}\bar{q}(\delta^U_{x,B}-\delta^U_{x,I})+\hat{p}\bar{q}^2(\delta^U_{x+1,B}-\delta^U_{x+1,I})+\dots\\&\quad+(\hat{p}\bar{q}-\bar{p}\hat{q})\delta^U_{x,I}+(\hat{p}\bar{q}^2-\bar{p}\hat{q}^2)\delta^U_{x+1,I}+\dots\end{aligned}$$

Given (A7), (A8) and $M^U_{t,I}\ge M^U_{t,B}$ for all $t\ge x$, we have $\delta^U_{t,B}-\delta^U_{t,I}\ge\delta^*_B-\delta^*_I$ for all $t\ge x$. We also know $\delta^U_{x,I}<\delta^U_{x+1,I}\dots<\delta^*_I$, $\hat{p}\bar{q}-\bar{p}\hat{q}+\hat{p}\bar{q}^2-\bar{p}\hat{q}^2+\dots<0$, and $\bar{q}\ge\hat{q}$. Given these, a comparison of (A9) and (A17) yields

(A18) $$F^U_{x,B}-F^U_{x,I}>F^*_B-F^*_I.$$

This contradicts (A14), and hence, it cannot be the case that $M^U_{t,I}\ge M^U_{t,B}$ for all $t\ge x$.

Using the same logic as above it can be shown that if there exists a period t, $t\ge x$, such that $M^U_{t,I}\ge M^U_{t,B}$, then there must exist a later period, call it t′, such that $M^U_{t',I}<M^U_{t',B}$. Suppose such a period exists, and let t now denote a period such that $M^U_{t,I}\ge M^U_{t,B}$, $M^U_{t-1,I}\le M^U_{t-1,B}$, and let t′ be the first

subsequent period such that $M^U_{t',I}<M^U_{t',B}$. We know

$$\hat{q}M^U_{t-1,I}+\bar{p}\hat{q}F^U_{t,I}\geq\bar{q}M^U_{t-1,B}+\hat{p}\bar{q}F^U_{t,B} \tag{A19}$$

or

$$F^U_{t,I}-F^U_{t,B}\geq\frac{1}{\hat{p}\bar{q}}\left\{\hat{q}(M^U_{t-1,B}-M^U_{t-1,I})+(\bar{q}-\hat{q})M^U_{t-1,B}+(\hat{p}\bar{q}-\bar{p}\hat{q})F^U_{t,I}\right\}, \tag{A20}$$

and

$$\hat{q}M^U_{t'-1,I}+\bar{p}\hat{q}F^U_{t',I}\leq\bar{q}M^U_{t'-1,B}+\hat{p}\bar{q}F^U_{t',B} \tag{A21}$$

or

$$F^U_{t',I}-F^U_{t',B}\leq\frac{1}{\hat{p}\bar{q}}\left\{\hat{q}(M^U_{t'-1,B}-M^U_{t'-1,I})+(\bar{q}-\hat{q})M^U_{t'-1,B}+(\hat{p}\bar{q}-\bar{p}\hat{q})F^U_{t',I}\right\}. \tag{A22}$$

It is easily demonstrated that $F^U_{t,I}<F^U_{t',I}$. Hence, (A20) and (A22) yield $F^U_{t,I}-F^U_{t,B}>F^U_{t',I}-F^U_{t',B}$.

We also know

$$cF^U_{t,I}=\bar{p}\hat{q}\delta^U_{t,I}+\bar{p}\hat{q}^2\delta^U_{t+1,I}+\dots, \tag{A23}$$

$$cF^U_{t,B}=\hat{p}\bar{q}\delta^U_{t,B}+\hat{p}\bar{q}^2\delta^U_{t+1,B}+\dots, \tag{A24}$$

$$cF^U_{t',I}=\bar{p}\hat{q}\delta^U_{t',I}+\bar{p}\hat{q}^2\delta^U_{t'+1,I}+\dots, \tag{A25}$$

and

$$cF^U_{t',B}=\hat{p}\bar{q}\delta^U_{t',B}+\hat{p}\bar{q}^2\delta^U_{t'+1,B}+\dots \tag{A26}$$

Let $R_B=\hat{p}\bar{q}+\hat{p}\bar{q}^2+\dots$, and $R_I=\bar{p}\hat{q}+\bar{p}\hat{q}^2+\dots$ We know $R_B<R_I$. (A25) and (A26) can be rewritten as

$$cF^U_{t',I}=R_I\gamma_{t',I} \tag{A27}$$

and

$$cF^U_{t',B}=R_B\gamma_{t',B}, \tag{A28}$$

or

$$cF^U_{t',I}-cF^U_{t',B}=R_I(\gamma_{t',I}-\gamma_{t',B})+(R_I-R_B)\gamma_{t',B}, \tag{A29}$$

where $\gamma_{t',I}$ ($\gamma_{t',B}$) is the weighted average of $\delta^U_{t',I}$, $\delta^U_{t'+1,I}$,... ($\delta^U_{t',B}$, $\delta^U_{t'+1,B}$,...). Further, (A23) and (A24) can be rewritten as

(A30) $$cF^U_{t,I}=(1-\hat{q}^{(t'-t)})R_I S_{t,I}+\hat{q}^{(t'-t)}R_I\gamma_{t',I}$$

and

(A31) $$cF^U_{t,B}=(1-\bar{q}^{(t'-t)})R_B S_{t,B}+\bar{q}^{(t'-t)}R_B\gamma_{t',B},$$

where $S_{t,I}$ ($S_{t,B}$) is the wighted average of $\delta^U_{t,I}$, $\delta^U_{t+1,I}$,...$\delta^U_{t'-1,I}$ ($\delta^U_{t,B}$, $\delta^U_{t+1,B}$,...$\delta^U_{t'-1,B}$). Given $S_{t,I}<\gamma_{t',I}$, (A30) yields

(A32) $$cF^U_{t,I}<(1-\bar{q}^{(t'-t)})R_I S_{t,I}+\bar{q}^{(t'-t)}R_I\gamma_{t',I}$$

or

(A33) $$cF^U_{t,I}-cF^U_{t,B}<(1-\bar{q}^{(t'-t)})[R_I S_{t,I}-R_B S_{t,B}]+\bar{q}^{(t'-t)}[R_I\gamma_{t',I}-R_B\gamma_{t',B}].$$

Rearranging yields

(A34) $$cF^U_{t,I}-cF^U_{t,B}<(1-\bar{q}^{(t'-t)})[R_I(S_{t,I}-S_{t,B})+(R_I-R_B)S_{t,B}]$$
$$+\bar{q}^{(t'-t)}[R_I(\gamma_{t',I}-\gamma_{t',B})+(R_I-R_B)\gamma_{t',B}].$$

We know $S_{t,B}<\gamma_{t',B}$. Also, since there may be multiple values for t which satisfy the definition, let t now denote the single value of these possible multiple values for which $S_{t,I}-S_{t,B}$ is the most negative. This implies $S_{t,I}-S_{t,B}<\gamma_{t',I}-\gamma_{t',B}$. A comparison of (A29) and (A34) now yields $F^U_{t,I}-F^U_{t,B}<F^U_{t',I}-F^U_{t',B}$, i.e., a contradiction. Q.E.D.

<u>Proof of Proposition 2</u>: i), ii), v), and vi) follow from arguments similar to those in the proof of Proposition 1. Additionally, we can also show along the lines of an argument in the proof of Proposition 1 that if there are two adjustment paths with different initial starting points, where B, I and Z are

constant both across paths and for all periods of each path, then the paths cannot cross. Call this the non-crossing property.

We will first consider iii). Suppose $M^A_{x-1,B} \leq M^U_{x-1,B}$. This implies

$$F^A_{x-1,B} \leq F^U_{x-1,B}. \tag{A35}$$

Additionally, given the non-crossing property we also have $M^A_{t,B} \leq M^*(\bar{B},\bar{I},\bar{Z})$ for all $t \geq x$. In period x-1 in the unanticipated case the anticipated return is given by

$$\Delta^U_{x-1,B} = \bar{p}\bar{q}\delta^*(\bar{B},\bar{I},\bar{Z}) + \bar{p}\bar{q}^2\delta^*(\bar{B},\bar{I},\bar{Z}) + \ldots \tag{A36}$$

In the anticipated case we have

$$\Delta^A_{x-1,B} = \bar{p}\bar{q}\delta^A_{x-1,B} + \bar{p}\bar{q}^2\delta^A_{x,B} + \ldots, \tag{A37}$$

where $\delta^A_{t,B} > (\geq) \delta^*(\bar{B},\bar{I},\bar{Z})$ for all $t > (=) x-1$. (A36) and (A37) imply $\Delta^A_{x-1,B} > \Delta^U_{x-1,B}$, which implies $cF^A_{x-1,B} > cF^U_{x-1,B}$. This contradicts (A35). In turn, given iii), iv) follows from the non-crossing property.

Now consider vii). Suppose $M^A_{x-1,I} \geq M^U_{x-1,I}$. This implies

$$F^A_{x-1,I} \geq F^U_{x-1,I}. \tag{A38}$$

Additionally, given the non-crossing property we also have $M^A_{t,I} \geq M^U_{t,I}$ for all $t \geq x$. In period x-1 in the unanticipated case the anticipated return is given by

$$\Delta^U_{x-1,I} = \bar{p}\bar{q}\delta^*(\bar{B},\bar{I},\bar{Z}) + \bar{p}\bar{q}^2\delta^*(\bar{B},\bar{I},\bar{Z}) + \ldots \tag{A39}$$

or

$$\Delta^U_{x-1,I} = \bar{p}\bar{q}\delta^*(\bar{B},\bar{I},\bar{Z}) + \bar{q}\Delta^*(\bar{B},\bar{I},\bar{Z}). \tag{A40}$$

In the anticipated case we have

(A41) $$\Delta^A_{x-1,I}=\bar{p}\bar{q}\delta^A_{x-1,I}+\bar{p}\bar{q}^2\delta^A_{x,I}+\ldots$$

or

(A42) $$\Delta^A_{x-1,I}=\bar{p}\bar{q}\delta^A_{x-1,I}+\bar{q}\Delta^A_{x,I}.$$

We know $\delta^A_{x-1,I}\le\delta^*(\bar{B},\bar{I},\bar{Z})$, while it is easy to demonstrate $\Delta^*(\bar{B},\bar{I},\hat{Z})<\Delta^*(\bar{B},\bar{I},\bar{Z})$. Further, v) and vi) tell us $\Delta^A_{x,I}<\Delta^*(\bar{B},\bar{I},\hat{Z})$, which implies $\Delta^A_{x,I}<\Delta^*(\bar{B},\bar{I},\bar{Z})$. A comparison of (A40) and (A42) now yields $\Delta^U_{x-1,I}>\Delta^A_{x-1,I}$, which implies $cF^U_{x-1,I}>cF^A_{x-1,I}$. This contradicts (A38). In turn, given vii), viii) follows from the non-crossing property.

We will now prove the statement on pp. 11-12 concerning the general case of an internal enforcement increase. The proof of vii) above demonstrates the point if we can show $\Delta^A_{x,I}<\Delta^*(\bar{B},\bar{I},\bar{Z})$ (all the equations are the same except for (A41)). Suppose $M^A_{x-1,I}=M^U_{x-1,I}$. This implies $\Delta^A_{x,I}=\Delta^U_{x,I}$. In turn, given $F^U_{x,I}<F^*(\bar{B},\bar{I},\bar{Z})$, we now have $\Delta^A_{x,I}<\Delta^*(\bar{B},\bar{I},\bar{Z})$. Suppose $M^A_{x-1,I}>M^U_{x-1,I}$. Given the non-crossing property, we have $\Delta^A_{x,I}$ is smaller than in the equality case just considered. Hence, we again have $\Delta^A_{x,I}<\Delta^*(\bar{B},\bar{I},\bar{Z})$. Q.E.D.

<u>Proof of Proposition 3</u>: Given that we are dealing with a steady state, $L^*(B,I,Z)$ is given by

(A43) $$L^*(B,I,Z)=\frac{p(B)q(I)(1-q(I))F^*(B,I,Z)}{V}+\frac{2p(B)q(I)^2(1-q(I))F^*(B,I,Z)}{V}+\ldots,$$

where $V=p(B)q(I)F^*(B,I,Z)[(1-q(I))+q(I)(1-q(I))+q(I)^2(1-q(I))+\ldots]$,

or

(A44) $$L^*(B,I,Z)=\frac{1+2q(I)+3q(I)^2+\ldots}{1+q(I)+q(I)^2+\ldots}.$$

We now see that $L^*(B,I,Z)$ only depends on I. (A44) can be rewritten as

(A45)

$$L^*(B,I,Z) = 1 + \frac{q(I)(1+2q(I)+3q(I)^2+\ldots)}{1+q(I)+q(I)^2+\ldots}$$

$$= 1+q(I) + \frac{q(I)(q(I)+2q(I)^2+3q(I)^3+\ldots)}{1+q(I)+q(I)^2+\ldots}$$

$$= 1+q(I) + \frac{q(I)^2(1+2q(I)+3q(I)^2+\ldots)}{1+q(I)+q(I)^2+\ldots}$$

$$= 1+q(I)+q(I)^2 + \frac{q(I)^2(q(I)+2q(I)^2+\ldots)}{1+q(I)+q(I)^2+\ldots}$$

$$\ldots$$

$$= 1+q(I)+q(I)^2+q(I)^3+\ldots$$

Q.E.D.

Footnotes

[1]INS (1984) - p. 188.

[2]There is a large literature dealing with issues which arise in the context of legal international migration. Topics dealt with in that literature include the problem of the brain drain (see Bhagwati (1979a), Bhagwati and Hamada (1974), and Rodriguez (1975)), and what happens when labor mobility is introduced to standard factor endowment models of international trade (see Bhagwati (1979b), Bhagwati and Brecher (1980), Brecher and Bhagwati (1981), Dixit and Norman (1980), Johnson (1965), Kemp (1966), Markusen and Melvin (1979), and Ohlin (1967)). One paper which considers illegal migration and the enforcement issue is that of Djajic (1985). However, that paper does not compare the two different methods of enforcement, but rather focuses on how immigration policy helps determine the manner in which disturbances to the labor market in one economy are transmitted to the other.

[3]The increase eventually brings a higher host country wage because it results in a reduction in the stock of illegal migrants.

[4]The Immigration Acts of 1929, 1958, and 1965 included such clauses (see Briggs (1984), p. 66).

[5]The linearity of this cost function is not crucial, but rather serves to simplify the mathematics.

[6]When an illegal migrant is caught and returned to the sender country because of either border or internal enforcement, the individual does not have the option of attempting to migrate again in the same period. Rather, for that period he simply receives the sender country wage. Note, given all agents are identical, this assumption is not at all crucial for the results

which follow, but rather serves to simplify some of the arguments in the proofs.

[7] That is, $\hat{I} \geq \bar{I}$ and $\hat{Z} \geq \bar{Z}$, where at least one holds as a strict inequality.

[8] The reader might note that this second factor is only present if $\hat{I} > \bar{I}$.

[9] Evidence indicates that for the recently enacted increase in internal enforcement by the U.S. Government, there has been a dramatic reduction in the number of agents attempting to cross the border (see the New York Times, February 20, 1987). This suggests that at least for this particular episode, the movement to the new steady state will be quicker than if the increase in enforcement was of the border enforcement type.

[10] There are many reasons why an illegal migrant might voluntarily return to the sender country. For example, he might voluntarily return because of a family crisis, because of changed labor market conditions for his specific occupation, or simply because he is homesick.

[11] Notice this proof is for the case $\hat{Z} > \bar{Z}$. v) is correct even if $\hat{Z} = \bar{Z}$, however, the proof for that case is somewhat different.

REFERENCES

Bhagwati, Jagdish N., (1979a) "International Migration of the Highly Skilled: Economics, Ethics and Taxes," Third World Quarterly, July 1979, 1, 17-30.

__________, (1979b) "International Factor Movements and National Advantage," 9th V.K. Ramaswami Memorial Lecture, Delhi, 1979.

__________, and Brecher, Richard A., "National Welfare in an Open Economy in the Presence of Foreign-Owned Factors of Production," Journal of International Economics, February 1980, 10, 103-16.

__________, and Hamada, Koichi, "The Brain Drain, International Integration of Markets for Professionals and Unemployment: A Theoretical Analysis," Journal of Development Economics, June 1974, 1, 19-42.

Brecher, Richard A. and Bhagwati, Jagdish N., "Foreign Ownership and the Theory of Trade and Welfare," Journal of Political Economy, June 1981, 89, 497-511.

Briggs, M. Vernon, Jr., Immigration Policy and the American Labor Force, Baltimore: The Johns Hopkins University Press, 1984.

Congressional Quarterly, October 18, 1986, 2597-2598.

Dixit, Avinash and Norman, Victor, Theory of International Trade, London: Cambridge University Press, 1980.

Djajic, S., "Illegal Aliens, Unemployment and Immigration Policy," February 1985, Queen's University Discussion Paper #591.

__________, and M. Ross, "An Equilibrium Model of Guest-Worker Migration," June 1985, Queen's University Discussion Paper #613.

Ethier, W.J., "Illegal Immigration: The Host-Country Problem," American Economic Review, March 1986.

________, "Internation Trade and Labor Migration," American Economic Review, September 1985.

Harris, John R. and Todaro, Michael, "Migration, Unemployment and Development: A Two-Sector Analysis," American Economic Review, March 1970, 60 126-42.

INS, Statistical Yearbook, 1984.

Johnson, Harry G., International Trade and Economic Growth, Cambridge: Harvard University Press, 1965.

Kemp, Murray C., "Gain from International Trade and Investment," American Economic Review, 1966, 26, 788-809.

Markusen, James R. and Melvin, James R., "Tariffs, Capital and Mobility, and Foreign Ownership," Journal of International Economics, August 1979, 9 395-409.

Ohlin, Bertil, Interregional and International Trade, rev. ed., Cambridge: Harvard University Press, 1967.

Rodriquez, Carlos A., "Brain Drain and Economic Growth: A Dynamic Model," Journal of Development Economics, September 1975, 2, 223-247.