

The Why, When and How of Immigration Amnesties

Gil S. Epstein^{a,b,c}
and
Avi Weiss^{a,b,*}

^a Department of Economics, Bar-Ilan University, 52900 Ramat-Gan, Israel

^b IZA, Bonn

^c CReAM, London

Abstract

This paper presents some of the many issues involved in the granting of an amnesty to illegal immigrants. Complementing studies by Chau (2001, 2003), Karlson and Katz (2003) and Gang and Yun (2006), we consider government behavior with respect to allocations on limiting infiltration (border control) and apprehending infiltrators (internal control) and with respect to the granting of amnesties, the timing of amnesties, and limitations on eligibility for those amnesties. We demonstrate the effects of government actions on allocations and the flow of immigrants, and how the interactions between these factors combine to yield an optimal amnesty policy. We also consider two extensions – intertemporal transfers of policing funds and “fuzziness” in declarations regarding eligibility for an amnesty aimed at apprehending and deporting undesirables.

JEL Classification Codes: J61, J68, H59

Keywords: Amnesty, Immigration, Illegal Immigration, Border Controls, Internal Controls.

*e-mail: weissal@mail.biu.ac.il. We would like to thank participants at seminars in Bar-Ilan University, IZA, Northern Illinois University, the University of Calabria, the University of Illinois at Chicago, and the European Public Choice Society meetings for helpful comments. Financial support from the Adar Foundation of the Economics Department of Bar-Ilan University is gratefully acknowledged.

I. Introduction

Among the most hotly debated issues in economic and political circles worldwide are those regarding the effects immigrants have on host countries. There has been a myriad of economic articles written on the subject (see, for example, Borjas, 1994 and 1995, and Zimmermann, 1995 for excellent surveys), and it has been a central issue in numerous elections throughout the Western hemisphere. One thing is clear – except in unusual circumstances,¹ Western countries tend to spend significant resources towards limiting the number and/or types of immigrants they allow into their countries. These limits are upheld via both border controls, through which undesired people are blocked from entering, and via internal enforcement, whereby undesired people are apprehended and expelled from the country (see, e.g., Ethier, 1986) and/or employers are fined (see, e.g., Chau, 2001).

Despite these efforts, however, many illegal immigrants tend to find a way to slip through cracks in the system, if the benefit from doing so is sufficiently large. As a result, the more prosperous countries tend to find themselves in a position whereby, despite their best efforts, a stock of illegal immigrants accumulates and grows in their countries, and the government is unsuccessful in apprehending and deporting these illegals. While there have been extensive debates about the effects *legal* immigrants have on an economy, it is likely that these *illegal* immigrants inflict a greater burden on the host economy, for reasons discussed below.

One way countries have increasingly dealt with such problems is to periodically grant an amnesty to any worker who can demonstrate that he/she fulfills certain requirements (such as length of stay in the country, no criminal record, etc.). In these amnesties, workers who come forward are put through a procedure, at the end of which they are either “regularized” by being given some type of permit to remain (ranging from a one-year permit to citizenship) or expelled. Table 1 presents select information about amnesties over the past twenty years. As seen in this table, the number of illegal workers regularized has been quite significant, and there have been a number of countries that have had recurring amnesties over a fairly short period of

¹There were instances in which immigration was not only not discouraged, but was actively sought. For example, in the middle of the last century Germany was in dire need of workers, and actively sought temporary workers from neighboring countries. Many of these “temporary” workers remained in the country after contracts expired, and became a part of the large illegal immigrant population of Germany. There are signs that this policy of actively seeking temporary workers is making a comeback due to the low birth rate and the subsequent aging of the population.

time. In many instances, when countries grant these amnesties, they concurrently announce plans to clamp down on border controls.

There have been few attempts to explain immigration amnesties. This paper is an updated version of our previously unpublished working paper, which, together with Chau (2001), were the first articles to investigate this issue theoretically, albeit from different angles. Chau (2001) considered the apparent inconsistency between imposing sanctions on employers that hire illegal workers, and amnesties granted by governments to those same workers. She provided a positive theory of amnesty provision in a model where the constrained optimal immigration reform is time inconsistent, and demonstrated that host countries can enhance the credibility of their immigration reforms by restricting their choice set, and granting a socially excessive amount of amnesty to illegal workers. In a latter paper Chau (2003) considered a political support model of immigration reforms, distinguishing between border enforcement and employer sanctions. She showed that while amnesty may appear to run contrary to the original intent of the immigration reform, it may nevertheless facilitate rent capturing by politicians. Karlson and Katz (2003) suggested that border patrols, the apprehension of illegal aliens, and the offering of immigration amnesties may be viewed as different facets of the same policy. They showed that a rich country can use this policy mix to attract cheap foreign workers while avoiding low ability migrants, who, once amnestied, become a burden on the public purse. Finally, Gang and Yun (2005) reviewed the role immigration amnesties have played in US immigration policy, placing them in the context of similar programs embarked upon by other nations. The theory of amnesties suggests rent seeking, bargaining, and costs as reasons for a country offering an amnesty, often in conjunction with increased border controls, internal enforcement and employer penalties. They modeled an immigration amnesty in which the destination country has a formal sector which employs only legal immigrants, an informal sector employing both legal and illegal immigrants, and open unemployment. They examined wages of Mexicans in the US and Mexican migration to the US, looking at who migrates and who doesn't, who

became legalized under IRCA, who under other programs, and who never became legalized.²

In this paper we also consider the issue from the perspective of the host country, and we consider government behavior with respect to allocations on limiting infiltration (border control) and apprehending infiltrators (internal control³) and with respect to the granting of amnesties (Why), the timing of amnesties (When), and limitations on eligibility for those amnesties (How). We demonstrate the effects of government actions on allocations and the flow of immigrants, and how the interactions between these factors combine to yield an optimal amnesty policy.

While there have been numerous studies of tax amnesties (see, for example, Malik and Schwab, 1991 and Andreoni, 1991) there are a few basic reasons why we cannot implement these results and models into the migration literature. First, a tax amnesty helps the authorities receive information about the illegal activities of different individuals and institutes. As a result of the amnesty the authorities can gain knowledge on methods used to evade taxes, and will be better placed to detect future illegal activities. This is not the case in migration amnesties, where there is little knowledge to be gained by authorities. While it may be argued that the authorities learn the origins of the illegal migrants, a fact that may help them allocate their border control budgets more efficiently, this information is in general already known to the authorities and is not the main objective. Second, one benefit from a tax amnesty is that the identity of the transgressor becomes known, which will tend to discourage him from future illegal activities of this sort, since the authorities are "wise to him." A legalized immigrant, however, will no longer have any incentive to become an illegal immigrant again. Third, a tax amnesty is backward looking in that with it authorities attempt to collect taxes owed from previous years that might otherwise be lost. This element is not present in immigration amnesties, and it is only the future that is under

² Guzman et al. (2007) consider the relationship between immigration enforcement, smuggling of migrants and non-wage income. They show how technological progress in the smuggling industry affects the level of migration and capital accumulation, and the effect changes in border enforcement has on the level of migration, capital accumulation, and smuggling activity. Moreover, they investigate the optimal level of enforcement as a result of technological progress in the smuggling industry. They show that the government chooses to devote resources to border enforcement only if the deterrent effect on smugglers is large enough. Otherwise, it is not worth taxing host-country natives as the taxes paid will more than offset any income gain resulting from fewer migrants.

³ In considering internal control, we consider deportation of apprehended illegal immigrants, while Chau (2001) considers employer sanctions.

consideration. Finally, immigration amnesties deal with people, and as such the amnesty has widespread implications such as externalities on other residents. This, of course, is what differentiates between labor economics and other branches of microeconomics. These important differences make tax and immigrant amnesties incompatible, although there are similarities in other aspects.⁴

The reasons a country might not desire immigration, particularly of low-skilled workers, have been widely discussed (see, e.g., Borjas, 1994). These well-recognized considerations aside, there are reasons to believe that *illegal* migrants are more costly to a country than legal migrants. Much of the supplementary objection to illegal immigration stems from the fact that illegal immigrants tend to be free riders – not paying their share of the tax burden while consuming public resources⁵ – and that because of their illegality they tend to be more involved in illicit activities, both by choice and when it is forced on them.⁶ Additional issues may include high social costs (schooling, health care, etc.), decreases in the wages of native workers, and effects on unemployment among natives, although these issues are pertinent for legal migrants also.⁷ Whether these costs exist and the magnitude of these costs is moot. We will make two observations. First, almost all countries limit immigration and try to keep illegals out. In fact, countries allocate considerable resources to agencies with the sole purpose of controlling immigration (e.g., the Immigration and Naturalization Service (INS) in the U.S.). Thus, at the very least, government officials believe there is some potential harm from allowing free migration. Second, the granting of an amnesty, and particularly an amnesty such as that granted in the U.S. in which citizenship was given, means that the officials believe that the country is better off with these people being legal than with them being illegal. We proceed under the assumption implicit from these observations – that illegal workers are more of a burden to a country than if those same migrants were legal.

⁴ Some of these differences may be less distinctive in some European and Asian amnesties. In the recent Greek amnesty, for instance, applicants were required to identify their former place of employment, thus identifying employers willing to hire undocumented immigrants. In addition, the applicants had to pay back “social insurance” taxes, so there was a backward looking element.

⁵ Although there are instances in which illegal residents are careful to pay taxes in order to avoid calling attention to them.

⁶ There are numerous instances of illegal workers being taken advantage of and being the victims of crimes.

⁷ Of course, the opposite effect also exists. Since illegal workers receive lower wages, local capital owners and skilled laborers tend to benefit from illegal workers more than from legal workers.

The next question then is: if this is so, why not immediately legalize all those who manage to cross the border? The obvious answer to this question is that such a policy will affect the incentives of other foreigners to attempt to enter the country – an act that will surely increase illegal immigration. Less obviously, legalized workers cannot be thrown out, while apprehended illegal workers can be. Thus, the illegal status may be preferred in order to allow for apprehension and deportation. Finally, political-economy reasons for keeping the workers illegal may exist, such as the benefit from having workers confined to certain sectors, which can be guaranteed in a democratic society only if they are illegal (Hillman and Weiss, 1999), or the benefit from having them largely unemployed for efficiency wage purposes (Epstein and Hillman, 2000).

The question then becomes: If the cost difference to the country does not justify an immediate amnesty, why grant an amnesty at all? One justification could be to offset the negative effects increasing border and internal control expenditures can have on a country. There exists a literature on the effects of these expenditures on the economy of the host country. Djajic (1999) examines the dynamic implications of border control policies and internal enforcement on illegal immigration, and the sectoral allocation of clandestine foreign workers. Myers and Papageorgiou (2000) present a model of a rich country with a redistributive public sector facing costly immigration control. They show that as border control becomes more expensive, inequality in the rich country increases.

Other reasons abound. First, the social costs from migrants may increase at a faster rate if the migrants are illegal than if they are legal. These social costs include illegals, as mentioned above, being involved in more crimes, both as felons and as victims. If this is so, there may be a critical mass at which point it becomes beneficial to legalize them rather than to continue bearing this additional cost. Second, the existence of a very large illegal base may signal the natives that illegality is acceptable and cause them to not pay taxes, for instance (since their illegal neighbors don't). Third, a large illegal immigrant presence may be a sign of impotence on the part of a government – which may be harmful both domestically and internationally. Fourth, it may be considered inhumane to have such a large illegal population, many of whom live in poverty. Finally, an amnesty will increase the tax base.

For all these reasons, and many others, the system is as it is. The illegal immigration is unwanted, money is spent to keep them out, and, if they infiltrate, to find them and deport them. However, if these steps are not sufficiently successful, and the population of illegals grows too big, the country may be better off legalizing them. At that point an amnesty is offered, much of the illegal population becomes legalized, and the country shifts expenditures from internal control (which becomes less necessary after the amnesty is granted) to border control. It is therefore not surprising that announcements of amnesties are often coupled with announcements about new measures taken to stop infiltration at the border.

The model will be presented as follows. In section II we first consider a country without an amnesty, and then show the effects of an amnesty. To this end, Section IIA begins with a country to which an exogenous number of people would like to immigrate, and considers the optimal manner in which the country should allocate the resources earmarked for controlling illegal immigration, when its options are spending funds on border control or on internal control. The former is used to stop infiltration by illegals, and the latter to apprehend individuals who managed to infiltrate. We show how the stock of illegal immigrants grows over time, and find the steady-state number of illegal immigrants.

Section IIB takes a more careful look at the migrants and their incentives. A model is presented in which the decision to migrate depends upon relative wages and the probability of being caught and deported. We show how the different parameters, including allocations to border and internal control, affect the size of the flow of migrants. This behavior by potential migrants feeds back into governmental allocation decisions.

We then turn in Section IIC to amnesties. We show how an amnesty affects the stock and flow of illegal immigrants, and, in turn, the cost to the country of these migrants. The cost is divided into two parts – the cost of the migrants who have been legalized, and the cost of the migrants who will arrive after the amnesty. One of the central issues is the effect an amnesty will have on migrant expectations. In particular, if potential migrants believe that amnesties will recur, the flow of migrants into the country will increase, implying a larger cost to the country. We demonstrate how the

optimal time of an amnesty is determined, and show the conditions necessary for this to be an equilibrium.

Section IID considers the possibility of a delayed amnesty, under which only those in the country for a certain minimum number of years or more are eligible for the amnesty, is considered. We show how this feeds back into potential migrant decisions, and, consequently, into costs, and demonstrate the tradeoff from such a plan.

Section IIE looks at a limited amnesty, in which illegal workers who come forward are granted a work permit for a fixed period, after which they are forced to return to their home country. Enforcement of the time period can be guaranteed by use of a bond deposited by the migrant or by someone willing to vouch for him. One of the effects of this plan is that some of the illegal immigrants do not make use of the amnesty, as it is preferable for them to remain in the country illegally, and take their chances that they will not be caught quickly.

Section III considers two extensions to the model – intertemporal transfers of control budgets and uncertainty. Our discussion on uncertainty stems from an empirical peculiarity. One of the results of many amnesties is that some applicants are refused amnesty, and are then deported (See, for example, the case of Italy in Table 1 for which we have data both on the number of applicants and the number of people granted the amnesty). If the criteria for receiving the amnesty are well known, we would not expect anyone to be expelled as a result of the amnesty, since all those who would be expelled would not step forward. For expulsions to exist the criteria must be unclear, and the reason immigrants come forward nonetheless is that their expected gain exceeds their expected loss. Thus, amnesty programs can also be a mechanism for ridding the country of some undesirables.

In Section IV we summarize and discuss the results and suggest additional extensions.

II. The Model

A. Border vs. Internal controls

Consider a country into which m_i individuals want to migrate in year i , and denote by M_i the stock of migrants in the country at the end of year i . For the

moment m_i is treated as exogenous, but this treatment is changed below where its determinants are discussed. We assume that migrants attempt to enter the country at the start of each period, and that migrants have a work life of N years, after which they retire at the end of a period. Thus, a worker entering at the start of period 1 will retire at the end of period N if still in the country. In the absence of efforts to hinder such immigrants from entering and residing in the country, the stock of illegal immigrants in the country at the end of period t (after those who entered in period $t-N+1$ have retired) will simply be $M_t = \sum_{i=t-N+2}^t m_i$.

The government has at its disposal a fixed yearly budget, E , earmarked for immigration control.⁸ Following Ethier (1986) expenditures can be bifurcated into expenditures for border controls and those for internal controls, where the former refers to expenditures aimed at keeping illegal immigrants from entering the country, and the latter refers to expenditures aimed at apprehending illegals who managed to enter the country despite the border controls. We therefore write $E_i^B + E_i^I = E$, where E_i^B are expenditures in period i on border controls and E_i^I are expenditures on internal controls. For demonstrative purposes we also assume, without any loss of generality, that the time sequence is such that all expenditures and apprehensions occur at the start of each period, so that expenditures on internal controls are effective only in apprehending illegals that are already in the country at the start of the period, and not for entrants during that period.

These expenditures are productive in preventing infiltration and in apprehending infiltrators.⁹ Let $P_i^B(E_i^B)$ and $P_i^I(E_i^I)$ denote the percentage of illegals apprehended at the border and internally at the start of year i , respectively, with $(P_i^j)' > 0$,

⁸ In Section IIIA we consider how the possibility of intertemporal budget transfers affects allocations between internal and border controls, and over time.

⁹ Note that we do not include a tenure element in the apprehension probability functions. While it is reasonable to assume that a migrant who has been in the country longer knows how to hide better, we abstract from this consideration.

$(P_i^j)'' < 0$, $P_i^j(0) = 0$, and $P_i^j(\infty) = 1$, $j = B, I$.¹⁰ Given this, the stock of illegals in the country at the end of any given year t is given by

$$(1) \quad M_t = (1 - P_t^B(E_t^B))m_t + (1 - P_t^I(E_t^I))M_{t-1} - (1 - P_{t-N+1}^B(E_{t-N+1}^B)) \prod_{j=t-N+2}^t (1 - P_j^I(E_j^I))m_{t-N+1}.$$

The first term on the rhs is the inflow of new migrants, the second term denotes the working migrants who are caught and deported, both of these occurring at the start of period t . The final term refers to the migrants who made it passed the border controls and were never caught, and have reached the age of retirement from the workforce at the end of period t . Solving this recursively:

$$(2) \quad M_t = \sum_{i=t-N+2}^t m_i (1 - P_i^B(E_i^B)) \prod_{j=i+1}^t (1 - P_j^I(E_j^I)).$$

To understand this equation, note that the stock of illegals in the country in period t depends on the flow in period i multiplied by the percentage of immigrants that managed to infiltrating the border that year, $1 - P_i^B(E_i^B)$, and by the probability that they were not caught in the subsequent $t-i$ years, $\prod_{j=i+1}^t (1 - P_j^I(E_j^I))$.

The government's objective function is assumed to be to minimize some function of the cost from illegal migrants, C_l , which we assume is monotonically increasing in the size of the stock of illegal immigrants. The objective function over a certain (possibly infinite) period is:

$$(3) \quad \begin{aligned} \underset{E_i^B, E_i^I}{\text{Min}} \sum_{i=1}^T \alpha_i C_l(M_i) &= \underset{E_i^B, E_i^I}{\text{Min}} \left[\sum_{i=1}^T \alpha_i C_l \left(m_i (1 - P_i^B(E_i^B)) + \sum_{j=i-N+1}^{i-1} m_j (1 - P_j^B(E_j^B)) \prod_{k=j+1}^i (1 - P_k^I(E_k^I)) \right) \right] \\ &\text{s.t.} \quad \sum_{i=1}^T \alpha_i = 1; \\ &\quad \alpha_i \geq 0 \forall i; \\ &\quad E_i^B + E_i^I \leq E \forall i; \\ &\quad E_i^I \geq 0 \forall i, l. \end{aligned}$$

¹⁰Our assumption is that the *percentage* caught depends on expenditures and not the *number* of those caught. This is the same assumption made in Ethier (1986) and in most of the related literature, and it conveys the idea that the greater the stock, the easier it is to find illegals – “like shooting fish in a barrel.”

We assume that the solution to (3) yields strictly positive values of E_i^B and E_i^I in all years unless the stock or flow at some point are zero (as will be the case immediately after an amnesty, as developed below).

The weights in (3), α_i , may be, but need not be, related to any number of factors including interest rates, other discount factors, political agendas, etc. We will discuss some possibilities later in this Section and in Section III, but for now we can ignore these weights because of the following lemma:

Lemma 1: *With fixed yearly budgets, allocations between internal and border controls are independent of time preferences.*

Proof: What this lemma states is that the weights do not effect the allocation of resources. To see this, replace the third constraint into the objective function by rewriting this constraint as $E_i^I = E - E_i^B$. Consider the effect of transferring expenditures from internal control to border control in period i . Clearly, from the lhs of (3), this will not effect the stock of illegals prior to period i . We differentiate the objection function, and note that the Envelope Theorem tells us that only terms in which expenditures in period i appear directly are affected, so that terms that refer to periods after all those who have entered in period i retire are not relevant. This yields:

$$(4) \quad \frac{\partial \Phi}{\partial E_i^B} = \sum_{j=i}^{i+N} \alpha_j C_I' \frac{\partial M_j}{\partial E_i^B},$$

where Φ denotes the objective function. Since we are changing only the allocation in year i , all changes in the stock in each are the result of the changes in period i . Hence:

$$(5) \quad \frac{\partial M_j}{\partial E_i^B} = \prod_{k=i+1}^j (1 - P_k^I) \frac{\partial M_i}{\partial E_i^B}, \quad j \leq N.$$

Hence, the first order condition for a maximum is (using 1):

$$(6) \quad \left[\sum_{j=i}^{i+N} \alpha_j C_I' \prod_{k=i+1}^j (1 - P_k^I) \right] \left[(P_i^B)' m_i - (P_i^I)' M_{i-1} \right] = 0.$$

Note that the term in the square brackets is clearly positive, so the allocations will be made optimally so that the term in the rounded brackets will equal zero. Since the

weights α_i do not appear in the rounded brackets, the choice of allocation of funds in any year i is independent of these weights, as per Lemma 1. *Q.E.D.*

The logic behind this finding is that since the budget is fixed, and the stock existing at the end of one period is passed on to the subsequent period, allocating resources to minimize the stock in one period will automatically minimize the stock in future periods also, since a smaller stock is being passed on. The message from this Lemma is that the optimization problem as specified is reasonable for deciding how to allocate resources between these two uses, since as long as a small stock is desired, the government will act as prescribed by (3) with respect to allocations between border and internal controls, independent of its intertemporal objective function.

From (3) we also get

Lemma 2: *The larger the stock relative to the flow, the more resources will be allocated to internal control.*

Proof: The first order condition in (6) can be rewritten as

$$(7) \quad \frac{(P_i^B)'}{(P_i^I)'} = \frac{M_{i-1}}{m_i}.$$

Since the left hand side of (7) is a decreasing function of E_i^B , the result in the Lemma follows. *Q.E.D.*

This result is intuitive, and has the following implication. Assume we started from a stock of illegal migrants of zero and that the probability functions are such that the stock is initially growing. This amounts to assuming that

$$(8) \quad \Delta M_2 = (1 - P_2^B)m_2 - P_2^I M_1 > 0.$$

The first term is the inflow of migrants, and the second term is those being deported from among the migrants who made it passed the border in period 1.¹¹ If (8) holds, then the stock will continue to grow initially. Assuming a nonincreasing flow over

¹¹ If the worklife is only 2 years, a third term denoting retirement needs to be included, as in Equation (9).

time, Lemma 2 says that this will lead to less border control and more internal control in order to lower the stock.

If the underlying conditions (the flow of migrants and the total yearly budget for illegal immigration control) remain constant, then a steady state exists. In the steady state, both the stock and flow of migrants are constant, as is the allocation of funds between border and internal controls, so that all time subscripts on the variables can be dropped. The steady state is described by the following equation:

$$(9) \quad (1 - P_s^B)m_s - P_s^I M_s - (1 - P_s^B)(1 - P_s^I)^{N-1} m_s = 0,$$

Where the last term refers to those who retire after remaining in the country and working for N years.

It is simple to show that such a steady state exists. Using (2), (9) can be rewritten as

$$\begin{aligned} (1 - P_s^B)m_s &= (1 - P_s^B)m_s \left(P_s^I \sum_{i=1}^{N-1} \prod_{j=i+1}^{N-1} (1 - P_s^I) + (1 - P_s^I)^{N-1} \right) \\ &= (1 - P_s^B)m_s \left(P_s^I \sum_{i=1}^{N-1} (1 - P_s^I)^{i-1} + (1 - P_s^I)^{N-1} \right) \end{aligned}$$

Simplifying, this becomes:

$$P_s^I \sum_{i=1}^{N-1} (1 - P_s^I)^{i-1} + (1 - P_s^I)^{N-1} = 1,$$

which is tautological. The size of the stock in the steady state will depend upon the solution to Equation 7, and the ensuing result in Equation 2.¹²

B. The Migrants

We turn now to consider the problem from the migrants' perspective. The incentive for migration is the wage differential between the home country and the host country. This differential must be great enough to outweigh the migration costs. In what follows we assume for simplicity that potential migrants are risk neutral.

¹² A simple example can be illustrative. Assume a fixed budget of 1, and probability functions $P^B = 0.2(E^B)^{0.5}$ and $P^I = 0.1(E^I)^{0.5}$. Assume also that the flow is constant and equal to 100, and that workers retire after 5 years. In this case, in the steady state over 95% of the available budget is spent on internal control, and the stock of illegal immigrants is 330.6, with 95.8 new migrants successfully entering the country each year, 32.3 being ejected, and 63.5 retiring.

There are Q heterogeneous workers in the source country each year who are interested in migrating.¹³ Wages vary across workers, with the distribution of source country wages by *potential* migrants given by $W_i^S \sim (0, W^I)$, where W^I is the wage received in the host country as an illegal immigrant. $g(W_i^S)$ is the pdf and $G(W_i^S)$ the cdf of the wage distribution. Anyone earning more than W^I in the source country is not a potential migrant.

There are potentially three types of costs associated with migration, any or all of which may exist – a cost of attempting to migrate, C_M , a cost if caught at the border, C_B , and a cost if caught inside the host country and deported, C_D . Workers will migrate if their expected income in the host country during their N years in the workforce is greater than the expected income in the source country over the same period. For simplicity, and without loss of generality, we assume no discounting.

Worker i 's lifetime wage in the source country is simply $V_i^S = NW_i^S$. In the host country the expected wage depends on the probability of being caught and deported. For worker i in period e this is given by:

$$(10) \quad V_i^H(e) = NW_i^S - C_M - P_e^B C_B + (1 - P_e^B) \left[\left(1 + \sum_{h=1}^{N-1} \prod_{k=1}^h (1 - P_{e+k}^I) \right) (W^I - W_i^S) - C_D \left(1 - \prod_{k=1}^{N-1} (1 - P_{e+k}^I) \right) \right].$$

The first term equals the wage in the source country, so that anything received above this in the host country is the wage premium from migration. The second and third terms, respectively, are the costs of migrating and the cost of being caught at the border, with the latter only being incurred if caught. The fourth term refers to the wage premium, $(W^I - W_i^S)$, which is achieved only if the worker manages to slip through the border controls. This occurs with probability $(1 - P_e^B) \cdot \prod_{k=1}^i (1 - P_{e+k}^I)$

represents the probability of still being in the country in year i , and $1 + \sum_{h=1}^{N-1} \prod_{k=1}^h (1 - P_{e+k}^I)$

¹³ Note that we do not include network effects. It is quite plausible that the flow desiring to migrate depends on the stock of *similar* migrants in the host country (see Bauer, Epstein and Gang, 2000). If this is so, a model aiming to analyze the incentives to migrate would have to define the stock of migrants as all those from the same country, whether legal or not. Such a definition would differ from the stock we use in our model in two respects: we consider the total number of illegal migrants without

is the sum of these probabilities over the N years. Note in particular the 1 in this equation stems from the fact that the migrant will receive the premium in the first period with certainty since internal controls are assumed to be relevant only for those in the country the prior year. The final term is the expected cost of being deported, with $\left(1 - \prod_{k=1}^N (1 - P_{e+k}^I)\right)$ being the probability of being deported at some point in the future.

All workers for whom $V_i^H > V_i^S$ will attempt to migrate. Thus, the flow of migrants in period e will be given by:

$$(11) \quad m_e = QG \left[W^I - \frac{(C_M + P_e^B C_B)/(1 - P_e^B) + C_D \left(1 - \prod_{k=1}^{N-1} (1 - P_{e+k}^I)\right)}{\left(1 + \sum_{h=1}^{N-1} \prod_{k=1}^h (1 - P_{e+k}^I)\right)} \right]$$

Note that, quite naturally, an increase in either internal control or border control expenditures will lower the number of migrants attempting to enter the country. What is unclear from (11) is how a shift from one to the other will affect migration. Say we consider a shift from border control to internal control (as per Lemma 2). On the one hand, the probability of getting in to the country increases, however, the probability of being caught and deported once inside the country also increases. In terms of Equation (11), the first set of terms in the numerator decreases (leading to more migration) while the second term increases (leading to less migration). In addition, the denominator decreases, leading to less migration on both accounts. As a result, if C_M and C_B are dominant costs, the result is unclear (both the numerator and the denominator decrease), however, if C_D is the dominant cost, we will have the following result:

Proposition 1: *Beginning from an initial stock of migrants below the steady state level, the flow of migrants will decrease over time.*¹⁴

concerning ourselves with the origin of these migrants, and we do not include legal migrants or those who received amnesties in the past.

Proof: Recall from Lemma 2 that if the stock relative to the flow increases, more resources will be allocated to internal control. Assume a constant flow. If we begin with a stock below the steady-state for that size flow, (8) will hold, and the stock will grow. Then, from Lemma 2, future allocations to border control will decrease in favor of increased allocations to internal control. As a result, if the numerator of (11) increases, the flow will fall. *Q.E.D.*

With the flow falling but the stock rising, a steady-state will be approached, and it will be reached when (9) holds, at which point allocations and flows will remain constant. This steady state is shown in the two panels of Figure 1. The top panel shows how allocations are changing over time, and the bottom panel shows the implications for the stock and flow of migrants over time. Both show the steady-state levels of the variables.

C. An Amnesty

To understand the effect of an amnesty, we first consider how the expectation of an amnesty will affect the flow of migrants, and then show the consequences of an amnesty for the host country. Given these consequences, we show how the optimal timing of an amnesty is determined.

Assume, then, that a country decides to grant an amnesty once every A years.¹⁵ For this to be an equilibrium, each party must be aware of the incentives and reactions of the other party, and must take these into account in choosing actions. Thus, in equilibrium, the timing of an amnesty (if any) is set by the government after taking into account the reaction of potential migrants to this timing, and migrants, in turn, knowing the government's objective function, know when the amnesty will occur. After an amnesty workers become legal and can no longer be deported. The expected

¹⁴ This Proposition depends on the assumption that there are no costs of migrating or of being caught at the border. If this assumption is relaxed, the flow of migrants may fall or increase, and a more exact specification of the functions is necessary to arrive at clear conclusions.

¹⁵The length of time between amnesties in our model will be constant in equilibrium because the problem always looks identical after each amnesty, as developed below. However, it must be noted that reality rarely behaves precisely as predicted by a deterministic model, and a glance at Table 1 shows that amnesties are not generally granted in fixed intervals. We discuss this issue in the conclusions.

lifetime income of a person considering immigrating e periods before the amnesty will increase from (10) to:¹⁶

$$(12) \quad V_i^H(e) = NW_i^S - C_M - P_e^B C_B + (1 - P_e^B) \left[\left(1 + \sum_{h=1}^e \prod_{k=1}^h (1 - P_{e+k}^I) \right) + (N - e) \right] (W^I - W_i^S) - C_D \left(1 - \prod_{k=1}^e (1 - P_{e+k}^I) \right)$$

and the number of workers migrating will increase from (11) to:

$$(13) \quad m_e = QG \left[W^I - \frac{(C_M + P_e^B C_B) / (1 - P_e^B) + C_D \left(1 - \prod_{k=1}^e (1 - P_{e+k}^I) \right)}{\left(N + 1 - e + \sum_{h=1}^e \prod_{k=1}^h (1 - P_{e+k}^I) \right)} \right].$$

This occurs for each cohort of potential immigrants from amnesty to amnesty, or, if the length between amnesties is greater than the work-life of the immigrant, for the last N years before an amnesty.

Note that if expenditures on internal control are kept constant over time, the flow of migrants into the country is going to increase as the amnesty approaches (as e gets smaller) even if the only cost of migrating is the deportation cost. This is in direct contrast to Proposition 1. Even if, as per Lemma 2, expenditures on internal control rise over time, it is likely that the positive effect of the approaching amnesty, and the benefits to be realized if the migrant manages to escape detection until then, will outweigh the negative effect of increased internal control. Thus, Lemma 2 and Proposition 1 are most likely reversed if an amnesty is known to be forthcoming. The stock of migrants in this case is demonstrated in Figure 2, in which the amnesty periods are marked. Note that the presence of an amnesty makes the shape of the curve between amnesties different from that presented in Figure 1.

Having shown the effect of an amnesty on potential migrants, we turn now to the government's decision to enact such an amnesty. In choosing whether and when to grant an amnesty, the government, for its part, must take into account not only the higher per period cost illegal immigrants inflict on the economy, but also the effect an amnesty will have on future immigration waves, as demonstrated above, and the fact that an illegal worker can be deported, while a legal worker cannot.

¹⁶ Note we have assumed that the migrant's wage does not change after becoming legal. There is good reason to believe, however, that this wage would increase, as the employment options facing the legal

We first posit the following:

Proposition 2: *The longer the length of time between amnesties, the larger will be the stock of illegal migrants prior to the amnesty.*

Proof: Proof by contradiction. Consider amnesties after A and $A+1$ periods, denoted the A -regime and the $A+1$ -regime, respectively. In the period just before the amnesties, which we denote period T , assume that the stock of migrants under the two regimes is equal. The size of the flow will be affected only by the allocation between border control and internal control in this period (the other conditions, such as costs, are exogenous) since all migrants who manage to enter the country will be granted an amnesty at year's end. The optimal allocation will therefore be the same in both periods, as will the flow of migrants. Then. Returning to period $T-1$, the flows will again be equal because of the identical allocations in the last period. As a result, allocations will also be identical under the two regimes in period $T-1$. This can be continued until the period $T-A$. However, in period $T-A$ the stock under the A -regime is by definition 0 (since an amnesty was just declared) while that in the $A+1$ -regime is positive because of the migration in the preceding period. Thus, the stocks cannot be equal in period T .

Assume now that the stock in period T is larger under the A -regime than under the $A+1$ -regime. Then by Lemma 2 more resources will be allocated to internal control in the last period in the A -regime, so the flow in period $T-1$ will be smaller in the A -regime. This is because if the same resources were allocated in both cases the flows would be identical, and Equation (7) would not hold. Hence, to get a larger stock in period T , an even larger stock must have remained from period $T-1$. Continuing, as in the previous paragraph, to period $T-A$, the stock in this period will have to be greater in the A -regime, which is impossible. Thus, the proposition holds.

Q.E.D.

This proposition is not obvious since the longer period before the amnesty will lead to smaller flows of migrants, and this effect had the potential to lead to a lower

migrant are far vaster than those facing an illegal immigrant. This increased wage would have the effect

total illegal presence. From the proof it is clear why this does not occur. This proposition now allows us to consider the issues involved in choosing the optimal timing of an amnesty.

We assume that the government is benevolent, and that it desires to allocate resources (on border and internal controls) and to set policy (on the frequency of amnesties) in order to minimize the cost to the country from these immigrants.¹⁷ Allocations of resources are as derived above in Section IIA. An amnesty, however, entails a tradeoff. On the one hand, illegal immigrants are assumed to be more costly to the country than if they were legalized, for the reasons discussed in the introduction. We denote the yearly cost of M illegal workers $C_I(M)$ and of M legal workers $C_L(M)$, with $C_I(M) > C_L(M)$. Hence, the earlier the amnesty the less costs the country must bear from migrants already in the country. On the other hand, once a worker is legalized he can no longer be expelled, and the earlier the amnesty, the larger the flow of migrants (as developed above). Thus, for instance, if an amnesty is granted each year there is no cost from illegality (although there is a cost from the legal migrants), but all foreign workers for whom the salary difference is enough to cover the migration costs will desire to migrate, and if they get passed the border controls they will remain in the country until they retire.

We now develop the conditions necessary for an amnesty once every A years to be optimal and an equilibrium. Assume the economy is at a point at which it must decide whether to grant an amnesty (A years after the last amnesty). Recall from the discussion above that the flow, and thus the stock, of illegal migrants depends on the allocation of expenditures on border and internal controls, and on the length of time between amnesties. The government takes this relationship into account in determining these parameters. We thus define the cost of illegal immigrants at period i given an amnesty period of A as $C_I(M_i(A))$, and the cost of the same number of legal workers as $C_L(M_i(A))$. When such an amnesty is granted, the illegal immigrants turn legal, and each legal immigrant remains in the country until he retires. Thus, an amnesty granted in period A will lead to the presence of legal migrants until period $A+N-1$, but the number will decrease over time since the earlier arrivals also retire

of further increasing the flow of immigrants as the amnesty date approaches.

¹⁷Note that this stated goal implies specific weights (α) in Equation (3). Changing the government's objective function to include, for instance, political considerations would alter the values of α .

earlier. Thus, $M_i(A)$ denotes the number of legal migrants remaining i years after the granting of an amnesty in year A . At period A , when the government is considering granting an amnesty, the cost of the existing and all future illegal immigrants that will result from a policy of amnesties every A periods is given by:¹⁸

$$(14) \quad C(A) = \sum_{i=1}^{N-1} \delta^i C_L(M_i(A)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i(A)) + \delta^A C(A),$$

where δ is the discount rate.¹⁹ The first term is the present value of the cost to the economy of those workers who have been legalized and will now remain in the country until retirement. The second term is the cost of all those immigrants who arrive between this amnesty and the next amnesty. The final term reflects the fact that the problem the government faces before this amnesty is identical to the one it will face before the next amnesty. Solving (14), we get:

$$(15) \quad C(A) = \frac{\sum_{i=1}^{N-1} \delta^i C_L(M_i(A)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i(A))}{(1 - \delta^A)}.$$

For A to be an *optimal* amnesty frequency, it must be the case that having an amnesty once every A periods is no more costly than having one once every B periods. This amounts to requiring that:

$$(16) \quad \frac{\sum_{i=1}^{N-1} \delta^i C_L(M_i(A)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i(A))}{(1 - \delta^A)} \leq \frac{\sum_{i=1}^{N-1} \delta^i C_L(M_i(B)) + \sum_{i=1}^{B-1} \delta^i C_I(M_i(B))}{(1 - \delta^B)}.$$

As shown in Proposition 2, the stock of immigrants will be greater in the final, and each intermediate, period the longer the amnesty period. Thus, if $B > A$ this will tend to make the RHS larger than the LHS. However, legalization occurs less often, which leads to two benefits from a later amnesty – lower costs from legalized aliens because of the less frequent amnesties (this is witnessed by the larger discount factor in the

¹⁸ In the case where A is a continuous variable and the amnesty can occur at any point in time (14)

becomes: (14') $C(A) = \int_{i=1}^{N-1} \delta^i C_L(M_i(A)) di + \int_{i=1}^{A-1} \delta^i C_I(M_i(A)) di + \delta^A C(A)$, and (14') is a

continuous function defined on a closed and compact set. Thus, there exists a level A that minimizes $C(A)$. In the case that A can only take on an integer value, we can find the value of A that minimizes (14') and then test which of the integers closest to it minimizes (14).

¹⁹ We changed the notation for time preference from that used in Equation 3 (α) to denote that while above we placed no restrictions on the relative values over time (see Lemma 1), here the deterioration from period to period is constant, for simplicity.

denominator on the RHS), and by the additional period of a low stock of illegal migrants when the amnesty frequency is lengthened.

For A to also be an *equilibrium* amnesty frequency it must not be worthwhile for the government to “fool” migrants. In other words, given that consumers believe that an amnesty will occur after A periods, it must not be beneficial for the government to either proclaim an amnesty a year earlier or to push the amnesty off for an additional year. To evaluate this, we assume that potential migrants can be fooled only once, and that if, for instance, an amnesty is pushed off by one year, migrants will then believe that amnesties will occur only once every $A+1$ periods. We consider the possibilities of delaying the amnesty by one year or of bringing the amnesty forward by one year. These conditions amount to:

$$(17a) \quad \sum_{i=1}^{N-1} \delta^i C_L(M_i(A)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i(A)) + \delta^A C(A) \leq \\ C_I(M_A(A)) + \sum_{i=2}^N \delta^i C_L(M_i(A)) + \sum_{i=2}^{A+1} \delta^i C_I(M_i(A+1)) + \delta^{A+2} C(A+1)$$

and

$$(17b) \quad C_I(M_{A-1}(A)) + \sum_{i=2}^N \delta^i C_L(M_i(A)) + \sum_{i=2}^A \delta^i C_I(M_i(A)) + \delta^{A+1} C(A) \leq \\ \sum_{i=1}^{N-1} \delta^i C_L(M_{i-1}(A)) + \sum_{i=1}^{A-2} \delta^i C_I(M_i(A-1)) + \delta^{A-1} C(A-1)$$

(17a) compares costs of an amnesty in period A with an amnesty in period $A+1$, when migrants expect the amnesty in period A . (17b) looks one period earlier, and compares the cost of waiting until the expected time for an amnesty, and proclaiming an immediate amnesty. The same tradeoffs discussed above continue to be present.

D. A Delayed Amnesty

An often-used strategy is to declare an amnesty only for those who can prove that they have been in the country for some minimum period. Thus, for example the 1986 U.S. amnesty required proof of residence in the U.S. from at latest January 1, 1982, and the Dutch 1995 amnesty required proof of presence for at least 6 years.

The aim of such a plan is to limit the effect of the amnesty on the desire of migrants to enter the country in order to be eligible for the amnesty. Say the amnesty is only for those who have been in the country for at least τ years. Then the lifetime

value of immigrating depends on when one migrated. If he migrated before the cutoff date, e.g., $e \geq \tau$ periods before the amnesty, then income is given by (12). However, if he migrated after the cutoff date, he will not become permanent until the next amnesty, so his lifetime income is given by:

$$(18) \quad V_i^H(e) = NW_i^S - C_M - P_e^B C_B + (1 - P_e^B) \left[\left(1 + \sum_{h=1}^{e+A} \prod_{k=1}^h (1 - P_{e+k}^I) \right) + (N - e - A) \right] (W^I - W_i^S) - C_D \left(1 - \prod_{k=1}^{e+A} (1 - P_{e+k}^I) \right).$$

The effect of such a plan is that all those who fall into this latter category will have a greatly lessened incentive to migrate. For this reason, and mostly because fewer immigrants will be around to receive the amnesty, the number of workers for whom the amnesty applies will be smaller. Assuming an amnesty every A years, and assuming $N > A + \tau$ the stock of migrants eligible for the amnesty will be:

$$M_A^L = \sum_{i=t-A-\tau}^{t-\tau} m_i (1 - P_i^B(E_i^B)) \prod_{j=i+1}^t (1 - P_j^I(E_j^I)).$$

The other side of the coin, of course, is that such a plan limits the benefit from the amnesty, since all those who entered the country during this ‘‘incubation’’ period remain in the country, and remain illegal. Thus, the stock of illegals is reduced, but not to zero. The stock of illegal immigrants that remain in the country immediately following an amnesty is:

$$M_A^I = \sum_{i=t-\tau}^t m_i (1 - P_i^B(E_i^B)) \prod_{j=i+1}^t (1 - P_j^I(E_j^I)).$$

The stock of illegal immigrants over time is exhibited in Figure 3. Note that, compared to Figure 2, the stock rises slower due to the decreased incentive to migrate, but it also falls less after an amnesty.

The government would like to set internal and border control allocations, an amnesty frequency, and an incubation period that brings the cost from illegal immigrants to a minimum. Thus, in an analogous manner to that above, the government would like to minimize

$$(19) \quad C(A, \tau) = \sum_{i=1}^{N-\tau-1} \delta^i C_L(M_i^L(A)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i^I(A, \tau)) + \delta^A C(A, \tau).$$

Conditions analogous to (16) and (17) will need to hold for this to be an equilibrium.

E. A Limited Amnesty

Many countries plagued by illegal immigration are reluctant to grant the type of amnesty granted in, for instance, the U.S. (where citizenship was granted) because they are not interested in having these illegals become citizens in their country. For these countries, the goal of the amnesty is often to rid the country of these undesirables. To this end, they devise an amnesty that will be sufficiently attractive to entice the illegal immigrants to come forward, while at the same time limiting their duration in the country. A limited amnesty is just such a plan, whereby workers are given a permit to remain and work in the country for a limited period of time, and are then required to leave once the permit has expired.²⁰ Thus, for example, the Greek amnesty in 1998 was comprised of two stages.²¹ In the first stage workers were invited to submit applications for a temporary residence permit (a white card), and in the second, they could apply for a green card if they could prove that they had worked for at least 40 days between January and July 1998. The green card enabled the worker to remain 1-3 years, with subsequent renewal for two years possible. Special provisions also existed for the granting of five-year permits. The 43% of those with white cards who were not granted green cards and who remained in the country are again considered illegal.²²

A limited amnesty introduces a new consideration into the model. Until now, all those eligible for an amnesty requested the amnesty. With a limited amnesty, however, those workers with a longer horizon will choose to bypass the amnesty, and instead remain illegal. In particular, the amnesty will certainly be accepted by anyone whose remaining work-life is shorter than the length of the work permit, but will tend to be rejected by those who will continue working for many years after the permit expires. In addition, the amnesty will be more attractive to those who lose less by

²⁰Any such plan must lend for the contingency that the worker will decide to overstay his permit, and will disappear into the economy and once again become an illegal immigrant. Thus, the granting of such a permit must include a mechanism that will allow the authorities the ability to enforce the departure of these illegal aliens. One such mechanism is the posting of a bond by the worker or his employer that is forfeited if the worker does not leave the country on time. For the effects of such bonds on illegal immigrants and their employers, see Epstein, Hillman and Weiss (1999).

²¹See *Trends in International Migration, 1999*.

²²Korea, for instance, took a slightly different route. In their 1997-8 and 1999 amnesties they did not grant work permits, but rather allowed the illegal residents to leave the country without risking sanctions. This can be incorporated in our model by setting $C_D=0$ if you accept the amnesty.

returning home because the wage differential is relatively low, i.e., those for whom W_i^S is relatively large.

Consider, then, an illegal worker, i , with a remaining work-life of X years, being offered a permit for Y years, $Y < X$. He will accept the offer if:

$$(20) \quad (W^I - W_i^S)Y \geq (W^I - W_i^S) \sum_{i=1}^{X-1} \prod_{k=1}^i (1 - P_k^I) - C_D \left(1 - \prod_{k=1}^{X-1} (1 - P_k^I) \right).$$

Note that our assumption that the worker's wage does not change once becoming legalized (see fn. 14) limits the desirability of such a program. Were we to make the wage once legalized higher than when illegal, the number of people coming forward to accept this offer of amnesty would increase. The qualitative results, however, would not change.

There will also be an effect on those intending to migrate. The expected income of a potential immigrant will be equal to

$$(21) \quad \begin{aligned} & \text{Max} \left\{ NW_i^S - C_M - P_e^B C_B + (1 - P_e^B) \left[\left(1 + \sum_{h=1}^e \prod_{k=1}^h (1 - P_{e+k}^I) \right) + Y \prod_{k=1}^e (1 - P_{e+k}^I) \right] (W^I - W_i^S) \right. \\ & \qquad \qquad \qquad \left. - C_D \left(1 - \prod_{k=1}^e (1 - P_{e+k}^I) \right) \right\}, \\ & NW_i^S - C_M - P_e^B C_B + (1 - P_e^B) \left[\left(1 + \sum_{h=1}^{N-1} \prod_{k=1}^h (1 - P_{e+k}^I) \right) (W^I - W_i^S) - C_D \left(1 - \prod_{k=1}^{N-1} (1 - P_{e+k}^I) \right) \right] \end{aligned}$$

The first term in the brackets give the expected income if the worker accepts the amnesty he will be offered, and the second term is the expected income if he does not. This latter term is identical to (10).

The result of this type of amnesty is that, in most cases, the amnesty will not rid the country of all illegal workers. Some will remain illegal, and continue to inflict the same costs upon the host country as in the original model. However, the incentive to migrate to the country is less than with a full amnesty, so again the stock of illegals in the country can be expected to vary as in Figure 3.

Interestingly, such a plan will actually make the incomes of those who do not accept the amnesty higher because government allocations will be shifted towards border controls and away from internal controls. This occurs because the existence of

an amnesty increases flows, but the amnesty itself lowers the stock. Thus, the essence of this amnesty limits its degree of success.

Much as in the previous section, the government would like to allocate resources and set the length of the temporary work permit and of the amnesty frequency such that it minimizes costs from the immigrants (both illegal and legal). In order to do so, the government should take into account the effect the length of the permit has on the percentage of people that will accept the amnesty offer, and the effect on new migration. The cost from such a program is:

$$C(A,Y) = \sum_{i=1}^Y \delta^i C_L(M_i^L(A,Y)) + \sum_{i=1}^{A-1} \delta^i C_I(M_i^I(A,Y)) + \delta^A C(A,Y),$$

where the illegal population at the time of the amnesty is divided into those who accept the amnesty, $M_1^L(A,Y)$, and those who do not, and are included, in addition to new migrants, in $M_1^I(A,Y)$.

It is also possible to combine a limited amnesty with a delayed amnesty. As discussed above, the goals of these two types of amnesty are different. Those using a limited amnesty are interested in getting rid of as many migrants as they can, while those using a delayed amnesty tend to desire the naturalization of the migrants who have been in the country for a sufficiently long period. Perhaps for this reason, there have not, to our knowledge, been amnesties that have combined these two arrangements. It is possible, however, that the two could be used in tandem in order to minimize costs. From a modeling perspective, this would mean simply combining this and the last section, and minimizing costs over three arguments – the frequency of the amnesties, the incubation period, and the length of the temporary permit. The qualitative results would not change.

III. Extensions

A. Intertemporal budget transfers

In Section IIA we considered a situation in which there was no amnesty, and the budget was fixed in each period. Returning to that scenario, consider now the effect of a budget that is fixed for the entire period, but can be transferred intertemporally. In this case, even without considering an amnesty, the simple solution inherent from

Lemma 1 may not hold. Equation (3) continues to be the objective function, but the third constraint now becomes:

$$(22) \quad \sum_{i=1}^T (E_i^B + E_i^I) \leq E,$$

where E is now the total budget allocated to the illegal immigration problem over the entire period. We thus rewrite the objective function as:

$$(23) \quad \begin{aligned} \underset{E_i^B, E_i^I, \lambda}{\text{Min}} L = & \left[\sum_{i=1}^T \alpha_i C_I \left(m_i (1 - P_i^B(E_i^B)) + \sum_{j=i-N+1}^{i-1} m_j (1 - P_j^B(E_j^B)) \prod_{k=j+1}^i (1 - P_k^I(E_k^I)) \right) \right] \\ & + \lambda \left(E - \sum_{i=1}^T (E_i^B + E_i^I) \right) \end{aligned}$$

where λ is a LaGrange multiplier.²³ Assuming, without loss of generality, that $N > T$, the first-order conditions are:

$$(24) \quad \frac{\partial L}{\partial E_i^B} : - \left[\alpha_i + \sum_{k=1}^{T-i} \alpha_{i+k} \prod_{j=1}^k (1 - P_{i+j}^I) \right] C_I' (P_i^B)' m_i - \lambda = 0;$$

$$(25) \quad \frac{\partial L}{\partial E_i^I} : - \left[\alpha_i + \sum_{k=1}^{T-i} \alpha_{i+k} \prod_{j=1}^k (1 - P_{i+j}^I) \right] (P_i^I)' M_{i-1} - \lambda = 0;$$

and condition (22). Comparing (24) and (25) for any given i , we get condition (7) again – independent of the amount allocated to a certain period, the allocation *within* the period is the same as before, for the same reasons. Comparing the allocation across periods is more difficult, and without further specifying the variables little can be said. We will, however consider two cases. Under the assumption that the flow (m) is constant over time, we consider the case where there is no time preference (i.e., all the α_i 's are equal), and the case where only the stock at the end of the period (possibly when a new election is to be held) is of interest.

i. No time preference

If all periods are given equal weight (e.g., the government is benevolent, there is no discount factor, and the cost from illegal workers is linear in their stock), then $\alpha_k = 1/(T+1)$, so the first order condition can be rewritten as:

²³ If $N < T$ nothing

$$(24') \quad \frac{\partial L}{\partial E_i^B} : -\frac{1}{T+1} \left[1 + \sum_{k=1}^{T-i} \prod_{j=1}^k (1 - P_{i+j}^I) \right] (P_i^B)' m_i - \lambda = 0; \text{ and}$$

$$(25') \quad \frac{\partial L}{\partial E_i^I} : -\frac{1}{T+1} \left[1 + \sum_{k=1}^{T-i} \prod_{j=1}^k (1 - P_{i+j}^I) \right] (P_i^I)' M_{i-1} - \lambda = 0$$

This yields the following proposition:

Proposition 3: *Beginning below steady-state, with a constant flow of immigrants, and when each period is of equal importance, allocations to border control will decrease over time, while the direction of change in allocations to internal control is ambiguous. In addition, as long as the flow of migrants is nondecreasing over time the ratio of expenditures on border control to internal control decreases over time.*

Proof: Comparing the first order condition (24') over two consecutive periods, we get

$$(26) \quad \left[1 + \sum_{k=1}^{T-i} \prod_{j=1}^k (1 - P_{i+j}^I) \right] (P_i^B)' = \left[1 + \sum_{k=1}^{T-i-1} \prod_{j=1}^k (1 - P_{i+1+j}^I) \right] (P_{i+1}^B)'.$$

The bracketed term on the RHS is clearly smaller than that on the LHS, so the second term on the RHS must be larger. For this to occur, it must be that $E_{k+1}^B < E_k^B$.

Comparing (25') for two consecutive periods:

$$(27) \quad \left[1 + \sum_{k=1}^{T-i} \prod_{j=1}^k (1 - P_{i+j}^I) \right] (P_i^I)' M_{i-1} = \left[1 + \sum_{k=1}^{T-i-1} \prod_{j=1}^k (1 - P_{i+1+j}^I) \right] (P_{i+1}^I)' M_i.$$

Since $M_k \geq M_{k-1}$, it is not clear whether expenditures increase or fall. The last part of the proposition follows directly from Lemma 2. *Q.E.D.*

Decreasing border control expenditures occur because earlier arrivals affect the stock for more periods, so it is more efficient to reduce the stock during the earlier periods rather than in later periods when their effect is for a more limited time period. This effect would seem to exist for internal controls also, but there is an opposing effect due to the growing size of the stock, making internal controls more crucial in later periods.

Recall from (11) that the flow depends on internal control expenditures and not on border control expenditures. Since it is uncertain how internal controls change over time, it is also uncertain how the flow of migrants will change over time. Note, however, that in keeping with our discussion of amnesties above, if the flow of migrants increases over time, allocations to both border and internal controls may still rise.

ii. Preference for the last period

In political economy literature, it is believed that politicians and voters place significant importance on occurrences during an election year. For instance, it is well known that governmental expenditures (particularly at the municipal level) increase during election years (see, for example, Nordhaus, 1975, Frey and Schneider, 1978, Rosenberg, 1992, and Rozevitch and Weiss, 1993). The importance of the election-year situation to voters extends to any issue pertinent to a campaign, with illegal immigration being no exception. It would be difficult for a challenger to an office to make an issue of the level of illegal immigration that pertained a few years earlier. Clearly, the current state of affairs is what voters are mostly concerned with. We take this idea to the extreme, and propose as follows:

Proposition 4: *When the stock in the last period is the only concern of the government, if the flow of migrants is nondecreasing over time, allocations to both border control and internal control will increase over time, and if the flow of migrants is increasing over time, allocations to border control may rise or fall, but allocations to internal control will still increase over time.*

Proof: Under this setting, the optimization problem is simplified, as $\alpha_T = 1$, and all other $\alpha_i = 0$. The first order conditions become:

$$(24'') \quad \frac{\partial L}{\partial E_i^B} : - \left[\prod_{j=1}^{T-i} (1 - P_{i+j}^I) \right] (P_i^B)' m_i - \lambda = 0; \text{ and}$$

$$(25'') \quad \frac{\partial L}{\partial E_i^I} : - \left[\prod_{j=1}^{T-i} (1 - P_{i+j}^I) \right] (P_i^I)' M_{i-1} - \lambda = 0;$$

Compare now two consecutive periods, k and $k+1$, and assume that $m_k \leq m_{k+1}$. From (24") we see that in equilibrium:

$$(28) \quad \left[\prod_{j=1}^{T-k} (1 - P_{k+j}^I) \right] (P_k^B)' m_k = \left[\prod_{j=2}^{T-k} (1 - P_{k+j}^I) \right] (P_{k+1}^B)' m_{k+1}, \text{ or}$$

$$(29) \quad (1 - P_{k+1}^I) (P_k^B)' m_k = (P_{k+1}^B)' m_{k+1}.$$

Since the first term is strictly less than one and the second derivative of P_i^B is strictly negative, it is clear that $E_{k+1}^B > E_k^B$. If, however, $m_k > m_{k+1}$ expenditures on border controls will increase only if $(1 - P_{k+1}^I) m_k < m_{k+1}$.

With respect to internal controls, a comparison of two consecutive years yields:

$$(30) \quad (1 - P_{k+1}^I) (P_k^I)' M_{k-1} = (P_{k+1}^I)' M_k.$$

Since the population of illegal immigrants grows until the steady state and then stays constant, $M_k \geq M_{k-1}$. Hence, from (28) it is immediate that $E_{k+1}^I > E_k^I$, independent of the direction of the flow. *Q.E.D.*

The logic behind the border control result is that immigrants who enter at an earlier period may still be caught and deported later on, so it is less important to catch them at the border. Those who manage to enter closer to the election year, however, will probably still be around at the end of the period, so it becomes more important to keep them out. Thus, unless the flow is significantly decreasing over time, expenditures will increase. With respect to internal controls the larger the stock the more illegals will be caught and deported, so expenditures on internal control become more cost efficient.

Recall from Section IIB that the increase in internal controls should lead to a decrease in the flow of illegal immigrants. Thus, while we can conclude that internal control expenditures will increase, it is not clear what will happen to border control expenditures. If, however, an amnesty is imminent, the flow of migrants will tend to increase over time so both types of expenditures will increase. This increased flow is

not guaranteed, however, since the increasing budgets allocated to apprehension may dampen this increased desire to migrate.²⁴

B. Uncertainty

An interesting empirical aspect of amnesties is that there tend to be migrants who come forward to get an amnesty, but are then denied the amnesty and instead shipped out of the country. This seems to be an unintentional (or perhaps intentional) side effect of the amnesty. In this section we consider whether this can be an equilibrium strategy.

Say potential candidates for an amnesty are distributed along an additional scale with respect to some variable that is of concern to the authorities. For instance, authorities may say that those found to have been involved in illegal activities of some sorts (theft, drugs, etc.) will be brought before a board to decide whether to grant them amnesty or to deport them. In this case, those clearly not involved will step forward, those heavily involved will not, but those in the middle will step forward only if their expected gain is positive.

From Equations (12) and (10) we can discern that the gain from being granted an amnesty to a worker depends on how many periods he has remaining in his worklife, and is given by:

$$(31) \quad \left(- \sum_{i=A}^{N-1} \prod_{k=A}^i (1 - P_k^I) + (N - A) \right) (W^I - W_i^S) + C_D \left(1 - \prod_{k=A}^{N-1} (1 - P_k^I) \right).$$

The first set of terms is the addition wage received over the migrant's remaining worklife, and the second set of terms is the expected savings from the fact that it is clear that he will not have to bear the deportation cost once he has received the amnesty. If, however, the worker who steps forward for an amnesty is denied that amnesty and, instead, deported, his expected loss (relative to had he not come forward) will be:

$$(32) \quad \left(\sum_{i=A}^{N-1} \prod_{k=A}^i (1 - P_k^I) \right) (W^I - W_i^S) + C_D \left(\prod_{k=A}^{N-1} (1 - P_k^I) \right).$$

²⁴ It will not, though, affect the gross flow in the last year before the amnesty since internal control will not be effective for them.

The first set of terms, again, being the loss in expected wage, and the second set of terms being the deporting cost. The reason this latter cost is multiplied by $\prod_{k=A}^{N-1} (1 - P_k^I)$ is because while the cost will certainly have to be paid, there was a probability that it would have been paid anyway (had he been caught), and so the loss from coming forward is just the difference.

Combining (31) and (32), and defining $P(A)$ as the probability of being granted the amnesty given the migrant's place on the scale, the migrants who will come forward to request amnesty will be those for whom:

$$(33) \quad \left(- \sum_{i=A}^{N-1} \prod_{k=A}^i (1 - P_k^I) + P(A)(N - A) \right) (W^I - W_i^S) + C_D \left(P(A) - \prod_{k=A}^{N-1} (1 - P_k^I) \right) > 0.$$

Isolating $P(A)$, those who will come forward will be those for whom:

$$(34) \quad P(A) > \frac{\sum_{i=A}^{N-1} \prod_{k=A}^i (1 - P_k^I)}{N - A + C_D} + \frac{C_D \prod_{k=A}^{N-1} (1 - P_k^I)}{(N - A + C_D)(W^I - W_i^S)}.$$

This will include two groups – those for whom the probability of gaining the amnesty is high and those for whom the alternative wage at home is sufficiently high so that the risk is relatively low.

The outcome of such a “fuzzy” amnesty declaration will be that there will be some deported, but they will tend to be those who have committed the least grievous crimes rather than those who the country would truly like to rid itself of. This will also be true since many of those harder criminals will be earning higher salaries doing what they are doing than if they became legal (and, as a result, visible).

IV. Summary

This paper presented an attempt at understanding Why, When and How of immigration amnesties, complementing studies by Chau (2001, 2003), Karlson and Katz (2003) and Gang and Yun (2006). We have considered government behavior with respect to allocations for limiting infiltration (border control) and apprehending infiltrators (internal control) and with respect to the granting of amnesties (Why), the timing of amnesties (When), and limitations on those amnesties (How). We have been able to reach some conclusions with respect to allocations and the flow of immigrants, and have gained insight into the timing and manner of amnesties. More specific

conclusions would require more specific functional specifications. We have also considered two extensions – intertemporal transfers of policing funds and “fuzziness” in declarations regarding eligibility for an amnesty aimed at apprehending and deporting undesirables.

The model presented in this paper is deterministic, and thus yields some strong results despite the minimal assumption regarding functional forms. For instance, the model predicts that amnesties will be evenly spaced temporally. However, a glance at Table 1, depicting actual amnesty programs, makes it clear that this is not, in fact, the case. There are numerous reasons that the predicted stationarity should not be overplayed, since there are numerous sources for uncertainty. For instance, the size of the control budget could change from year to year, as could the probabilities of being apprehended and the number of migrants interested in migrating (which is a function of the relative wages and level of unemployment in each country, themselves random variables). Producing a model with such random factors is beyond the scope of this paper, however, the basic setup, and the results thereof, are set out in this paper.

There are many extensions that could be considered, even without including uncertainty. Throughout most of the paper we considered a fixed yearly budget. It would be interesting to consider exogenous changes to this budget, and to see how this would affect outcomes. Alternatively, the size of the allocation for immigration control could be endogenized in a more general model which incorporates this expenditure as part of the government’s total budget, with the size of the yearly allocation depending on the sizes of the flows and stocks of illegal immigrants.

In the model we assumed that potential migrants were drawn from a population of workers who were heterogeneous in their wages. An alternative would be to have source country wages identical (they could all, for instance, be unemployed in their home countries), but have potential migrants differ in other ways. For instance, their skills could differ, in which case the better workers would be the first to migrate. Or, even if workers are homogeneous in abilities, they could differ in their attachment to the source country. Thus, married people would be less likely to move, particularly if they have young children. Also, those with elderly parents might be less inclined to abandon them.

An additional alternative is differing levels of risk aversion. In the model we assumed workers are risk neutral, and so considered only expected income. If workers, however, have differing levels of risk aversion (or risk loving), a self-selection equilibrium can be had without resorting to heterogeneous workers. Since there is risk in migrating – the worker may not get into the country (border control) or may be apprehended and deported (internal control) – those who are least risk-averse will be the first to migrate. The result of this is that those who come may be the most risk-loving of the potential migrants – which may help explain why so many of them end up involved in risky activities, such as criminal activities.

The paper also has numerous empirical implications regarding changing allocations over time, changes in migration flows over time, and differences between countries that grant amnesties and those that do not (perhaps because the stock or flow of illegals does not warrant such a measure). We leave all these to future research.

References

- Andreoni, J. (1991) "The Desirability of a Permanent Tax Amnesty," *Journal of Public Economics*, 45, 143-59.
- Bauer, T., Epstein, G.S., and Gang, I.N. (2000) "What are Migration Networks?" *IZA Discussion Paper* 200.
- Borjas, G. (1994) "The Economics of Immigration," *Journal of Economic Literature*, 32, 1667-1717.
- Borjas, G. (1995) "The Economic Benefits from Immigration," *Journal of Economic Perspectives*, 9, 3-22.
- Chau, N.H. (2001) "Strategic Amnesty and Credible Immigration Reform," *Journal of Labor Economics*, 19, 604-634.
- Chau, N.H. (2003) "Concessional Amnesty and the Politics of Immigration Reforms," *Economics and Politics*, 15(2), 193-224.
- Chiswick, B.R., and Miller, P.M. (1999) "Ethnic Networks and Language Proficiency among Immigrants," *Journal of Population Economics*, 12, 19-35.
- Djajic, S. (1999) "Dynamics of Immigration Control," *Journal of Population Economics*, 12, 45-61.
- Epstein, G.S., and Hillman, A.L. (2003) "Unemployed Immigrants and Voter Sentiments in the Welfare State," *Journal of Public Economics*, 87, 1641-1655.
- Epstein, G.S., Hillman, A.L. and Weiss, A. (1999) "Creating Illegal Immigrants," *Journal of Population Economics* 12, 3-21.
- Epstein, G.S., and Weiss, A. (2001), "A Theory of Immigration Amnesties," *IZA Discussion Paper* 302.
- Ethier, W.J. (1986) "Illegal Immigration: The Host Country Problem," *American Economic Review*, 76, 56-71.
- Frey, B., and Schneider, F. (1978) "An Empirical Study of Politico-economic Interaction in the U.S.," *Review of Economics and Statistics*, 60, 174-183.
- Gang, I.N. and Yun, M.S. (2005) "Immigration Amnesty and Immigrant's Earnings," Working Paper.
- Gavosto, A., Venturini, A. and Villosio C. (1999) "Do Immigrants Compete with Natives?" *Labour* 13, 603-621.

- Guzman, M., Haslag, J., and Orrenius, P. (2007) "On the Determinants of Optimal Border Enforcement," *Economic Theory*, 34, 261-296.
- Hanson, G.D., Robertson R., and Spilimergo A. (1999) "Does Border Enforcement Protect USA workers from Illegal Immigrants?" NBER working paper no. 7054.
- Hillman, A.L., and Weiss, A. (1999) "A Theory of Permissible Illegal Immigration," *European Journal of Political Economy*, 15, 585-604.
- Karlson, S.H., and Katz E. (2003) "A Positive Theory of Immigration Amnesties," *Economics Letters*, 78, 231-239.
- Malik, A.S., and Schwab, R.M. (1991) "The Economics of Tax Amnesties," *Journal of Public Economics*, 41, 29-49.
- Myers, G.M., and Papageorgiou Y.Y. (2000) "Immigration Control and Welfare State," *Journal of Public Economics*, 75, 183-207.
- Nordhaus, W. (1975) "The Political Business Cycle," *Review of Economic Studies*, 42, 169-190.
- Rosenberg, J. (1992) "Rationality and the Political Business Cycle: The Case of Local Government," *Public Choice*, 73, 71-81.
- Rozevitch, S., and Weiss, A. (1993) "Beneficiaries from Federal Transfers to Municipalities: The Case of Israel," *Public Choice*, 76, 335-346.
- Venturini, A. (1999) "Do Immigrants Working Illegally Reduce the Natives' Legal Employment? Evidence from Italy," *Journal of Population Economics*, 12, 135-154.
- Zimmermann, K.F. (1995) "Tackling the European Migration Problem," *Journal of Economic Perspectives*, 9, 45-62.

Table 1
Selected Regularization Programs

Country	Year	Number of regularized immigrants	Details
Argentina	1994	210,000	
Belgium	2000	52,000	Started in January 2000. Number of applicants
France	1981-2	121,100	Excluding seasonal workers and small traders
	1997-8	77,800	143,000 applicants
Greece	1997-8	371,000	Granted White cards, of which 220,000 applied for green cards. Permits to remain up to 5 years
	2001	351,000	Number of applicants
Italy	1987-8	118,700	
	1990	217,700	
	1996	244,500	258,761 applicants
	1998	271,100	350,000 applicants
	2002	634,700	702,200 applicants
Korea	1997-8	45,000	Allowed to leave without sanctions
	1999	?	
Portugal	1992-3	39,200	
	1996	21,800	
	2001	179,200	Excluding 24,600 other applicants not yet examined
Romania	1997	30,000	Extended temporary residence visas
Spain	1985-6	43,800	Number of applications received
	1991	110,100	
	1996	21,300	
	2000	163,900	
	2001	234,600	
Switzerland	2000	15,200	
United States	1986	2,684,900	1989-1996 under 1986 Immigration and Reform Control Act. Excludes dependents
	1997-8	405,000	Nicaraguan Adjustment and Central American Relief Act (1997), and Haitian Refugee Immigration Fairness Act (1998)
	2000	400,000	Estimate of applicants under Legal Immigration Family Equity Act

Source: Trends in International Migration, OECD 1998-2004.

Figure 1

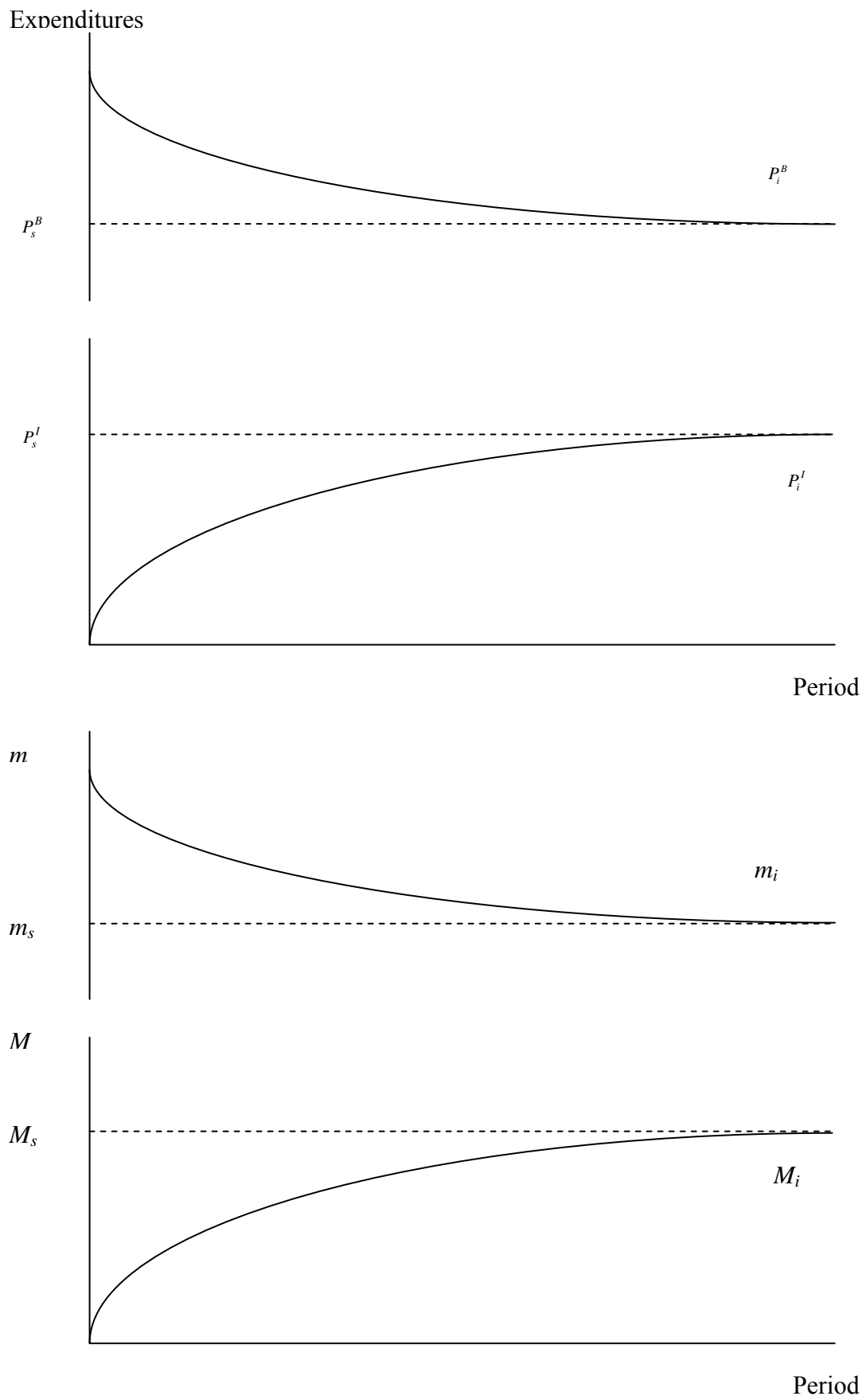


Figure 2
Amnesty

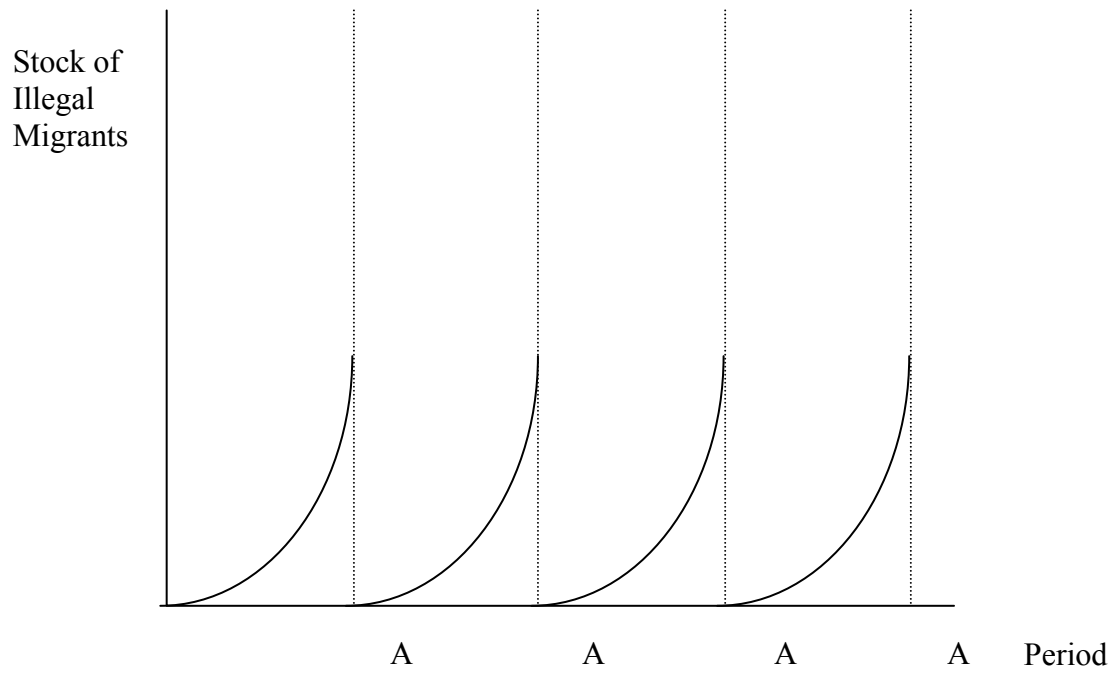
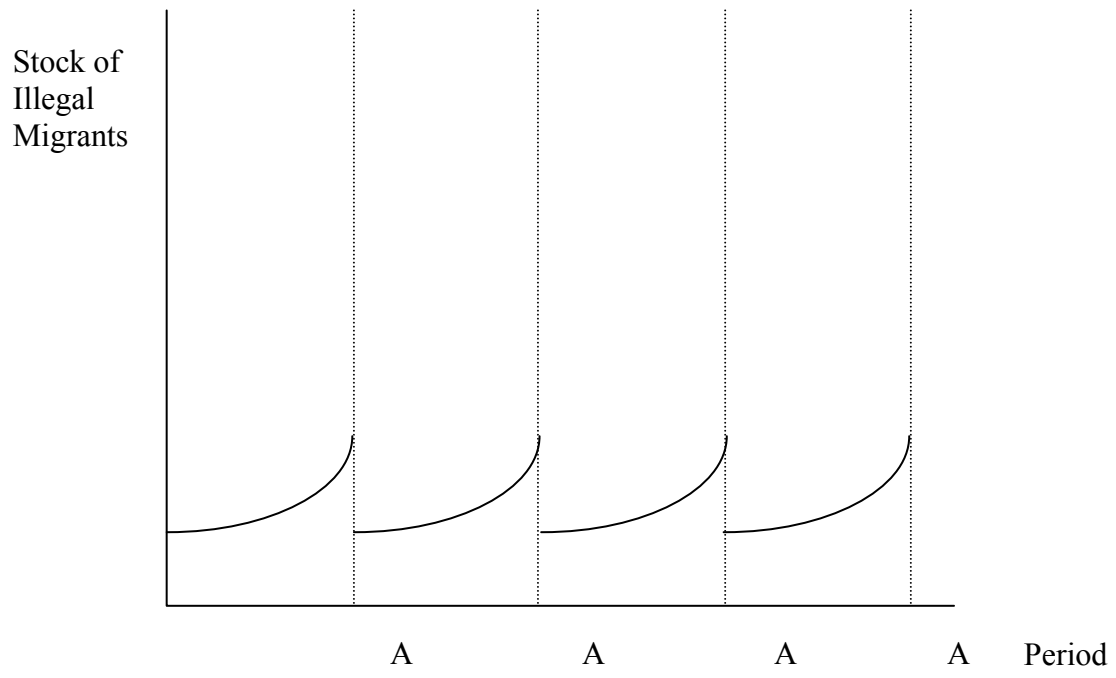


Figure 3
Delayed Amnesty



Bar-Ilan University
Department of Economics
WORKING PAPERS

- 1-01 **The Optimal Size for a Minority**
Hillel Rapoport and Avi Weiss, January 2001.
- 2-01 **An Application of a Switching Regimes Regression to the Study of Urban Structure**
Gershon Alperovich and Joseph Deutsch, January 2001.
- 3-01 **The Kuznets Curve and the Impact of Various Income Sources on the Link Between Inequality and Development**
Joseph Deutsch and Jacques Silber, February 2001.
- 4-01 **International Asset Allocation: A New Perspective**
Abraham Lioui and Patrice Poncet, February 2001.
- 5-01 **מודל המועדון והקהילה החרדית**
יעקב רוזנברג, פברואר 2001.
- 6-01 **Multi-Generation Model of Immigrant Earnings: Theory and Application**
Gil S. Epstein and Tikva Lecker, February 2001.
- 7-01 **Shattered Rails, Ruined Credit: Financial Fragility and Railroad Operations in the Great Depression**
Daniel A. Schiffman, February 2001.
- 8-01 **Cooperation and Competition in a Duopoly R&D Market**
Damiano Bruno Silipo and Avi Weiss, March 2001.
- 9-01 **A Theory of Immigration Amnesties**
Gil S. Epstein and Avi Weiss, April 2001.
- 10-01 **Dynamic Asset Pricing With Non-Redundant Forwards**
Abraham Lioui and Patrice Poncet, May 2001.
- 11-01 **Macroeconomic and Labor Market Impact of Russian Immigration in Israel**
Sarit Cohen and Chang-Tai Hsieh, May 2001.

Electronic versions of the papers are available at
http://www.biu.ac.il/soc/ec/wp/working_papers.html

- 12-01 **Network Topology and the Efficiency of Equilibrium**
Igal Milchtaich, June 2001.
- 13-01 **General Equilibrium Pricing of Trading Strategy Risk**
Abraham Lioui and Patrice Poncet, July 2001.
- 14-01 **Social Conformity and Child Labor**
Shirit Katav-Herz, July 2001.
- 15-01 **Determinants of Railroad Capital Structure, 1830–1885**
Daniel A. Schiffman, July 2001.
- 16-01 **Political-Legal Institutions and the Railroad Financing Mix, 1885–1929**
Daniel A. Schiffman, September 2001.
- 17-01 **Macroeconomic Instability, Migration, and the Option Value of Education**
Eliakim Katz and Hillel Rapoport, October 2001.
- 18-01 **Property Rights, Theft, and Efficiency: The Biblical Waiver of Fines in the Case of Confessed Theft**
Eliakim Katz and Jacob Rosenberg, November 2001.
- 19-01 **Ethnic Discrimination and the Migration of Skilled Labor**
Frédéric Docquier and Hillel Rapoport, December 2001.
- 1-02 **Can Vocational Education Improve the Wages of Minorities and Disadvantaged Groups? The Case of Israel**
Shoshana Neuman and Adrian Ziderman, February 2002.
- 2-02 **What Can the Price Gap between Branded and Private Label Products Tell Us about Markups?**
Robert Barsky, Mark Bergen, Shantanu Dutta, and Daniel Levy, March 2002.
- 3-02 **Holiday Price Rigidity and Cost of Price Adjustment**
Daniel Levy, Georg Müller, Shantanu Dutta, and Mark Bergen, March 2002.
- 4-02 **Computation of Completely Mixed Equilibrium Payoffs**
Igal Milchtaich, March 2002.
- 5-02 **Coordination and Critical Mass in a Network Market – An Experimental Evaluation**
Amir Etziony and Avi Weiss, March 2002.

- 6-02 **Inviting Competition to Achieve Critical Mass**
Amir Etziony and Avi Weiss, April 2002.
- 7-02 **Credibility, Pre-Production and Inviting Competition in a Network Market**
Amir Etziony and Avi Weiss, April 2002.
- 8-02 **Brain Drain and LDCs' Growth: Winners and Losers**
Michel Beine, Frédéric Docquier, and Hillel Rapoport, April 2002.
- 9-02 **Heterogeneity in Price Rigidity: Evidence from a Case Study Using Micro-Level Data**
Daniel Levy, Shantanu Dutta, and Mark Bergen, April 2002.
- 10-02 **Price Flexibility in Channels of Distribution: Evidence from Scanner Data**
Shantanu Dutta, Mark Bergen, and Daniel Levy, April 2002.
- 11-02 **Acquired Cooperation in Finite-Horizon Dynamic Games**
Igal Milchtaich and Avi Weiss, April 2002.
- 12-02 **Cointegration in Frequency Domain**
Daniel Levy, May 2002.
- 13-02 **Which Voting Rules Elicit Informative Voting?**
Ruth Ben-Yashar and Igal Milchtaich, May 2002.
- 14-02 **Fertility, Non-Altruism and Economic Growth: Industrialization in the Nineteenth Century**
Elise S. Brezis, October 2002.
- 15-02 **Changes in the Recruitment and Education of the Power Elites in Twentieth Century Western Democracies**
Elise S. Brezis and François Crouzet, November 2002.
- 16-02 **On the Typical Spectral Shape of an Economic Variable**
Daniel Levy and Hashem Dezhbakhsh, December 2002.
- 17-02 **International Evidence on Output Fluctuation and Shock Persistence**
Daniel Levy and Hashem Dezhbakhsh, December 2002.
- 1-03 **Topological Conditions for Uniqueness of Equilibrium in Networks**
Igal Milchtaich, March 2003.
- 2-03 **Is the Feldstein-Horioka Puzzle Really a Puzzle?**
Daniel Levy, June 2003.

- 3-03 **Growth and Convergence across the US: Evidence from County-Level Data**
Matthew Higgins, Daniel Levy, and Andrew Young, June 2003.
- 4-03 **Economic Growth and Endogenous Intergenerational Altruism**
Hillel Rapoport and Jean-Pierre Vidal, June 2003.
- 5-03 **Remittances and Inequality: A Dynamic Migration Model**
Frédéric Docquier and Hillel Rapoport, June 2003.
- 6-03 **Sigma Convergence Versus Beta Convergence: Evidence from U.S. County-Level Data**
Andrew T. Young, Matthew J. Higgins, and Daniel Levy, September 2003.
- 7-03 **Managerial and Customer Costs of Price Adjustment: Direct Evidence from Industrial Markets**
Mark J. Zbaracki, Mark Ritson, Daniel Levy, Shantanu Dutta, and Mark Bergen, September 2003.
- 8-03 **First and Second Best Voting Rules in Committees**
Ruth Ben-Yashar and Igal Milchtaich, October 2003.
- 9-03 **Shattering the Myth of Costless Price Changes: Emerging Perspectives on Dynamic Pricing**
Mark Bergen, Shantanu Dutta, Daniel Levy, Mark Ritson, and Mark J. Zbaracki, November 2003.
- 1-04 **Heterogeneity in Convergence Rates and Income Determination across U.S. States: Evidence from County-Level Data**
Andrew T. Young, Matthew J. Higgins, and Daniel Levy, January 2004.
- 2-04 **“The Real Thing:” Nominal Price Rigidity of the Nickel Coke, 1886-1959**
Daniel Levy and Andrew T. Young, February 2004.
- 3-04 **Network Effects and the Dynamics of Migration and Inequality: Theory and Evidence from Mexico**
David McKenzie and Hillel Rapoport, March 2004.
- 4-04 **Migration Selectivity and the Evolution of Spatial Inequality**
Ravi Kanbur and Hillel Rapoport, March 2004.
- 5-04 **Many Types of Human Capital and Many Roles in U.S. Growth: Evidence from County-Level Educational Attainment Data**
Andrew T. Young, Daniel Levy and Matthew J. Higgins, March 2004.

- 6-04 **When Little Things Mean a Lot: On the Inefficiency of Item Pricing Laws**
Mark Bergen, Daniel Levy, Sourav Ray, Paul H. Rubin and Benjamin Zeliger,
May 2004.
- 7-04 **Comparative Statics of Altruism and Spite**
Igal Milchtaich, June 2004.
- 8-04 **Asymmetric Price Adjustment in the Small: An Implication of Rational Inattention**
Daniel Levy, Haipeng (Allan) Chen, Sourav Ray and Mark Bergen, July 2004.
- 1-05 **Private Label Price Rigidity during Holiday Periods**
Georg Müller, Mark Bergen, Shantanu Dutta and Daniel Levy, March 2005.
- 2-05 **Asymmetric Wholesale Pricing: Theory and Evidence**
Sourav Ray, Haipeng (Allan) Chen, Mark Bergen and Daniel Levy,
March 2005.
- 3-05 **Beyond the Cost of Price Adjustment: Investments in Pricing Capital**
Mark Zbaracki, Mark Bergen, Shantanu Dutta, Daniel Levy and Mark Ritson,
May 2005.
- 4-05 **Explicit Evidence on an Implicit Contract**
Andrew T. Young and Daniel Levy, June 2005.
- 5-05 **Popular Perceptions and Political Economy in the Contrived World of Harry Potter**
Avichai Snir and Daniel Levy, September 2005.
- 6-05 **Growth and Convergence across the US: Evidence from County-Level Data (revised version)**
Matthew J. Higgins, Daniel Levy, and Andrew T. Young , September 2005.
- 1-06 **Sigma Convergence Versus Beta Convergence: Evidence from U.S. County-Level Data (revised version)**
Andrew T. Young, Matthew J. Higgins, and Daniel Levy, June 2006.
- 2-06 **Price Rigidity and Flexibility: Recent Theoretical Developments**
Daniel Levy, September 2006.
- 3-06 **The Anatomy of a Price Cut: Discovering Organizational Sources of the Costs of Price Adjustment**
Mark J. Zbaracki, Mark Bergen, and Daniel Levy, September 2006.

- 4-06 **Holiday Non-Price Rigidity and Cost of Adjustment**
Georg Müller, Mark Bergen, Shantanu Dutta, and Daniel Levy.
September 2006.
- 2008-01 **Weighted Congestion Games With Separable Preferences**
Igal Milchtaich, October 2008.
- 2008-02 **Federal, State, and Local Governments: Evaluating their Separate Roles in US Growth**
Andrew T. Young, Daniel Levy, and Matthew J. Higgins, December 2008.
- 2008-03 **Political Profit and the Invention of Modern Currency**
Dror Goldberg, December 2008.
- 2008-04 **Static Stability in Games**
Igal Milchtaich, December 2008.
- 2008-05 **Comparative Statics of Altruism and Spite**
Igal Milchtaich, December 2008.
- 2008-06 **Abortion and Human Capital Accumulation: A Contribution to the Understanding of the Gender Gap in Education**
Leonid V. Azarnert, December 2008.
- 2008-07 **Involuntary Integration in Public Education, Fertility and Human Capital**
Leonid V. Azarnert, December 2008.
- 2009-01 **Inter-Ethnic Redistribution and Human Capital Investments**
Leonid V. Azarnert, January 2009.
- 2009-02 **Group Specific Public Goods, Orchestration of Interest Groups and Free Riding**
Gil S. Epstein and Yosef Mealem, January 2009.
- 2009-03 **Holiday Price Rigidity and Cost of Price Adjustment**
Daniel Levy, Haipeng Chen, Georg Müller, Shantanu Dutta, and Mark Bergen,
February 2009.
- 2009-04 **Legal Tender**
Dror Goldberg, April 2009.
- 2009-05 **The Tax-Foundation Theory of Fiat Money**
Dror Goldberg, April 2009.

- 2009-06 **The Inventions and Diffusion of Hyperinflatable Currency**
Dror Goldberg, April 2009.
- 2009-07 **The Rise and Fall of America's First Bank**
Dror Goldberg, April 2009.
- 2009-08 **Judicial Independence and the Validity of Controverted Elections**
Raphaël Franck, April 2009.
- 2009-09 **A General Index of Inherent Risk**
Adi Schnytzer and Sara Westreich, April 2009.
- 2009-10 **Measuring the Extent of Inside Trading in Horse Betting Markets**
Adi Schnytzer, Martien Lamers and Vasiliki Makropoulou, April 2009.
- 2009-11 **The Impact of Insider Trading on Forecasting in a Bookmakers' Horse Betting Market**
Adi Schnytzer, Martien Lamers and Vasiliki Makropoulou, April 2009.
- 2009-12 **Foreign Aid, Fertility and Population Growth: Evidence from Africa**
Leonid V. Azarnert, April 2009.
- 2009-13 **A Reevaluation of the Role of Family in Immigrants' Labor Market Activity: Evidence from a Comparison of Single and Married Immigrants**
Sarit Cohen-Goldner, Chemi Gotlibovski and Nava Kahana, May 2009.
- 2009-14 **The Efficient and Fair Approval of "Multiple-Cost–Single-Benefit" Projects Under Unilateral Information**
Nava Kahanaa, Yosef Mealem and Shmuel Nitzan, May 2009.
- 2009-15 **Après nous le Déluge: Fertility and the Intensity of Struggle against Immigration**
Leonid V. Azarnert, June 2009.
- 2009-16 **Is Specialization Desirable in Committee Decision Making?**
Ruth Ben-Yashar, Winston T.H. Koh and Shmuel Nitzan, June 2009.
- 2009-17 **Framing-Based Choice: A Model of Decision-Making Under Risk**
Kobi Kriesler and Shmuel Nitzan, June 2009.
- 2009-18 **Demystifying the 'Metric Approach to Social Compromise with the Unanimity Criterion'**
Shmuel Nitzan, June 2009.

- 2009-19 **On the Robustness of Brain Gain Estimates**
Michel Beine, Frédéric Docquier and Hillel Rapoport, July 2009.
- 2009-20 **Wage Mobility in Israel: The Effect of Sectoral Concentration**
Ana Rute Cardoso, Shoshana Neuman and Adrian Ziderman, July 2009.
- 2009-21 **Intermittent Employment: Work Histories of Israeli Men and Women, 1983–1995**
Shoshana Neuman and Adrian Ziderman, July 2009.
- 2009-22 **National Aggregates and Individual Disaffiliation: An International Study**
Pablo Brañas-Garza, Teresa García-Muñoz and Shoshana Neuman, July 2009.
- 2009-23 **The Big Carrot: High-Stakes Incentives Revisited**
Pablo Brañas-Garza, Teresa García-Muñoz and Shoshana Neuman, July 2009.
- 2009-24 **The Why, When and How of Immigration Amnesties**
Gil S. Epstein and Avi Weiss, September 2009.