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Illegal Immigration, Deportation Policy, and the Optimal Timing of Return

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Abstract

Countries with strict immigration policies often resort to deportation measures to reduce their stocks of illegal immigrants. Many of their undocumented foreign workers, however, are not deported but rather choose to return home voluntarily. This paper studies the optimizing behavior of undocumented immigrants who continuously face the risk of deportation, modeled by a stochastic process, and must decide how long to remain in the host country. It is found that the presence of uncertainty with respect to the length of stay abroad unambiguously reduces the desired migration duration and may trigger a voluntary return when a permanent stay would otherwise be optimal. Voluntary return is motivated by both economic and psychological factors. Calibration of the model to match the evidence on undocumented Thai migrants in Japan suggests that the psychological impact of being abroad as an illegal alien may be equivalent to as large as a 68% cut in the consumption rate at the point of return.

JEL Classification: F22, J61

Key Words: Illegal immigration, deportation, optimal return, uncertainty

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1 Introduction

Illegal immigration is considered to be undesirable by most of the receiving countries. In an effort to control this problem they have introduced various barriers to entry, internal enforcement measures to impede labor-market access for unauthorized workers, and they even resort to deportations to remove illegal immigrants from their territory. Deportation policies and levels of enforcement vary across nations. The somewhat lenient measures applied in the U.S.A. and countries of Western Europe are in sharp contrast with the very strict policies on illegal immigration in the Gulf Cooperation Council (GCC) States and East Asian economies, such as Hong Kong, Singapore, Malaysia, South Korea, Taiwan, and Japan.¹ The main purpose of this paper is to show how the risk of deportation affects an undocumented migrant's decision to return home *voluntarily*. This analysis has important implications for the effectiveness of deportations as a policy instrument aimed at reducing the stock of illegal immigrants.

In countries where enforcement is strict, undocumented migrants cannot live normal lives. They are in constant fear of being detected, apprehended and deported. In the words of one illegal immigrant in Japan, "We stay to ourselves. Outside don't talk."² In such circumstances undocumented immigrants typically intend to stay and work in the host country for only a limited period of time, just to accumulate enough savings for the purpose of raising their consumption after return, starting a business or improving the quality of their housing back in the source country.³ In a study of Thai overseas migration, Jones and Pardthaisong (1999) find that in 61 out of 63 surveyed villages, the proportion of overseas workers who voluntarily returned to Thailand was 95% or more. Sobieszczyk (2000) is another informative study of Thai overseas migrants, both docu-

¹In East Asia and especially in the GCC States, illegal entry, as well as an overstay of the officially allowed duration of residence, are considered to be very serious infractions entailing severe penalties (see Section 2.2.2 for more details).

²Global Envision (2006).

³See Jones and Pardthaisong (1999) and Sobieszczyk (2000).

mented and undocumented. The documented ones in her sample worked on contracts of fixed duration (typically 2 years), while unauthorized migrants were able to choose how much time to spend in a foreign country if they managed to avoid getting deported. This availability of choice with respect to the duration of stay (rather than being obliged to return when the official work contract expires) was, in fact, one of the reasons for migrating illegally rather than through official recruitment channels. The duration of stay for such migrants was on average 30 months.

The fact that an overwhelming majority of undocumented immigrants returns voluntarily from countries with strict deportation policies and low tolerance for illegal immigration raises a series of interesting questions that have not been addressed in the literature: Given that apprehension and deportation are uncertain, how is the optimal migration duration determined in this risky environment? What are the characteristics of the migrant's optimal consumption and saving profiles abroad and after return, given the conditions prevailing in labor, commodity, and capital markets in both countries? With respect to the timing of voluntary return, how important is the role of social factors, such as homesickness or the lack of access to social capital that is available to migrants in their country of origin? The present study addresses these questions within a stochastic life-cycle model. The stochastic element comes from the fact that the event of deportation is assumed to follow a random process.

The literature on optimal migration duration and voluntary return (including the contributions of Hill 1987, Djajić and Milbourne 1988, McCormick and Wahba 2001, Mesnard 2004, and Kirdar 2013) focuses extensively on *legal* temporary migrants. By contrast, the literature on illegal immigration, starting with the work of Ethier (1986), typically takes migration to be permanent (see, e.g., Bond and Chen 1987, Djajić 1997, Bandyopadhyay and Bandyopadhyay 1998, Gaytan-Fregoso and Lahiri 2000, Yoshida 2000, Woodland and Yoshida 2006, and Auriol and Mesnard 2012). These authors

assume that once an illegal immigrant manages to get into the host country, she does not go back to the country of origin. Moreover, when apprehension is considered explicitly, as in the works of Woodland and Yoshida (2006), Djajić (2011) and Auriol and Mesnard (2012), it is modeled deterministically as a zero-one event at the point of entry, with the probability of forced repatriation dropping to zero after a migrant successfully crosses the border of the host country. This framework allows the authors to study the effectiveness of apprehensions in *detering* illegal entries but it does not provide a suitable setting for examining the question of the optimal return date of an undocumented migrant who is already working in the host country and is *continuously* facing the risk of deportation. More recent papers by Friebel and Guriev (2006), Djajić (2013), Djajić and Mesnard (2013) and Djajić and Vinogradova (2013), allow for the possibility of deportation after a successful entry, although this is modeled deterministically and the option of voluntary return is not considered.

The present study contributes to the literature by developing a framework of *temporary illegal* immigration where uncertainty with respect to the duration of stay abroad is the fundamental feature of the environment, as is the case in East Asia or the Middle East.⁴ It is shown that in the presence of economic and/or psychological factors that pull the migrant back to her home country, the possibility of deportation unambiguously reduces the desired migration duration. Moreover, the prospect of deportation can trigger a voluntary return under conditions that would otherwise, in the absence of deportation risk, make a *permanent* undocumented stay in the host country optimal.

A direct implication of the analysis is that, for any given inflows of illegal immigrants,

⁴It is important to emphasize that the focus of the paper is on the voluntary return decisions of undocumented aliens facing the prospect of apprehension in countries with *strict* deportation policies. It does not apply to lenient deportation regimes, such as the one in the U.S.A., where non-criminal illegal aliens were gradually being released in February 2013 due to the lack of funding needed to proceed with the deportations (Hamilton 2013). Voluntary return of undocumented Mexican migrants from the U.S.A. requires a conceptually different framework of analysis. See, for example, Cornelius 2005 and the survey of the literature on migration from Mexico to the U.S.A. by Hanson 2006.

countries with stricter deportation policies host a smaller stock of undocumented aliens. This is not only because they are more active in physically removing them from their territory but also because by doing so, they indirectly induce illegal immigrants to return voluntarily *sooner* to their countries of origin. The optimal migration duration is shown to be decreasing and convex in the deportation rate. This implies that a tightening of the deportation policy is most effective in shortening the length of an unauthorized stay when the initial risk of apprehension is relatively low.

The fact that the risk of deportation unambiguously reduces the desired duration of stay in the host country is rather intuitive, although new to the literature. What makes this problem more intriguing and complex, is that the result stems from two distinct forces operating on an illegal immigrant's behavior. First, the risk of being suddenly apprehended and sent back from a high-wage to a low-wage environment affects the migrant's saving behavior. The saving rate increases, wealth accumulation accelerates, and the utility gain from staying longer in the host country diminishes more quickly over time to advance the date of voluntary return. Second, there are psychological factors that influence behavior of undocumented aliens residing in countries with strict deportation measures. Living without proper documentation and under a constant threat of apprehension restricts one's freedom of movement and access to public and even private goods and services. It imposes, as well, severe limitations on a migrant's social interactions. Descriptive studies suggest that under such conditions migrants tend to exhibit strong signs of homesickness. The desire to reunite with their family and to return to the social environment of the home country also affects the timing of return.

Accounting for the risk of deportation and homesickness phenomenon allows us to obtain more realistic predictions for migration durations of undocumented workers than those arising from a deterministic model. The latter tends to overestimate the optimal migration duration and, if used as a basis for policy prescriptions, may lead to imple-

mentation of overly restrictive and thus more costly policies.

How the economic and psychological factors individually and jointly influence the optimal duration of stay of undocumented aliens is a complex question. One of the objectives of this paper is to disentangle and evaluate these two elements. We use the data on unauthorized Thai migrants in Japan from the Sobieszczyk (2000) study to extract the intensity of homesickness which is consistent with the observed behavior, given the other, economic, factors that influence the timing of return. It is found that, on average, Thai migrants experience a loss of welfare due to family separation and social isolation during their last month abroad which is equivalent to a change in utility associated with a 17 to 68% cut in the consumption rate, depending on the assumed degree of concavity of the utility function. Finally, we use the calibrated model to predict the impact of a change in the deportation policy on return decisions of undocumented Thai migrants in Japan. A doubling of the deportation rate from its average in the late 1990s and early 2000s would have reduced the duration of an unauthorized stay by about 1.25 to 8.5 months.

The paper is organized as follows. A migrant's optimization problem under uncertainty is presented and solved in Section 2, assuming that wages, prices, and rates of return on savings differ across countries. The solution is then illustrated with a numerical example. Section 3 extends the model to account for psychological and social factors influencing voluntary return, referred to as "homesickness", and calibrates the model for the case of undocumented Thai migrants in Japan. Section 4 concludes the paper with a summary of the main results.

2 The Framework

Consider an individual who migrates abroad as an undocumented alien (U for short) at time $t = 0$ with a possibility to return to her country of origin at some future date τ . The length of the planning horizon is T . U's initial asset holdings net of migration costs are given by $a_0 \geq 0$. At each instant in the host country, U earns the time-invariant wage w^* , which is assumed to be higher than the time-invariant source-country wage, w . The rates of return on accumulated savings are given by r and r^* at home and abroad, respectively, with $r > r^*$.⁵ The price levels at home and abroad are constant at p and p^* , with p^* assumed to be greater than p . The subjective rate of time preference is a constant ρ and the utility function is assumed to be of the CRRA form: $u(c) = \frac{c^{1-\theta}}{1-\theta}$, where $1/\theta$ is the elasticity of intertemporal consumption substitution (hereafter EICS).

2.1 The Optimal Return Decision

Due to the unauthorized status, U may be deported to her country of origin at any moment. The event of deportation is assumed to follow the Poisson process with a constant mean arrival rate λ . Deportation entails a monetary penalty $\pi \geq 0$.⁶ U's optimization problem consists of maximizing the expected lifetime welfare by choosing the consumption rate abroad, c_t^* , the consumption rate after return, c_t , if return is voluntary, or \tilde{c}_t , if return occurs due to deportation. The optimal date of voluntary return to the source country, τ , must also be chosen in the event that deportation does not occur before τ .

Let a_t denote U's asset position at time t and \dot{a}_t its time derivative. The dynamic

⁵See Djajić (2010) for the analysis of an optimal return decision with interest rate differentials across countries in a deterministic setting. The same paper also provides supportive evidence for the assumption that $r > r^*$. See also footnote 16 in this paper.

⁶Some countries, such as Singapore, South Korea, and numerous Middle Eastern economies impose monetary and other forms of penalties on apprehended illegal aliens as part of deportation proceedings (see Human Development Report 2009 and OECD 2002). This issue will be discussed in greater detail later in the paper.

budget constraint while abroad is then given by

$$\dot{a}_t = r^* a_t + w^* - p^* c_t^*, \quad a_0 \text{ given}, \quad (1)$$

and after return

$$\dot{a}_t = r a_t + w - p c_t, \quad a_T = 0 \quad (\text{if voluntary return}), \quad (2)$$

$$\dot{a}_t = r a_t + w - p \tilde{c}_t, \quad a_T = 0 \quad (\text{if deportation}), \quad (3)$$

If U returns voluntarily to the source country at some date τ , she brings back savings equal to a_τ . If she is deported by the immigration authorities at date ε , she brings back only $a_\varepsilon - \pi$ after having paid the deportation penalty.⁷

In this framework, an illegal immigrant faces a variant of an optimal stopping problem which can be analyzed in the following way. At each instant U must decide whether to return voluntarily to her country of origin, i.e., to stop the ongoing program and receive the termination payoff, or to continue the program for an extra instant and stop then. Continuation of the program for an extra instant may result in deportation with probability λdt . The termination payoff in case of voluntary return is denoted by Ω_t and it is a function of the state variable - the asset position, a_t . If, on the contrary, U decides to remain abroad, her expected payoff is EW_t , which is also a function of a_t . Thus at each instant $t \in (0, T]$, U must compare the termination payoff $\Omega(a_t)$ with $EW(a_t)$ and if $\Omega(a_t) \geq EW(a_t)$, U returns home voluntarily, otherwise she remains abroad until at least the next instant. Thus the original problem of choosing the optimal return date

⁷The model implicitly assumes that if by time ε U has not accumulated sufficient amount of savings to pay for the penalty, she will be repaying the difference $\pi - a_\varepsilon$ from her income back home, having chosen her consumption-saving plan accordingly. In reality, deportation penalties are not prohibitively high, so that undocumented migrants typically have enough savings to cover the penalty. Alternatively, they can, in some countries, choose to serve a jail term instead of paying the fine. The penalty π in the model can thus be also interpreted as an opportunity cost of being in jail in terms of forgone income.

includes two subproblems. One is to optimally choose the consumption rate after return, c_t , so as to maximize Ω_t for a given return date. The other is to optimally choose c_t^* and \tilde{c}_t to maximize EW_t . Once the optimal Ω_t and EW_t are computed as functions of the return date, it is straightforward to find the optimal point of return, τ , that sets $EW_\tau = \Omega_\tau$. A rigorous analysis is presented below in three steps: first, we obtain the maximized value of the termination payoff; second, we obtain the maximized expected continuation payoff; third, we compare the payoffs at each point in time to determine the optimal τ .

Termination Payoff

As the first step, consider the subproblem associated with choosing the optimal paths of consumption and asset holdings in case of a voluntary return at some date $\tau \in (0, T]$:

$$\max_{c_t} \int_{\tau}^T u(c_t) e^{-\rho(t-\tau)} dt$$

subject to the constraint (2). The solution for the optimal c_t is obtained in a straightforward manner using the standard dynamic optimization technique:⁸

$$c_t = c_\tau e^{\frac{r-\rho}{\theta}(t-\tau)}, \quad c_\tau = \frac{1}{p} \left[a_\tau + w \frac{1 - e^{-r(T-\tau)}}{r} \right] \frac{g}{e^{g(T-\tau)} - 1}, \quad t \in [\tau, T], \quad (4)$$

where $g \equiv \frac{r-\rho}{\theta} - r$. The optimal consumption rate follows the standard Keynes-Ramsey rule such that its growth rate is equal to the difference between the rate of interest, r , and the rate of time preference, ρ , adjusted by the elasticity of intertemporal consumption substitution, $1/\theta$. An interest rate in excess of the time preference rate stimulates saving and therefore implies a positive consumption growth rate. The opposite is true when $r < \rho$. The starting point of the path, c_τ , is increasing in the stock of assets accumulated up to time τ , a_τ , and in the home-country wage, w . It is obviously decreasing in the

⁸The derivations of all the equations that follow are relegated to the Appendix.

price level, p . The termination payoff is equal to

$$\Omega(a_\tau) = u(c_\tau) \frac{e^{g(T-\tau)} - 1}{g}. \quad (5)$$

Expected Continuation Payoff

Consider the second subproblem associated with the choice of the optimal paths of consumption and asset holdings while U is abroad. In doing so, U must take into account the risk of deportation. She therefore faces a stochastic optimization problem, which can be analyzed with the aid of the Hamilton-Jacobi-Bellman equation (HJB). Denoting the value function while abroad by V and the value function after deportation by \tilde{V} , the HJB equation may be written as

$$\rho V(a_t) = \max_{c_t^*} \left\{ u(c_t^*) + \frac{\partial V(a_t)}{\partial a_t} (r^* a_t + w^* - p^* c_t^*) + \lambda (\tilde{V}(a_t) - V(a_t)) \right\} \quad (6)$$

The optimality conditions with respect to c_t^* and a_t yield the following differential equation describing the growth rate of consumption while abroad:

$$\frac{\dot{c}_t^*}{c_t^*} = \frac{1}{\theta} \left\{ \lambda \left[\frac{p^*}{p} \left(\frac{\tilde{c}_t}{c_t^*} \right)^{-\theta} - 1 \right] + r^* - \rho \right\}. \quad (7)$$

Note that if there is no uncertainty, i.e., $\lambda = 0$, the first term in the curly brackets in eq. (7) vanishes and the usual Keynes-Ramsey equation for the consumption growth rate applies. Furthermore, it is easy to see that the term in the square brackets is unambiguously positive, so that the presence of uncertainty results in a higher consumption growth rate relative to the certainty case.⁹ This higher growth rate is supported by a high saving rate at the beginning of the planning horizon, implying that uncertainty triggers precautionary saving. Eq. (7), however, is not sufficient to characterize the path

⁹Note that even if ρ exceeds r^* the consumption growth rate may be positive due to the deportation risk.

of c_t^* , since \tilde{c}_t is yet to be determined. The optimal \tilde{c}_t can be easily obtained by noting that if deportation occurs at some date ε , U's optimal consumption in the source country must be such that it maximizes

$$\int_{\varepsilon}^T u(\tilde{c}_t) e^{-\rho(t-\varepsilon)} dt \quad (8)$$

subject to (3) and the initial condition for asset holdings given by $a_{\varepsilon} - \pi$, i.e., the amount of assets accumulated up to time ε net of the deportation penalty. The solution to this deterministic control problem is given by

$$\tilde{c}_t = c_{\varepsilon} e^{\frac{r-\rho}{\theta}(t-\varepsilon)}, \quad \tilde{c}_{\varepsilon} = \frac{1}{p} \left[a_{\varepsilon} - \pi + w \frac{1 - e^{-r(T-\varepsilon)}}{r} \right] \frac{g}{e^{g(T-\varepsilon)} - 1}, \quad t \in [\varepsilon, T], \quad (9)$$

and the maximized value of (8) is

$$\tilde{V}(a_{\varepsilon}) = u(\tilde{c}_{\varepsilon}) \frac{e^{g(T-\varepsilon)} - 1}{g},$$

The optimal paths of consumption and asset holdings pertaining to the problem in (6) can thus be fully characterized by eqs. (1), (3), (7), and (9). The expected continuation payoff at instant $\xi \in (0, T]$ is obtained as

$$EW_{\xi} = (1 - \lambda d\xi) \left\{ u(c_{\xi}^*) + \int_{\zeta}^T u(c_t) e^{-\rho(t-\xi)} dt \right\} + \lambda d\xi \left\{ \int_{\xi}^T u(\tilde{c}_t) e^{-\rho(t-\xi)} dt \right\}, \quad (10)$$

where ζ is the next instant after ξ .¹⁰ The interpretation of (10) is the following. If the migrant decides to remain abroad for an extra instant, i.e., from ξ to ζ , and return home at ζ , her expected welfare will consist of two terms. The first term is the present

¹⁰In writing (10) I make use of the memorylessness property of the Poisson process. The analysis can be extended to random processes with per-unit-time probability of success being a function of the elapsed time. This complication, however, produces a quite predictable outcome: If the probability (per unit of time) of being deported is an increasing (diminishing) function of the length of stay in the foreign country, the optimal migration duration is shorter (longer).

discounted value (PDV) of lifetime welfare in the event that U is not deported between ξ and ζ , with probability $1 - \lambda d\xi$. It consists of the utility from consumption at time ξ plus the present value of utility from consumption after voluntary return, from time ζ to T . The second term is the PDV of lifetime welfare in the event of deportation during this extra instant, which occurs with probability $\lambda d\xi$.

The Optimal Return Date

In the third and the final step, the difference, D , between EW_t and Ω_t is computed at each instant $t \in (0, T]$, and the optimal date of return to the source country is determined as

$$\tau = \inf \{t \in (0, T] \mid D \equiv EW_t - \Omega_t = 0\}, \quad (11)$$

that is, the earliest date such that the termination payoff is equal to the continuation payoff (see, e.g., the value matching condition in Dixit and Pindyck, 1994).

An explicit analytical solution is unfortunately not feasible for this type of an optimal stopping problem. We therefore resort to numerical methods, which will allow us to visualize the optimal time profiles of consumption and asset position, as well as the termination and continuation payoffs. We shall focus on two economic factors which draw migrants back to their country of origin, namely the international price and return-on-investment differentials. This analysis is useful for understanding the mechanics of the model and, in particular, the effect of uncertainty on the optimal choice of migration duration. In Section 3 the model is calibrated to match the data on illegal Thai migrants in Japan in the late 1990s. The calibration is used to evaluate the effectiveness of deportations as an immigration policy instrument in Japan.

2.2 Numerical Solution

There is very little systematic evidence available on the behavior of and the conditions facing unauthorized workers in the economies with strict deportation measures. In order to calibrate the model we draw on various sources of evidence on undocumented migration in East Asia. The key parameters to calibrate include the wage ratio between the host and the source country (w^*/w) and the deportation rate (λ). For the case of illegal Chinese migrants in South Korea, Kim (2004, p.326) writes that "...ethnic Korean Chinese reported that their average income equaled roughly one million won per month (about \$800). This is six to seven times higher than the average income in Yanbian, which is about \$110 per month." On the basis of information provided by Jones and Pardthaisong (1999, p. 45 and Table 6), we can calculate that w^*/w of undocumented Thai migrants in Japan was in some instances as high as twenty. A survey of undocumented Filipino workers in South Korea, which compares their wages at home and abroad, reports a wage ratio of eight.¹¹ On the basis of these and other sources of evidence¹², we calibrate the international wage differential to ten by normalizing the monthly source-country wage, w , to unity and setting the host-country wage for undocumented workers to $w^* = 10$.

We assume that the deportation penalty, π , is initially zero and subsequently examine the implications of relaxing this assumption. The length of the planning horizon is 50 years to reflect a situation facing a young migrant in her early twenties. The benchmark value of the coefficient of relative risk aversion, θ , is set at 0.9 and the sensitivity of the results to variations in θ is checked later in the paper.¹³ The risk-free interest rate in

¹¹Ignacio-esteban, Ma. Angelina. "The Dynamics of Illegal Migration: The Philippines-South Korea Case," available at <http://www.filipiniana.net/publication/the-dynamics-of-illegal-migration-the-philippines-south-korea-case/13197759176933/8/1>

¹²See Human Development Report (2009, p. 50), Djajić (2013), and "Illegal status in Malaysia worth the risk, migrant workers claim" available at <http://monnews.org/?p=751>

¹³Given the assumed structure of the preferences, the coefficient of relative risk aversion, θ , is equal to the inverse of the elasticity of intertemporal consumption substitution (EICS). Although there is not an

the host country is assumed to be 3% per year and, for simplicity, is set equal to the migrant's rate of time preference. We set the Poisson arrival rate $\lambda = 0.25$ per year, which implies that U may be deported, on average, once in 4 years (by the property of the Poisson process). This corresponds, for example, to the case of Malaysia where the stock of undocumented Indonesian migrants is estimated to be 450'000 and 10'000 are deported every month (OECD 2002, p.254). These figures imply a deportation rate of 0.26 per year.¹⁴ The parameter calibrations are summarized in Table 1.

planning horizon, years	T	50
wage differential	w^*/w	10
risk-free interest rate	r^*	0.03
rate of time preference	ρ	0.03
Poisson deportation rate	λ	0.25
elasticity of marginal utility	θ	0.9
initial assets net of migration cost	a_0	0

Table 1: Benchmark calibration.

We first illustrate the implications of the model when there are only two motives for return, both of which have been emphasized in the existing literature on temporary migration: (i) the international differential in the rates of return on accumulated assets and (ii) the differential in the price levels.¹⁵ The first simulation looks at the effect of the former and subsequently we look at the effect of the latter. We also examine the implications of a deportation penalty. Later in Section 3, we formally introduce into the model the psychological factors which motivate a voluntary return. This will complete our analysis of the economic and social considerations influencing return decisions of

unanimous view in the literature on the magnitude of the latter, many empirical studies of EICS conclude that the relevant values lie below 2, which corresponds to θ above 0.5. See Epstein and Zin (1991), Hansen and Singleton (1982), and Vissing-Jørgensen (2002).

¹⁴In Japan, the stock of illegal aliens in 2005 was estimated at 193'745 with 33'192 deportations, making the deportation rate roughly 0.17 per year (Vogt 2007). Kibria (2004, p.12) reports that the average duration of stay of deported Bangladeshi migrants was 2.7 years, implying a deportation rate of 0.37 per year.

¹⁵As we are considering a population of unskilled undocumented workers, the return motive based on the intention to capitalize on the skill acquisition abroad is not likely to be relevant in the present setting.

undocumented foreign workers facing the prospect of deportation.

2.2.1 Rate of Return Differential

While r^* and ρ are assumed to be 3% per year, the interest rate in the source country is set at 10% per year in the benchmark case.¹⁶ The price levels in both countries are initially set equal to each other and normalized to unity for the purpose of isolating the effect of the interest differential. Figure 1 plots the value of D , the difference between continuation and termination payoffs for the benchmark case (bold line) and for several other values of the rate of return on investment in the home country (thin lines). As has been shown in eq. (11), the optimal return date is the earliest date such that $D = 0$. For the chosen parameter values, the optimal τ under the benchmark calibration is 15.82 years after arrival to the host country. For a low enough interest rate differential, e.g., $r = 6\%$, it is in fact not optimal to return since the possibility of earning a ten times higher wage abroad yields a higher expected continuation payoff for all t . By contrast, when the rate of return differential is relatively high, as shown by the thin line labeled $r = 0.15$, the date of return is advanced to 8.35 years. In general, an increase in the difference between r and r^* brings forward the optimal date of voluntary return as the incentive to go back home with accumulated savings is stronger.

¹⁶As mentioned in the introductory section, migrants typically seek to accumulate savings while abroad in order to improve their standard of living back home or start up a business or both. Recent empirical studies estimate rates of return for small enterprises in developing countries to be substantial, so that the assumed figure of 10% should be interpreted as a lower bound. Udry and Anagol (2006), for example, report that Ghanian farmers who employ new technology for pineapple cultivation enjoy average returns of 250% per annum on median-sized plots; while for farmers employing traditional technology the average returns are 30 - 50% annually. McKenzie and Woodruff (2006) estimate *monthly* returns in Mexican microenterprises to be in the range of 15% (controlling for entrepreneurial ability) for investments below \$200 and 3 - 5% for investments above \$500. The authors also note that only a small fraction (0.3%) of firms in their sample obtained start-up financing from a formal financial institution, suggesting the importance of informal financing, which often includes remittances and savings repatriated by migrants returning from the U.S.A. It is also important to note that temporary migrants typically start their entrepreneurial activities only after return. Their physical presence is in most cases required for the efficient running of the business (see Jones and Pardthaisong 1999)

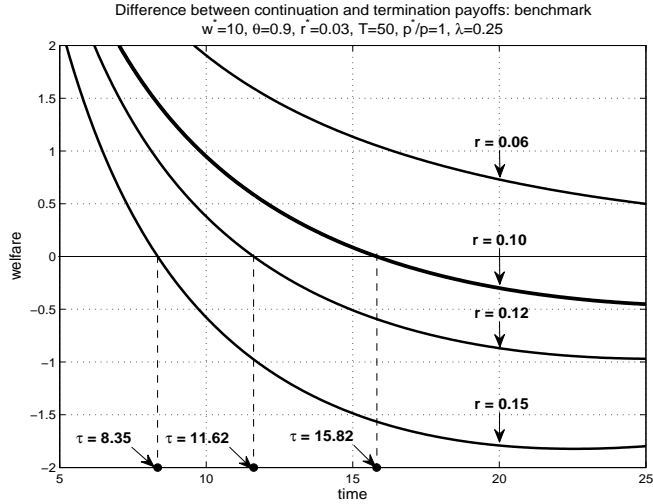


Figure 1: Difference between continuation and termination payoffs: interest rate differential.

The importance of the return-on-investment differential as a factor influencing voluntary return can be better understood by comparing the evolution of the asset position at home (i.e., after return) and abroad (i.e., if the migrant suboptimally chooses not to return at the optimal τ and remains permanently in the host country continuing to face deportation risk). This is illustrated in figure 2 for the benchmark calibration. The time profile of asset holdings over the life cycle exhibits the usual hump-shaped pattern. Under the voluntary return scenario (thick solid line), however, the asset position is larger at each point in time for $t \in [15.82, 50]$, as compared to the suboptimal "stay-abroad scenario" (dashed line), due to the difference in the rates of return on savings.¹⁷ The thin solid line shows the evolution of U's asset position if she remains permanently in the source country. Comparing the thick solid and the thin solid schedules we clearly see that migration, with the possibility of earning a higher foreign wage, entails larger asset holdings at each point in time. Even if U happens to be deported before her optimal

¹⁷With a 7% interest difference and repatriated assets of 1508.6, the interest earnings plus the home-country wage exceed the flow of income available abroad.

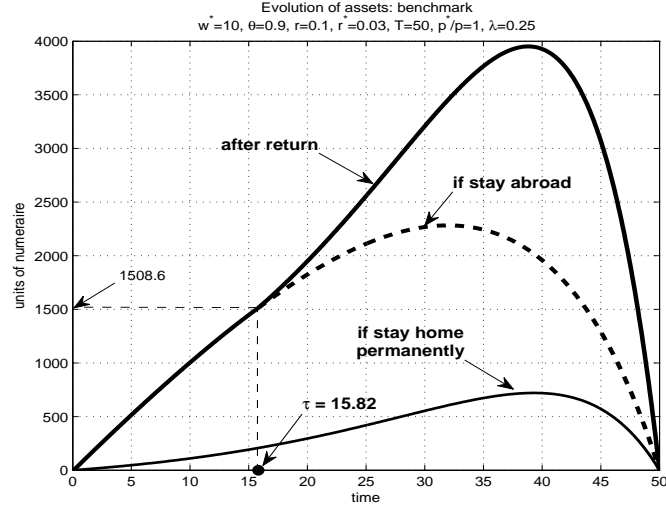


Figure 2: The assets path and the optimal return date.

return date, i.e., at some $t \in (0, \tau]$, she will arrive home with a larger stock of assets than the one she would have accumulated had she chosen not to migrate.

The evolution of asset holdings of a "voluntary" returnee is linked to her optimal consumption path, which is shown in figure 3 by the thick solid line. The dashed line represents the time profile of consumption in the host country, c_t^* . It overlaps with the solid line for $t \in [0, \tau]$. The dotted line shows c_τ , $\tau \in [0, T]$, i.e., the *initial* consumption rate in the home country if voluntary return occurs at $t = \tau$ (note that the dotted line is *not* the time profile of c_t).¹⁸ At the point of voluntary return, there is a downward jump in consumption rate from c_τ^* to c_τ . Subsequently, c_t grows along the solid line at a positive rate $\frac{r-\rho}{\theta}$ (see eq. (4)) and eventually crosses the time path of c_t^* , as illustrated in the figure. Return to an environment where $r > \rho$ from the one where $r^* = \rho$, tilts the time profile of consumption counterclockwise. This explains both the drop in consumption at the point of return and the subsequent increase in the consumption rates above those

¹⁸Under the current calibration with $\pi = 0$, the time path of \tilde{c}_t coincides with the time path of c_t and therefore the dotted line also represents \tilde{c}_τ , $\tau \in [0, T]$.

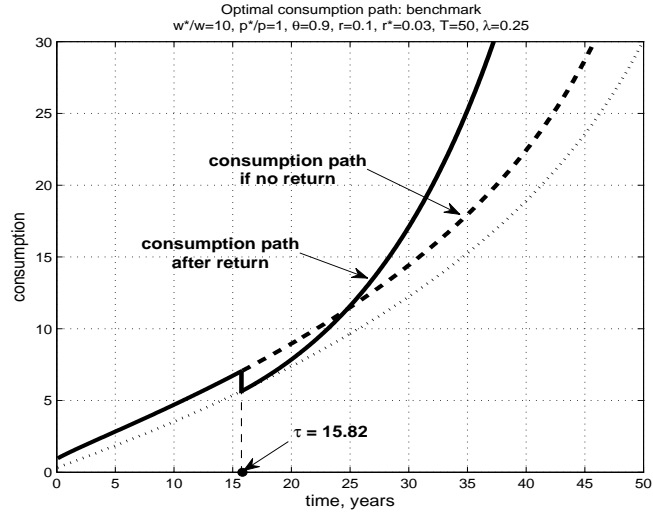


Figure 3: The optimal path of consumption.

that could be realized abroad. If, instead, the interest rate in the home country were identical to ρ (and hence to r^*), the time profile of c_t would be flat, although in this case it would not be optimal to return voluntarily under the current calibration.

2.2.2 Deportation Penalty

So far we have assumed that the deportation penalty is equal to zero. In many East Asian economies, as well as in the GCC States, both monetary and non-pecuniary penalties imposed on apprehended unauthorized migrants can be substantial. For instance, under the Immigration Act of Singapore the penalties for overstaying or illegal entry are a jail term of up to six months plus a minimum of three strokes of the cane (Singapore Immigration Act (133)). In United Arab Emirates a penalty charge of Dhs. 25 (US\$ 7) - Dhs. 100 (US\$ 28) per day is imposed on visitors who remain within the territory beyond the officially authorized duration of stay. If the overstay extends to a significant amount of time, then a court hearing is issued and the judge decides what penalties

to impose.¹⁹ In Saudi Arabia, individuals who overstay their visit in the Kingdom are subject to a fine of 10'000 Saudi Riyals (or \$2'667) and incarceration pending deportation proceedings.²⁰ According to Malaysian Immigration Department website, "Section 15 (4) of the Immigration Act 1959/63 (Act 155) provides a fine of not less than RM10'000 or imprisonment not exceeding 5 years or both."²¹

For our purpose of examining the role of penalties that accompany deportations, let us assume that they can be captured by a monetary fine. Introducing such a penalty unambiguously advances the date of voluntary return. Having to pay the fine in the case of apprehension constitutes an additional cost of remaining abroad and thus reduces the continuation payoff. With π set equal to six months of host-country income ($\pi = 60$) the optimal τ is reduced by 1.5 years in the benchmark calibration.

2.2.3 Price Differential

Another important factor that draws migrants back to the home country is the possibility of consuming commodities at lower prices than in the host country (Djajić 1989, Kirdar 2013). For the purpose of isolating the effect of the price differential on the decision to return, I set $r = r^* = \rho = 3\%$, normalize p to unity and let p^* lie in the range between 1 and 5, while keeping the values of other parameters unchanged. Figure 4 shows the optimal return date, τ , as a function of the price differential, p^*/p , for various values of the risk aversion parameter θ , with the benchmark calibration ($\theta = 0.9$) shown by the bold curve. Clearly, the larger the price differential, the shorter the desired duration of stay in the host country: Higher cost of consumption (p^*), for a given w^* , reduces the attractiveness of staying abroad. It follows that undocumented migrants from countries with a relatively low cost of living will choose to return home sooner than migrants from

¹⁹<http://www.dubai-airport.info/visa.html>

²⁰http://travel.state.gov/travel/cis_pa_tw/cis/cis_1012.html#page

²¹<http://www.imi.gov.my/index.php/en/enforcement/overstayed>

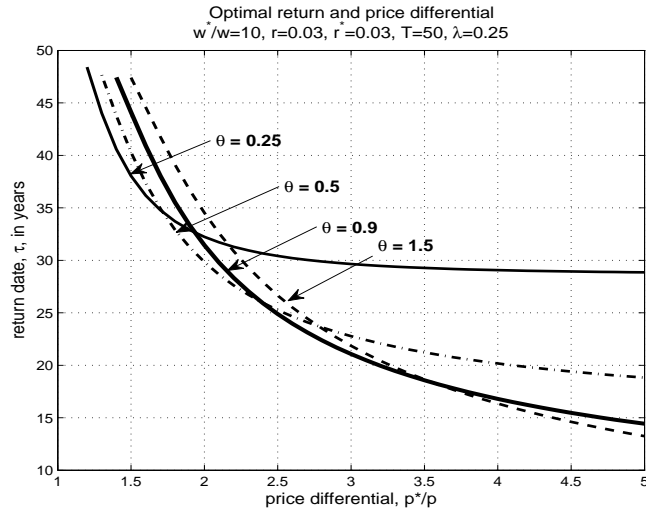


Figure 4: The optimal return and the price level differential.

countries with a comparatively higher cost of living, all else equal. Moreover, for any given θ there exists a threshold level of p^*/p below which it is not optimal to return. For instance, under the benchmark calibration of $\theta = 0.9$ and $\lambda = 0.25$, if the foreign price level is only about 30% higher than at home, there is no interior solution for the optimal voluntary return date, i.e., it is not optimal to return if p^* is sufficiently low in relation to p , given the wage differential.

2.2.4 Role of Uncertainty

One of the key points of this paper is to show that the risk of deportation has important implications, not only for the timing, but also for the occurrence of a voluntary return. A risky environment may trigger return under conditions that would otherwise, in the absence of deportation risk, result in the optimality of a permanent stay abroad. In the section "Returning in Anticipation of Deportation" Kibria (2004, p.20) writes: "There were also accounts of returning to Bangladesh in response to *anticipated* trouble with

the official authorities abroad...Such anticipation was often linked to the migrant's undocumented status. But it also reflected changes in the political environment, such as a crackdown on foreign workers which could motivate undocumented workers *who might otherwise have remained in the receiving country* [emphasis added] to return home." Our framework is capable of rationalizing such behavior of undocumented Bangladeshi migrants. If uncertainty is completely absent, i.e., $\lambda = 0$, U may prefer to stay permanently abroad under certain market conditions, but would choose to return to the country of origin for a sufficiently high value of λ . For instance, if $p^*/p \leq 2.35$ (with $r = r^* = 3\%$), it is not optimal to return when there is no deportation risk but it is optimal to do so after 26.36 years when the deportation rate is set at the benchmark value $\lambda = 0.25$. Alternatively, in our benchmark calibration with only interest rate differential, the optimal return occurs at $\tau = 15.82$ (see figure 2). However, if $\lambda = 0$ the solution for the optimal τ does not exist, i.e., it is optimal to remain permanently in the host country.

More generally, a higher deportation arrival rate, λ , encourages earlier voluntary return. The reason is that a higher λ entails more intensive precautionary saving and hence a larger asset position at each point in time. Larger asset holdings, in turn, induce migrants to return home sooner in order to take advantage of the relatively more favorable market opportunities in the source country, be they in the capital market in the form of a higher rate of return on savings or in the commodity market in the form of lower prices. Figure 5 provides a more general illustration. It shows the optimal return date, τ , plotted on the vertical axis as a function of λ . Clearly, a higher probability of deportation advances the date of voluntary return, although at a lower incremental rate. The convexity of the optimal return date in the deportation rate has important implications for immigration policy: A policy of increasing λ , may quickly lose its potency in terms of creating a stronger incentive for undocumented aliens to leave the host country sooner. In addition, the figure shows that beyond a certain value of λ stricter deportation

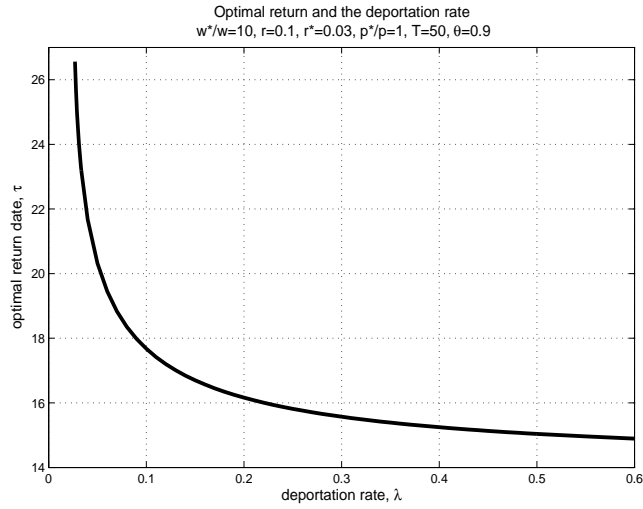


Figure 5: The optimal return and the Poisson arrival rate.

measures become almost totally ineffective in building on the incentives for voluntary return. We shall be more specific on this point in the next section when we consider the case of deportation policy in Japan.

Overall, the model predicts that when an undocumented migrant follows her optimal program over a given planning horizon, she chooses to return *voluntarily* to her country of origin at some point in time if the pull-back factors are sufficiently strong and the risk of deportation sufficiently high. Otherwise, she will attempt to remain permanently abroad as an undocumented alien. Migrants from economies with a relatively low cost of living and attractive investment opportunities will choose a shorter duration of undocumented stay abroad.

3 Role of Social Factors

3.1 The Evidence

Evidence gathered on the basis of interviews with return migrants suggests that they do not derive utility only from consuming goods and services but also from *where* and *with whom* their consumption takes place. Many undocumented migrants explicitly mention being homesick and missing their families as a reason for not staying abroad for a longer period of time. As reported by Businessweek (2005), for example, a Sri Lankan undocumented worker in South Korea "...has little to do during his free time but to fret about his loved ones at home." The undocumented status prevents such individuals from going back and forth to visit their relatives, while the tight visa restrictions prevent family members from entering the host country. In many cases this can prevent family reunion until the migrant is deported or returns voluntarily.

To our knowledge, there is only a small number of studies that attempt to measure homesickness of immigrant workers. The few papers that deal with the issue are focused on legal foreign-born workers or students. On the basis of a sample of 171 employees of a Dutch multinational company, Eurelings-Bontekoe et al. (2000) show that the relationship between feeling homesick and the time spent in the host country is non-linear. The prevalence of self-identified homesickness was the highest (44.2%) in the group of individuals who spent between 6 and 8 years abroad. The next highest (42.1%) was in the group who spent between 0.5 and 5 years abroad. This is followed by 21.2% among those with 9 to 18 years and, finally, 17.5% for those with 19 to 38 years abroad. These figures indicate a hump-shaped relationship with the peak of the hump at around 8 years. Although these findings are based on a sample of legally employed persons in the Netherlands, they are indicative of the fact that there is a psychological burden associated with being away from home. The intensity of homesickness for illegal immigrants is

arguably stronger and increasing over time as their ability to communicate with and visit their relatives and friends in the country of origin is much more limited due to their irregular status.

More evidence on the role of homesickness in the decision to return is provided in the study by Niedomysl and Amcoff (2010). It focuses on the reasons for return migration and shows that social factors, such as the desire to be with family and friends, are just as important in explaining return migration as income and employment opportunities. This result is supported by the evidence on Bangladeshi migrants in Kibria (2004, p.16): "Besides the successful achievement of their economic objectives, the 'voluntarily returned' also included those who had come back for personal reasons... For Abul, who had worked in Japan for almost nine years, there were clearly multiple factors at work. But paramount was a desire to get married and to start a family, options that he did not see as available to him if he had remained in Japan...".

Apart from homesickness, undocumented immigrants obviously feel unwelcome in the host country. They typically have to accept a way of life which minimizes their exposure to local authorities and even to locals who may signal the presence of an illegal alien to the police. Unauthorized migrants therefore cannot fully enjoy a range of public goods and services and even their consumption of private goods is restricted by the fear of being exposed to someone who will report them to the authorities.²² Moreover, as there is practically no scope for remaining permanently in a host country with strict deportation measures, undocumented workers have little incentive to invest their time in social-integration efforts abroad, focusing instead on maintaining strong ties with their relatives and friends at home (primarily over the internet or SMS). Thus, while Eurelings-Bontekoe et al. (2000) show that legal workers experience only a slight

²²"People living and working with irregular status are often denied a whole host of basic entitlements and services and lead their lives in constant fear of arrest and deportation." (Human Development Report 2009, p. 17.)

increase in homesickness over the first 8 years abroad, the above-mentioned constraints faced by undocumented workers are likely to contribute to a much higher rate of increase in homesickness over time.

3.2 The Model with "Homesickness"

The most natural way to capture the effect of social isolation and family separation is to generalize U's utility function to account for the time spent abroad. In the literature on temporary migration it is commonly assumed that a given quantity of consumption good yields a smaller utility if it is consumed abroad rather than at home, i.e., there is a discount on utility in the host country (see, e.g., Hill 1987, Djajić and Milbourne 1988, Djajić 2010). In the case of undocumented migration this discount is time-dependent. Moreover, it is quite likely that the time dependence is not linear but rather convex due to the above-mentioned constraints associated with the undocumented status. We shall therefore assume that the marginal homesickness increases as U spends more and more time in the host country. The migrant's utility function while abroad takes the following form:

$$u(c_t^*, t) = \frac{c_t^{*1-\theta}}{1-\theta} - h_t, \quad h_t = e^{\alpha t} - 1, \quad \alpha > 0, \quad (12)$$

where h_t stands for "homesickness", with $\frac{\partial u(c_t^*, t)}{\partial t} < 0$ and $\frac{\partial^2 u(c_t^*, t)}{\partial t^2} < 0$. The parameter α governs the intensity of homesickness. If the migrant is located in the source country, $\alpha = 0$. Later in this section we present and discuss the sensitivity of our results with respect to alternative specifications of the h_t function. We shall consider a linear and a concave specification, where the latter captures decaying intensity of homesickness.

The optimization program with respect to consumption is not affected by the introduction of homesickness in the utility function, as long as time does not affect the marginal utility of consumption, which is the case here. The optimal consumption path

is therefore identical to that derived in the previous subsection, although, the value functions have now two arguments, a_t and t , which are the two state variables of the program. The optimality condition for the time of return is derived along the lines presented in subsection 2.1. In our benchmark calibration of section 2.2.4 reflecting the East-Asian context, the optimal return date is $\tau = 9.02$ when both economic pull-back factors are present ($r = 10\%$, $r^* = 3\%$, $p^*/p = 3$) and the deportation rate is $\lambda = 0.25$. Introducing homesickness into the model ($\alpha = 0.01$ as a starting point) yields a more realistic value of $\tau = 4.82$ for the optimal migration duration. This is comparable to the reported 2 - 5 year durations of stay abroad of illegal aliens in Japan, South Korea, Taiwan, Malaysia, and Singapore (Jones and Pardthaisong 1999, Kibria 2004, Sobieszczyk 2000).

3.3 The Japanese Case

The data on undocumented Thai migrants in Sobieszczyk (2000) allows us, in fact, to extract the value of α for those who worked in Japan.²³ The Sobieszczyk (2000) study covers a total of 29 migrants who worked illegally in Japan between 1986 and 1997. We shall use 1995 as the benchmark year for our calibration as the data for most of the required parameters is readily available for this year (except for the deportation rate and the price ratio for which only the data in 2000 is available). For the purpose of retrieving the value of α on the basis of this sample, we calibrate the following parameters: w^*/w , p^*/p , r^* , r , λ , and τ .

Wage ratio. For the 29 migrants, the average monthly wage in Japan was equal to \$1'378.11 (in current dollars). Unfortunately, Sobieszczyk (2000) does not provide information on the wage earned in Thailand before or after migration. However, we know that the average monthly wage of an unskilled worker in Thailand in the mid

²³The full sample contains information on 104 temporary migrants who worked in various destination countries including Japan, Hong-Kong, Singapore, Taiwan, Brunei, South Korea and Malaysia. However, due to the lack of data on deportation rates, we are only able to analyze the case of migration to Japan.

1990s was 6'267 baht, which is equal to \$250.68 at the exchange rate of 25 baht per dollar in 1995-1996 (Jones and Pardthaisong 1999, footnote to Table 6). This value of the monthly wage rate is consistent with the ILO data on wages in Thailand in 1995 (\$250.56). Dividing \$1'378.11 by \$250.68 we obtain the wage ratio $w^*/w = 5.49$.

Price ratio. The data on the price ratio is taken from OECD Comparative price levels for 2000 (data for 1995 are not available, although one may expect that in 1995 the price differential was larger than in 2000). The value of the index for Japan was 164 and for Thailand it was 40, implying that $p^*/p = 164/40 = 4.1$.

Interest rates. The real interest rate in 1995 was equal to 4% in Japan and 7.3% in Thailand (World Bank Data²⁴). Thus we have $r^* = 0.04$ and $r = 0.073$. Since the benchmark time period used in the model simulation is one month, these values will be divided by twelve in the calculations below.

Deportation rate. The Japanese Ministry of Justice provides information on the number of deportations and the estimated stocks of illegal immigrants as of 1999. The ratio of annual deportations of undocumented Thai nationals to the stock of illegal aliens from Thailand residing in Japan is on average 0.144 for the seven years from 1999 to 2005.²⁵ I therefore set $\lambda = 0.144$.

Deportation penalty. According to the Revised Immigration Control and Refugee Recognition Act (1999), the penalty for illegal stay in Japan is imprisonment of up to 3 years or a fine of up to 3 hundred thousand yen.²⁶ This monetary penalty is equal to \$2'638, applying the average exchange rate in 1999 of 113.71 yen per dollar.²⁷ Given that the average earnings of a migrant were \$1'378.11 per month, the penalty represents

²⁴<http://data.worldbank.org/indicator/FR.INR.RINR?page=3>

²⁵For each of these years, the ratio is reported to be as follows: $3886/30065 = 0.1292$ in 1999, $3359/23503 = 0.1429$ in 2000, $2552/19500 = 0.1308$ in 2001, $2391/16925 = 0.1412$ in 2002, $2272/15693 = 0.1447$ in 2003, $2521/14334 = 0.1758$ in 2004, and $1895/12787 = 0.1481$ in 2005 (Japanese Ministry of Justice, 2005, 2011).

²⁶http://www.jca.apc.org/apfs/nyukan_rev_e.html

²⁷I use the Board of Governors of the Federal Reserve System release on monthly dollar-yen exchange rate to calculate the average. The data is available at <http://research.stlouisfed.org/fred2/data/EXJPUS.txt>

approximately 1.91 times the monthly wage.

Trip duration. The average duration of stay abroad of the 29 undocumented Thai migrants in Japan was 60.19 months or 5.015 years, which is in fact less than the hypothetical expected stay (given the deportation rates) of $1/\lambda = 6.9$ years.

If we use these data to characterize the economic environment facing an undocumented Thai migrant and calculate the optimal duration of stay in Japan in the absence of homesickness (i.e., by setting $\alpha = 0$), we obtain $\tau = 8.88$ years. This is almost 4 years longer than the observed average length of stay. The value of the homesickness parameter which is consistent with the observed average migration duration of 5.015 years is $\alpha = 0.0117$, assuming the benchmark elasticity of marginal utility $\theta = 0.9$. Column 2 of Table 3 reports the value of α for θ ranging from 0.75 to 3. These estimates are, of course, a result of a rough calculation based on a small sample and should be only considered as suggestive. They allow us, nonetheless, to interpret the utility loss due to homesickness in more concrete terms if we relate it to the utility enjoyed from the consumption of commodities. That is, we can calculate the consumption-equivalent loss due to social isolation. Using as the point of reference the optimal consumption rate in the last month of the undocumented stay, we calculate that the impact of homesickness on utility is identical to a 17 - 89% cut in the consumption rate (see Table 2, column 5), depending on the degree of concavity of the utility function (θ ranging from 0.75 to 3).

Our results are undoubtedly sensitive to the chosen specification of the homesickness function. One might argue that homesickness increases with time spent abroad following a linear trend. Or, alternatively, homesickness increases but at a decreasing rate due to better assimilation, for example, or even declines over time. The latter case is, however, highly unlikely for illegal Thai migrants in Japan as they typically do not learn the Japanese language and restrain from being seen in public. We consider two alternative specifications of the h_t function: linear ($h_t = \alpha t$) and concave ($h_t = t^\alpha - 1$), where the

$\theta \backslash h_t$	exponential,30	linear,30	concave,30	exponential,60	linear,60	concave,60
$\theta = 0.75$	55.67	65.63	83.11	89.81	89.86	89.93
$\theta = 0.9$	37.59	43.69	59.75	68.32	68.37	68.45
$\theta = 1.25$	20.20	22.47	32.89	40.51	40.53	40.60
$\theta = 3.00$	7.40	7.69	11.79	16.88	16.88	16.92

Table 2: Consumption-equivalent loss at 30th and 60th month for alternative homesickness functions.

latter captures decaying marginal homesickness effect. In the absence of homesickness ($\alpha = 0$) all the three functions are normalized to zero. In each case, the parameter α is extracted from the data on undocumented Thai migrants in Japan. The predicted consumption-equivalent loss is reported in Table 2 for alternative values of θ and two consumption reference points: the 30th month (half average trip duration) and the 60th month. The results are remarkably similar across all the three specifications. If we consider the 30th month as the point of reference, then the effect of homesickness is equivalent to a 7.4% ($\theta = 3$) to 55.6% ($\theta = 0.75$) cut in the migrant's consumption rate in that month when h_t is exponential, a 7.7% to 65.6% cut when h_t is linear, and a 11.8% to 83.1% cut when h_t is concave. Logically, the convex functional form yields a relatively smaller loss than the linear form which in turn yields a smaller loss than the concave function. If we consider the last month of the trip as the point of reference, then the effect of homesickness translates into approximately a 17% ($\theta = 3$) to 89% ($\theta = 0.75$) decline in the consumption rate for all the three specifications. Homesickness thus appears to be a powerful element influencing return decisions of undocumented foreign workers, as suggested by descriptive studies (see, e.g., Kibria 2004).

One may go a step further to measure the influence of homesickness in relation to other pull-back factors, such as, for example, the expected rate of return on investments in Thailand. How large would this rate have to be in the absence of the homesickness effect in order to induce undocumented Thai migrants to return after spending 5 years

in Japan? The model predicts that the real interest rate in Thailand would need to be 15.5% (instead of the observed rate of 7.3%), implying an increase of 8.2 percentage points. The sensitivity of this result to variations in the elasticity of marginal utility (θ) can be seen in the 3d column of Table 3, which shows that, within a realistic range of values of θ , the overall effect of homesickness is equivalent to that of a 5.07 to 9.63 percentage-point increase in the rate of return on investment in the sending country.

As the final step, we examine the predicted impact of a change in λ on undocumented Thai migrants' duration of stay in Japan. Given the estimated value of the homesickness

Inverse of EICS	Homesickness intensity	Equivalent increase in interest rate,%	Reduction in τ due to doubling of λ ,%	Reduction in τ due to tripling of λ ,%
$\theta = 0.75$	$\alpha = 0.014438$	9.63	2.07	3.89
$\theta = 0.85$	$\alpha = 0.0125347$	8.68	2.62	4.72
$\theta = 0.9$	$\alpha = 0.011715$	8.24	3.01	5.14
$\theta = 0.95$	$\alpha = 0.010973$	7.83	3.03	5.56
$\theta = 1.05$	$\alpha = 0.0096935$	7.15	3.81	6.38
$\theta = 3.00$	$\alpha = 0.0028235$	5.07	8.74	13.95

Table 3: Exponential homesickness function, $h_t = e^{\alpha t} - 1$.

Inverse of EICS	Homesickness intensity	Equivalent increase in interest rate,%	Reduction in τ due to doubling of λ ,%	Reduction in τ due to tripling of λ ,%
$\theta = 0.75$	$\alpha = 0.0230045$	9.63	2.59	4.58
$\theta = 0.9$	$\alpha = 0.0170148$	8.24	3.40	5.78
$\theta = 3.00$	$\alpha = 0.0030764$	5.07	8.89	14.18

Table 4: Linear homesickness function, $h_t = \alpha t$.

Inverse of EICS	Homesickness intensity	Equivalent increase in interest rate,%	Reduction in τ due to doubling of λ ,%	Reduction in τ due to tripling of λ ,%
$\theta = 0.75$	$\alpha = 0.212093$	9.63	3.40	5.98
$\theta = 0.9$	$\alpha = 0.17209$	8.24	4.35	7.37
$\theta = 3.00$	$\alpha = 0.041477$	5.07	10.74	16.93

Table 5: Decaying homesickness function, $h_t = t^\alpha - 1$.

parameter, the model implies that a doubling of the deportation rate to 0.2882 reduces the optimal τ by 2 - 8.74% or 1.25 to 5.26 months (depending on the choice of θ), as shown in the fourth column of Table 3. The fifth column shows the change in τ following a 3-times increase in the deportation rate. It amounts to a decline in the duration of stay of 2.5 ($\theta = 0.75$) to 8.5 months ($\theta = 3$). Not surprisingly, the higher is the elasticity of intertemporal consumption substitution ($1/\theta$), the smaller is the implied change in τ . Tables 4 and 5 report similar results for the linear and, respectively, concave specification of the h_t function. Column 2 shows the extracted value of α for three representative values of θ . Column 3 shows the required increase in the real interest rate to induce a voluntary return after 5 years in the absence of the homesickness effect (identical to the values in Table 3). Columns 4 and 5 show the change in τ following a two-fold and, respectively, a three-fold increase in the deportation rate. The concave h_t function captures a relatively fast-growing negative impact of homesickness at the beginning of the trip and a subsequent slow-down. The linear function captures a steady increase, while the convex function captures a slowly growing homesickness at the beginning of the trip but an explosively high growth at longer durations. The effect of an increase in the deportation rate on the change in the optimal-return date is thus more pronounced for a concave specification (regardless of θ) since the marginal impact of homesickness (the slope of h_t) is larger for $t < \tau$. For instance, a doubling of λ reduces τ by 6.5 months if h_t is concave and only by 5.26 months if it is convex (assuming $\theta = 3$). The difference of 5 weeks may seem to be negligible but one should keep in mind that in certain countries tolerance towards illegal immigrants is minimal and an overstay of even a few weeks is punished by heavy monetary penalties or imprisonment or a ban on reentry.

In closing our discussion on the role of homesickness in a model of temporary migration we would like to emphasize that it allows us to improve our understanding of undocumented migrants' behavior and, in particular, their incentives to return to the

country of origin. Homesickness is only one of the drivers of return decision but its role is reinforced in environments characterized by sharp intolerance of illegal immigration and strict deportation policies. This is, for example, the case in East-Asian economies and the Gulf States. It is relevant to a lesser extent for illegal Mexican migrants in the United States, where deportations are fairly rare.

We have shown that taking into account the risk of deportation allows us to obtain more realistic values for optimal trip durations of undocumented migrants than those arising from standard deterministic models of temporary migration. Incorporating the homesickness phenomenon allows to further refine those results and thus reduce the potential for erroneous policy prescriptions. It is clear that when the migration duration of undocumented workers is overestimated, an overly restrictive policy may be introduced which may not only result in a gap in labor supply in certain sectors (if not accompanied by relevant legal migration programs) but also in an unnecessary burden on the immigration authorities' budget. The present model has no ambition of comparing effectiveness of various immigration policies, as this would require information on the numbers of deterred entries and relative costs of each policy. We can, however, conclude that deportation policy (i) has a non-negligible indirect effect of reducing the stock of illegal immigrants by inducing them to leave the host country sooner and (ii) acts as a homesickness catalyst which in turn is a powerful pull-back factor that may speed-up voluntary return even when economic incentives (such as rate of return on investment, for instance) are relatively weak.

4 Conclusion

The present paper develops a framework for the analysis of temporary illegal immigration. Its main contribution is three-fold. Starting with the characterization of the

solution for the optimal timing of return to the source country when the event of deportation follows a stochastic process, we show that a more vigorous deportation policy advances the date of voluntary return. This helps explain why undocumented immigrants choose to remain for only a relatively short period of time in countries with very strict deportation measures, such as Japan, South Korea, Singapore, Malaysia and the Gulf States, while tending to stay for longer durations or even permanently in countries with a more lenient stance, such as the U.S.A. or the EU. A higher deportation risk creates stronger incentives for voluntary return by operating through two channels: acceleration of wealth accumulation and "homesickness". In addition, it is found that the risk of deportation may trigger voluntary return under conditions that would otherwise make a *permanent* undocumented stay optimal.

An important policy implication of this analysis is that for any given flow of undocumented workers, a host country with stricter deportation policies will have a smaller stock of illegal immigrants at each point in time. This is not only because it physically removes more undocumented aliens, but also because the policy indirectly induces those who are not apprehended to *voluntarily* leave the country sooner. In addition to these direct and indirect effects which contribute to a reduction in the stock of illegal aliens for a given flow, deportations obviously have a deterrent effect on the inflow.

The paper also shows that consideration of just the economic pull-back factors, such as international return-on-investment or cost-of-living differentials, which have been extensively studied in the literature on temporary migration, is not sufficient to account for the observed behavior of *undocumented* aliens. Although these factors do play an important role in drawing migrants back to their country of origin, they do not explain why deportable illegal immigrants return voluntarily after only 2 to 5 years of work abroad. Accounting, in addition, for the effects of "homesickness" and using the evidence on the behavior of undocumented Thai migrants in Japan, enables us to measure the influence

of these psychological and social factors on the timing of voluntary return. They are found to be just as important as economic considerations. On average, the loss of welfare associated with family separation and social isolation experienced by undocumented Thai migrants during their last month in Japan is equivalent to a change in utility associated with a 17 to 68% cut in the consumption rate abroad (in the empirically relevant range of the intertemporal substitution elasticity). For illegal immigrants in countries with very strict deportation measures, the degree of social isolation and separation from other family members is indeed unique across the spectrum of migrant types. It therefore deserves particular attention in both theoretical and empirical studies.

Our calibration of the model for the case of undocumented Thai migrants in Japan also allows us to draw conclusions on the effectiveness of a change in the intensity of deportations in terms of its impact on the optimal duration of an undocumented stay. Our model predicts that while stricter deportation measures can be quite effective in building on the incentives for voluntary return at relatively low rates of deportation, it is also true that, after a certain point, a further tightening of this policy becomes less effective. In the case of Japan, we find that doubling the deportation rate from its level in the late 1990s would have reduced the optimal duration of stay of illegal aliens from Thailand by about 1.25 to 8.5 months, depending on the intertemporal substitution elasticity and the shape of the homesickness function.

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A Optimal Return with Risk of Deportation

A.1 Derivation of optimal consumption growth rate abroad

The Hamilton-Jacobi-Bellman equation is given by

$$\rho V(a_t) = \max \left\{ u(c_t^*) + \frac{\partial V(a_t)}{\partial a_t} (r^* a_t + w^* - p^* c_t^*) + \lambda (\tilde{V}(a_t) - V(a_t)) \right\}. \quad (13)$$

The first order conditions with respect to c_t^* and a_t yield

$$u'(c_t^*) - p^* \frac{\partial V_t}{\partial a_t} = 0, \quad (14)$$

$$\rho \frac{\partial V_t}{\partial a_t} = \frac{\partial^2 V_t}{\partial a_t^2} \dot{a}_t + r^* \frac{\partial V_t}{\partial a_t} + \lambda \left(\frac{\partial \tilde{V}_t}{\partial a_t} - \frac{\partial V_t}{\partial a_t} \right). \quad (15)$$

Differentiating (14) with respect to time and using the result in (15) yields

$$\frac{u''(c_t^*)}{u'(c_t^*)} \dot{c}_t^* + r^* + \lambda \left(\frac{u'(\tilde{c}_t) p^*}{u'(c_t^*) p} - 1 \right) - \rho = 0.$$

After rearranging terms and using $u'(x) = (x)^{-\theta}$ ($x = \tilde{c}_t, c_t^*$), we obtain

$$\frac{\dot{c}_t^*}{c_t^*} = \frac{1}{\theta} \left\{ \lambda \left[\left(\frac{\tilde{c}_t}{c_t^*} \right)^{-\theta} \frac{p^*}{p} - 1 \right] + r^* - \rho \right\}. \quad (16)$$

A.2 Derivation of optimal consumption growth rate after deportation

If U is deported at time ε , her objective is to maximize

$$\int_{\varepsilon}^T u(\tilde{c}_t) e^{-\rho(t-\varepsilon)} dt$$

subject to

$$\dot{a}_t = ra_t + w - p\tilde{c}_t, \quad t \in [\varepsilon, T], \quad a_\varepsilon \text{ given}, \quad a_T = 0.$$

The solution to this problem is well known. The optimal growth rate of consumption is constant at $\frac{r-\rho}{\theta}$ and hence $\tilde{c}_t = \tilde{c}_\varepsilon e^{\frac{r-\rho}{\theta}(t-\varepsilon)}$. Using this in the differential equation for the asset position allows to solve for \tilde{c}_ε (see eq. (9) in the text) and subsequently for the time profile of assets:

$$a_t = a_\varepsilon e^{r(t-\varepsilon)} + w \frac{e^{r(t-\varepsilon)} - 1}{r} - p\tilde{c}_\varepsilon \frac{e^{\frac{r-\rho}{\theta}(t-\varepsilon)} - e^{r(t-\varepsilon)}}{g}, \quad t \in [\varepsilon, T].$$

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