



No. 01-2013

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On the Interdependence of Illegal and Legal Immigration

Moritz Bonn*

January 3, 2013

Abstract

This paper accounts for the interdependency between illegal and legal immigration and its effects on average migrant productivity as well as on the fiscal budget. I present a simple model which proposes that the host country's government can reduce the required skill level for legal entry in order to maximize the immigrant's average productivity. With regard to the fiscal surplus that is achieved by immigration, the model presumes that the government is encouraged to substitute illegal workers by legal ones if the former are characterized by lower tax benefit ratios or if over-qualification among unauthorized aliens is widespread.

JEL Classification: F22 · H24 · K4

Keywords: Illegal Immigration, Fiscal Contribution, Immigration Policy

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1 Introduction

Illegal immigration has become a source of rising concerns for policy makers in most developed countries. This especially applies to countries which due to their geographical location are most hit by the causes of illegal immigrants. According to recent estimations, the percentage share of irregular residents to total population have reached significantly high levels of 1.09% in Italy, 1.11% in Austria, 1.22% in Switzerland, 2.69% in Greece and 3.94% in the U.S. (OECD 2009). The U.S. is a striking example for the development of illegal immigration within the last decades. Whereas the number of undocumented residents was estimated to be 5 million in 1996, it has increased to 8.4 million in 2000 and to 11.1 million in 2005 (Passel 2006).

Opinion polls and election results further indicate that the general public rewards irregular immigration to be purely negative. Leading policy makers account for this by increasingly trying to find adequate instruments to prevent clandestine border crossing, fraudulent entrance by use of false documents and the overstaying of temporary visas which tend to be the most common ways to become an unauthorized alien in the host country (OECD 2009).

By contrast, legal immigration is often regarded as a requirement to overcome skill shortages and other problems that are related to the demographic change. Comparing this to the critical view on illegal immigrants, it may seem surprising that the residential status of immigrants is of such an important relevance for the native population. However, there are decisive differences between the two types. First, on average, legal migrants are higher skilled. If they enter the host economy on a working-based visa, their educational attainment is often above that of the native average. Thus, legal immigrants are believed to be net contributors to the welfare state and to prepare the ground for innovation and high technology. Second, different from illegal immigrants, the government can control for specific skills and other characteristics such as age, nationality or the migrant's affinity to the host country's cultural values which might even be more important for the majority of domestic voters. Third, undocumented immigration is perceived to be undesirable simply because of its irregularity. By definition, irregular immigration is contrarian to the governmental objectives. The issue is even strengthened by the widespread belief that the government should always be able to control immigration, no matter whether it is good or bad for the host country.¹ Moreover, the legal status influences the probability that the migrant is involved in criminal activity. Due to their unauthorized status, illegal migrants' opportunities to earn a living are often

¹By contrast, Hanson (2007, 2009) stresses the higher flexibility of undocumented and thus uncontrolled migrants who respond efficiently to market forces and constitute an appealing source of cheap labor for U.S. employers.

restricted to unpleasant or criminal activity. Finally, there are humanitarian concerns since in many cases, illegal immigrants are dependant on criminals such as traffickers and middle men who exploit the migrants' inconvenient situation (Entorf 2002).

It is however disputable whether it is accurate to simply distinguish between legal and illegal migrants since both are often causally related. It has been mentioned that overstaying a legal temporary visa is the dominant source of illegal residency in many countries. Apart from this, legal migrants may work as middle men for potential illegal workers, provide them with important information about accommodation and job offers in the informal sector. At the same time, legalization of initially undocumented aliens has become a relevant source of official population growth.

This paper focuses on another link between irregular and regular migration. By determining the preliminaries that applicants need to satisfy for regular immigration, the government influences the stock of both, the legal and the illegal immigrants. More precisely, I point at the governmental opportunity to antagonize illegal entrance by improving the opportunities for legal immigration. I construct a simple model, where a constant pool of individuals with heterogeneous skills is willing to immigrate into the host country. The government is able to set a preliminary skill level and thus determine the scope of legal immigrants. However, I assume that there is a share of those who were rejected who are successfully immigrating illegally. Thus, by reducing the requirements for legal entry, the government can destroy the breeding ground for illegal immigration, but at the same time, it reduces the average quality of both legal and illegal immigrants. The model predicts that the government is able to pursue a policy to maximize immigrants' average productivity. Furthermore, I use a simple model of fiscal redistribution in order to analyze how the potential of illegal immigration affects the policy of the host economy. If illegal and legal migrants, due to their residential status, have systematically different tax benefit ratios or different access to the host country's labor market, the government has an incentive to further liberalize or restrict legal immigration accordingly.

Surprisingly, the literature on illegal immigration has hardly taken account of the interdependencies between legal and illegal immigrants. In a pioneering work, Ethier (1986) studies the importance of border enforcement to limit the scope of illegal migrants. In his model, a decline of legal immigrants leads to a proportional increase of the illegal ones and vice versa. Immigrants, however are assumed to differ only by their legal status but not by skills or other characteristics so that the government has no incentive to curtail illegal by enlarged legal immigration. Among others, Epstein et al. (1999), Schiff (2004), Djajić and Michael (2009) account for legal temporary visas which can be both, source of increased as well as

decreased illegal immigration.

There is a comparably small literature focusing on the fiscal effects of illegal immigrants.² The main consensus is that skilled immigrants contribute to the fiscal budget whereas unskilled migrants rather exploit the welfare state. Since illegal immigrants are mostly low skilled they are often assumed to extract more than they pay. This argument is even strengthened by the circumstance that illegal immigrants systematically pay lower taxes than natives and legal migrants since they are often restricted to work in the informal sector (Camarota 2004; Hanson 2009).³ At the same time, one must take into account that unauthorized aliens often have difficulties in taking advantage of public goods and hardly receive transfers (Porter 2005).⁴ Storesletten (2000) provides a dynamic model to calculate life time net contributions of natives, legal as well as illegal immigrants. He estimates that legal and illegal immigrants take more from public budget than they contribute and that illegal migrants account for the larger fiscal loss. However, his calculation is based on the critical assumption that illegal migrants do not pay any contribution to the fiscal budget. Furthermore, his model does not account for any interdependency between legal and illegal immigration.

The rest of this paper is structured as follows: the next section provides the basic framework. The Sections 3 and 4 point at the policy implications when the host country's government's objective is to maximize the migrants' average productivity or the government's fiscal surplus caused by them. Section 5 concludes.

2 The Model

Assume that there is a mass of 1 of individuals from country A who are willing to immigrate into a richer country B . The incentives to migrate are assumed to stem from exogenous wage differentials or differences with regard to the welfare state between the host and the source economy. For example, suppose that in both countries a homogenous good is produced with a linear production technology, where labor is the only relevant factor and wage differentials between individuals of the same skill type solely stem from technology differences between the two countries. Assume further that income tax rates and transfers as well as individual

²See Rowthorn (2008) for a recent summary of the empirical studies.

³Probably, illegal residents also pay systematically less consumption taxes. This results from the empirical fact that illegal residents spend a lower income share on consumption. First, they remit a substantial share of their income to their families who often remain in the respective home country. Additionally, illegality prevents certain consumption opportunities and induces uncertainty that leads to precautionary behavior which negatively affects consumption (Dustmann et al. 2012).

⁴In this context, one should consider the short term nature of illegal immigration (Chiswick 1988; Reyes 1997; Conligio et al. 2009) which prevents that these individuals take advantage of potential health and retirement subsidies.

migration costs are constant so that the incentive to immigrate into country B is independent of the scope of migrants. Migrants are heterogeneous with regard to their individual productivity level θ_i which is distributed on the interval $[0, 1]$. The government can directly affect the mass of legal immigrants by choosing a reference value $\tilde{\theta}$ so that those whose productivity is larger than $\tilde{\theta}$ are permitted to immigrate legally. Furthermore, the government has to take into account that a certain share γ of the remaining individuals enters the country illegally.

The mass of immigrants is therefore equal to:

$$m(\tilde{\theta}) = 1 - (1 - \gamma) \int_0^{\tilde{\theta}} f(\theta) d\theta = 1 - (1 - \gamma) F(\tilde{\theta}) \quad (1)$$

where $f(\theta)$ is the density function of the distribution of immigrants over the individual productivity level and $F(\theta)$ is the corresponding antiderivative. Due to the prior assumptions, it is clear that $F(\tilde{\theta} = 0) = 0$ and $F(\tilde{\theta} = 1) = 1$. The probability that a randomly drawn immigrant is a legal immigrant is thus $p(\gamma, \tilde{\theta}) = \frac{1 - F(\tilde{\theta})}{1 - (1 - \gamma)F(\tilde{\theta})}$ and the counter probability that a migrant is illegal is $q(\gamma, \tilde{\theta}) = 1 - p(\gamma, \tilde{\theta}) = \frac{\gamma F(\tilde{\theta})}{1 - (1 - \gamma)F(\tilde{\theta})}$. The expected productivity of a legal immigrant is:

$$E_L(\tilde{\theta}) = \frac{1}{1 - F(\tilde{\theta})} \int_{\tilde{\theta}}^1 \theta f(\theta) d\theta = \frac{1 + G(\tilde{\theta}) - \tilde{\theta}F(\tilde{\theta}) - G(1)}{1 - F(\tilde{\theta})} \quad (2)$$

where $G(\tilde{\theta})$ is the antiderivative of $F(\tilde{\theta})$. Thus, it is obvious that $G'(\tilde{\theta}) = F(\tilde{\theta}) > 0$, $G''(\tilde{\theta}) = f(\tilde{\theta}) > 0$ and $G(0) = 0$, $0 < G(1) < 1$. The expected productivity of an illegal immigrant is:

$$E_I(\tilde{\theta}) = \frac{1}{F(\tilde{\theta})} \int_0^{\tilde{\theta}} \theta f(\theta) d\theta = \frac{\tilde{\theta}F(\tilde{\theta}) - G(\tilde{\theta})}{F(\tilde{\theta})}. \quad (3)$$

It is unambiguous that all illegal immigrants have a lower productivity than legal immigrants. Thus, the expected productivity of a legal immigrant is larger than that of an illegal one.

3 Migrants' Average Productivity

Often, the success of an immigration policy is judged by the average productivity of migrants. Countries, where the average immigrant is relatively skilled are thus thought to gain from efficient immigration guidelines. In a world without illegal immigration, things would be much easier since the government was able to control completely for the skill level. However, if illegal immigration is apparent, the government needs to account for the interdependencies between regular and irregular migration. Consider that the government aims at maximizing the average productivity of migrants E .

$$E(\gamma, \tilde{\theta}) = p(\gamma, \tilde{\theta}) E_L(\tilde{\theta}) + (1 - p(\gamma, \tilde{\theta})) E_I(\tilde{\theta}) \quad (4)$$

Hence, since $E_L(\tilde{\theta}) > E_I(\tilde{\theta})$, it is clear that a marginal increase of γ leads to a reduction of immigrants' average productivity. This is true because a larger share of immigrants is made up by illegal immigrants who attain a lower productivity level. This is illustrated by (5).

$$\frac{\partial E(\gamma, \tilde{\theta})}{\partial \gamma} = \underbrace{\frac{\partial p(\gamma, \tilde{\theta})}{\partial \gamma}}_{<0} [E_L(\tilde{\theta}) - E_I(\tilde{\theta})] < 0 \quad (5)$$

However, it is relatively costly to reduce γ . The government needed to largely increase the expenses for border enforcement or employer inspection.⁵ A less expensive opportunity is to set $\tilde{\theta}$ efficiently. Therefore, I derive (4) with respect to $\tilde{\theta}$ which leads to:

$$\frac{\partial E(\gamma, \tilde{\theta})}{\partial \tilde{\theta}} = \underbrace{\frac{\partial p(\gamma, \tilde{\theta})}{\partial \tilde{\theta}}}_{<0} [E_L - E_I] + p \underbrace{\frac{\partial E_L(\tilde{\theta})}{\partial \tilde{\theta}}}_{>0} + (1 - p) \underbrace{\frac{\partial E_I(\tilde{\theta})}{\partial \tilde{\theta}}}_{>0}. \quad (6)$$

The effects described by (6) illustrate the trade off that a government faces by maximizing the average productivity of immigrants. An increase of legal immigration indicated by a reduction of $\tilde{\theta}$ increases the probability that a randomly chosen immigrant is a legal one. However, at the same time, it leads to a reduction of both, average productivity among the

⁵In the U.S., the costs for border security and immigration enforcement have increased from \$4.2 billion in 2002 to \$13 billion (proposed) in 2008. The numbers vastly exceed the economic gains from restricting illegal immigration (Hanson 2007)

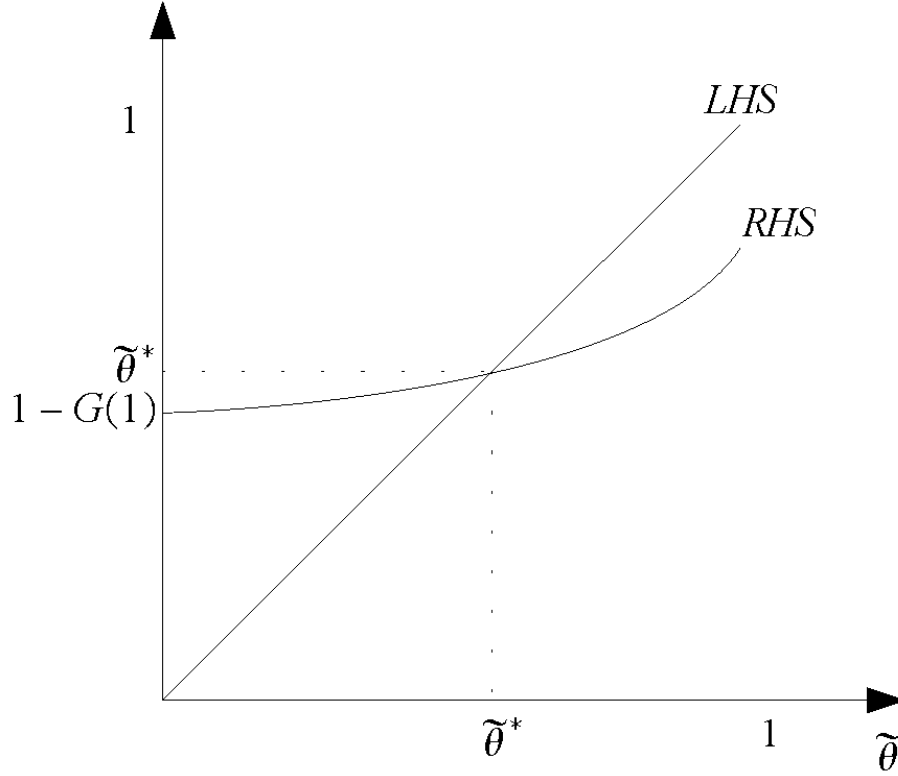


Figure 1: Maximum average productivity of all migrants

legal and the illegal immigrants.

In fact, there is exactly one optimal value between 0 and 1 that maximizes the average productivity of migrants. It can be shown (See Appendix A.1) that average productivity of migrants is highest if $\tilde{\theta}$ is described by the following equation:

$$\tilde{\theta}^* = 1 - G(1) + (1 - \gamma) G(\tilde{\theta}^*). \quad (7)$$

The left (*LHS*) and right hand side (*RHS*) of (7) are illustrated by figure 1. There is exactly one intersection point of the two curves between 0 and 1. Both are continuously increasing in $\tilde{\theta}$ and lie between 0 and 1. Since *RHS* is a convex function, $LHS(0) = 0 < RHS(0) = 1 - G(1)$ and $LHS(1) = 1 > RHS(1) = 1 - \gamma G(1)$, there is exactly one intersection point of *RHS* and *LHS*.

One can further prove (See Appendix A.2) that $E(\tilde{\theta}^*) = \tilde{\theta}^*$. Thus, if the government's objective is to maximize the average productivity of migrants, it reduces $\tilde{\theta}$ as long as it is larger than the average productivity of all immigrants.

4 Fiscal Contribution of Migrants

Apart from average productivity, one can suppose that the government's objective is to maximize the total surplus that is achieved by migrants. It is straightforward that in a world without illegal immigration the government should permit immigration to all those who are supposed to be net contributors to the society.

Consider that the government focuses on the fiscal costs and benefits of immigration. This is feasible since it is of particular public concern whether immigrants 'pay their way' in the welfare system (Dustmann et al. 2009). Besides the differences in average skills, one has to take into account that there are systematic asymmetries that arise from the legal status itself. First, the undocumented status of many illegal workers prevents that they are directly involved in the tax benefit system. It is reasonable to assume that illegal migrants thus contribute disproportionately to the welfare state but also receive fewer benefits from it than regular migrants. Second, due to the undocumented status of migrants, they have limited access to higher paid occupations in the formal labor market. Therefore, illegal migrants are found to be overqualified more often than legal migrants. I account for the systematic differences with regard to fiscal contributions and labor market access in the following two sub-sections.

4.1 Fiscal Asymmetries between Legal and Illegal Migrants

Suppose that legal migrants receive a transfer equal to V_L and that their individual income is taxed by a tax rate t_L . Illegal immigrants due to their unauthorized status receive a smaller transfer $V_I = \mu V_L$ ($\mu < 1$), but also pay taxes at a lower tax rate $t_I = \rho t_L$ ($\rho < 1$)⁶. Suppose further that individual gross wage income depends on individual productivity.

$$I_i = \theta_i \bar{w} \tag{8}$$

Thus, *ceteris paribus*, the larger is the average productivity of migrants, the larger is the probability that the fiscal contributions of migrants will outweigh the costs. I introduce the *net fiscal contribution* of immigrants NFC as a governmental objective. Depending on the average productivity of migrants, it can be positive or negative.

$$NFC = m_L \left(t_L \bar{w} E_L(\tilde{\theta}) - V_L \right) + m_I \left(\rho t_L \bar{w} E_I(\tilde{\theta}) - \mu V_L \right) \tag{9}$$

⁶One can for instance imagine that illegal migrants only pay consumption taxes but no income taxes which reduces their average tax rate.

$m_L = 1 - F(\tilde{\theta})$ is the mass of legal and $m_I = \gamma F(\tilde{\theta})$ the mass of illegal migrants. Together with (2) and (3) and some transformation, one finds that

$$NFC = t_L \bar{w} \left[\int_{\tilde{\theta}}^1 (\theta - \alpha) f(\theta) d\theta + \gamma \int_0^{\tilde{\theta}} (\rho\theta - \mu\alpha) f(\theta) d\theta \right] \quad (10)$$

where $\alpha = \frac{V_L}{t_L \bar{w}}$ describes the benchmark productivity level where a legal immigrant's fiscal contributions exactly equal the received transfers. Maximizing (9) subject to $\tilde{\theta}$ leads to:

$$\tilde{\theta}^* = \frac{1 - \mu\gamma}{1 - \rho\gamma} \alpha. \quad (11)$$

The result shows that if asymmetries between legal and illegal migrants are equally apparent on the revenue and the expenditure side ($\mu = \rho$), it is optimal for the government to set $\tilde{\theta}$ to α . This is reasonable since it is optimal to allow entrance only to those who are net contributors to the welfare state. A further decrease of the requirements for legal entry would harm the fiscal budget. However, if fiscal asymmetries between illegal and legal migrants do exist ($\mu \neq \rho$), the government needs to take into account the interdependencies between legal and illegal migrants. If $\mu > \rho$ meaning that illegal migrants have a lower tax benefit ratio compared to legal migrants it is optimal to decrease the preliminaries for legal entry by increasing the share of legal migrants. By contrast, if $\mu < \rho$ the government has an additional incentive to further restrict legal immigration.

An extreme result is reached if $\alpha \geq \frac{1 - \rho\gamma}{1 - \mu\gamma}$. Then, $\tilde{\theta}^* \geq 1$ and the governments will not permit any legal immigration. Obviously, this case becomes more probable if μ is relatively small. Hence, if illegal immigrants hardly receive any transfers, the government has no incentive to decrease the scope of illegal immigrants by facilitating legal immigration.

4.2 Over-qualification of Illegal Migrants

A typical feature of illegal migrants is that they are generally restricted to work in the informal sector where they accomplish standardized tasks in industries like retail, farming or construction. Beside the common claim that illegal workers are lower skilled and thus have no other option than working in these occupations, one needs to take into account that unauthorized migrants need to find jobs that shelter them from being detected. Thus, even

if an undocumented alien has some higher education, it is often impossible that he or she can make use of it, properly. Hence, it was estimated that at least part of the relatively lower productivity of illegal migrants is caused by the illegal status itself (Rivera-Batiz 1999, Kossoudji and Cobb-Clark 2002). If wage differentials between host and source countries are large enough, even some workers from the poorer source country who have intermediate skills have incentive to work in low skilled jobs in the informal sector of the rich host country. These illegal migrants are overqualified. However, one needs to bear in mind that the lowest skilled individuals have the highest incentive to work in these occupation since they gain the highest surplus. Hence, the probability that an unauthorized alien is low skilled is even further enhanced. All in all, the limitation of illegal immigrants to work in the informal sectors bears an extra cost to society since it reduces immigrants' average productivity and thus their average income.

In order to include the problem of over-qualification into the model framework, consider that all potential migrants have at least a productivity of q so that $0 < q < \alpha$ which is required to perform a routine tasks in the informal sector. All illegal migrants are paid the same wage and receive a gross wage income of $I_I = q\bar{w}$. Thus, all illegal migrants whose productivity is above q are overqualified. However, those who are higher qualified are less vulnerable to immigrate illegally because, compared to lower skilled migrants, they gain less from working in the informal sector. Let us account for this circumstance by assuming the following individual probability function for illegal entry if legal entry was rejected:

$$P_i(\theta_i) = \gamma h(\theta_i) \tag{12}$$

where $\frac{\partial h(\theta_i)}{\partial \theta_i} < 0$, $h(q) = 1$ and $h(1) = 0$. These assumptions state that a higher educational attainment reduces the probability of illegal entry. The latter becomes 0 if the individual is highest skilled ($\theta = 1$). If the individual is least skilled ($\theta = q$), the probability of entry is equal to the one in the last subsection ($P = \gamma$).⁷ Let us further abstract from the differences according to the fiscal participation between legal and illegal migrants ($\mu = \rho = 1$). Then, (9) changes to:

⁷This is reasonable since those who exactly attain the skill that is required in the informal sector are in the same way encouraged to immigrate into the host economy.

$$\begin{aligned}
NFC &= m_L \left(t_L \bar{w} E_L(\tilde{\theta}) - V_L \right) + m_I (t_L q \bar{w} - V_L) \\
&= t_L \bar{w} \left[\int_{\tilde{\theta}}^1 (\theta - \alpha) f(\theta) d\theta + \gamma (q - \alpha) \int_q^{\tilde{\theta}} h(\theta) f(\theta) d\theta \right] \tag{13}
\end{aligned}$$

Maximization of (13) subject to $\tilde{\theta}$ leads to:

$$\tilde{\theta}^* = \alpha - \gamma (\alpha - q) h(\tilde{\theta}^*). \tag{14}$$

(14) outlines that there is always at least one equilibrium value for $\tilde{\theta}$ between $(1 - \gamma) \alpha + \gamma q$ and α . Thus, the problem of over-qualification encourages the government to curtail illegal immigration by reducing the requirements for legal entry below the *pay their way level* α . The government needs to trade off the costs of over-qualification and the costs of lower average productivity of legal migrants. From (14) one can further deduce that γ has a negative impact on $\tilde{\theta}^*$. Hence, if illegal immigration as a whole becomes more probable, the government has an incentive to further liberalize the immigration policy to avoid over-qualification of undocumented aliens.

5 Conclusions

By use of a simple model, I have studied the interdependency between illegal and legal immigration and its effect on average migrant productivity as well as the fiscal budget. I pointed at the government's incentives to countervail illegal immigrants by decreasing the requirements for legal entry. The results of the model propose that the government can reduce the required skill level to a certain value to maximize immigrant's average productivity. They further indicate that the incentive to facilitate legal immigration is largest if illegal immigration is relatively frequent. With regard to the immigrants' net fiscal contributions, the model presumes that the government is encouraged to substitute illegal by legal workers if the former are characterized by lower tax benefit ratios or if over-qualification among unauthorized aliens is widespread. If illegal immigrants however receive disproportionately low transfers, the government is encouraged to further restrict legal immigration.

Naturally, the results only to a certain extent account for all the relevant aspects that are decisive for the government. Due to the assumption that wages and employment do not de-

pend on factor endowments, this paper has abstracted from the potential labor market effects caused by immigration. Usually unskilled workers suffer from illegal immigration whereas employers and high skilled worker benefit from it. Since skill endowments differ between migrants and natives, the host country as a whole can gain by the factor complementarity between high and low skilled workers (Borjas 1995). However, this effect (also know as the immigration surplus) is estimated to be very small, especially compared to the fiscal loss which was assumed to be more than three times larger (Hanson 2007). Hence, I suppose that it is not inadequate to focus on the fiscal impact as the most relevant effect of immigrants on native welfare. Nevertheless, the issue of illegal immigration is certainly subject to a much broader public concern. As has been mentioned, criminal activity, cultural segregation and humanitarian concerns are certainly relevant for the decisive government and should therefore be considered in a model of illegal immigration.

The objective of this paper was to provide a simple framework which accounts for the interrelations of legal and illegal immigration. Different from other papers, I based these interdependencies on the assumptions that legal and illegal migrants come out of the same pool of those who are willing to enter the host country. There are several ways to expand the model. For instance, one could endogenize the probability of illegal entry. In this context, one could assume that illegal residents require a certain scope of legal migrants to provide them with accommodation and job opportunities in the informal sector. Another opportunity would have been to study the costs and benefits of border and employer enforcement in such a model framework as well as the pros and cons of programs which intend to legalize undocumented aliens.

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A Appendix

A.1 The Average Migrant Productivity Maximizing Benchmark Level

By setting (6) equal to 0, one achieves the average migrant productivity maximizing benchmark level $\tilde{\theta}^*$. In this context, one can calculate that : $\frac{\partial p(\gamma, \tilde{\theta})}{\partial \tilde{\theta}} = -\frac{\gamma f(\tilde{\theta})}{(1-(1-\gamma)F(\tilde{\theta}))^2}$, $\frac{\partial E_L(\tilde{\theta})}{\partial \tilde{\theta}} = \frac{f(\tilde{\theta})(1-\tilde{\theta}-G(1)+G(\tilde{\theta}))}{(1-F(\tilde{\theta}))^2}$ and $\frac{\partial E_I(\tilde{\theta})}{\partial \tilde{\theta}} = -\frac{f(\tilde{\theta})G(\tilde{\theta})}{F(\tilde{\theta})^2}$. Inserting in (6) leads to:

$$\frac{\partial E(\gamma, \tilde{\theta}^*)}{\partial \tilde{\theta}} = \frac{(1-\gamma)f(\tilde{\theta})\left(1-\tilde{\theta}-G(1)+(1-\gamma)G(\tilde{\theta})\right)}{\left(1-(1-\gamma)F(\tilde{\theta})\right)^2} = 0 \quad (15)$$

One can easily deduce that (15) is only fulfilled if $\tilde{\theta}^* = 1 - G(1) + (1 - \gamma)G(\tilde{\theta}^*)$.

A.2 The Average Migrant Productivity

Inserting the average migrant productivity maximizing benchmark level $\tilde{\theta}^*$ into (4) leads to:

$$E(\gamma, \tilde{\theta}^*) = \frac{1 - G(1) + (1 - \gamma)G(\tilde{\theta}^*) - (1 - \gamma)\tilde{\theta}^*F(\tilde{\theta}^*)}{1 - (1 - \gamma)F(\tilde{\theta}^*)}. \quad (16)$$

Since $1 - G(1) + (1 - \gamma)G(\tilde{\theta}^*) = \tilde{\theta}^*$, it easily follows that

$$E(\gamma, \tilde{\theta}^*) = \tilde{\theta}^*. \quad (17)$$