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Braving the waves: The economics of clandestine migration from Africa

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Abstract. Illegal immigration from the developing world to rich countries is one of the most controversial topics today. Using a unique data set on potential illegal migrants collected in Dakar, Senegal, we characterize the preferences and characteristics of illegal migrants, and the manner in which these factors interact so as to yield observed behavior. On the basis of our theoretical model, we evaluate a measure of the time and risk preferences through the individual discount rates and the individual coefficients of absolute risk aversion. Then, we test empirically our theoretical propositions and we show that these variables play a role, in the illegal migration decision, in the willingness to pay a smuggler and in the choice of the method of migration, at least as important as "classical" migration determinants such as the expected wage in the host country.

Keywords: Illegal Migration; Preferences; Expectations.

JEL Classification numbers: F22, O15, O16, R23

1 Introduction

Illegal immigration, from less developed countries to rich countries, is one of the most controversial topics around. Moreover, received wisdom has it that the issue will become more and more important as the 21st century progresses. Images of "fortress Europe", with hordes of impoverished people knocking at the gates are the basis upon which many a right-wing European politician bases his or her legitimacy.

To the Ethier(1986) and Djajic (1987) theoretical models, which analyze illegal migration, can be added the Friebel and Guriev (2006) model, which introduces financial constraints between illegal migrants and intermediaries. However, the flow of illegal migrants has been studied above all in the case of the USA and Mexico. Hanson and Spilimbergo (1999) identify the economic volatility in Mexico, the high real wage in the US and then the large wage differentials, as the main causes of illegal migration between the two countries. The geographic proximity and the networks are other determinants. Networks, for example, help to make the link between US employers and migrants, to obtain a future regularization for individuals with families legally installed or to reduce migration costs in general (Munshi, 2003; Hanson, 2006). Hanson, Robertson and Spilimbergo (2002) study the effect of border control enforcement on the labor market in the US and Mexican border regions in the context of illegal migration. Nevertheless, contrary to press reports, which document the tragic plight of groups of illegal migrants drifting off the coasts of the Canary Islands or Sicily, academic studies of the phenomenon of illegal migration, particularly when it comes from Africa, are few and far between. Chiuri, de Arcangelis, D'Uggento, and Ferri (2007) document the characteristics of illegal migrants to Italy based on a sample of individuals picked up by Italian immigration authorities and held under lock and key in various detention centers.

In the beginning of the intensification of illegal migration in Africa, the roads were the principal way used by illegal African migrants. They crossed by Maghreb countries and the Straits of Gibraltar to reach European coasts. But the control of those roads has transferred the problem. Illegal migrants, now, take sea routes to get round borders control. It is this new form of illegal migration which has strongly developed in Senegal, which justifies our country choice. Thus, we conducted a field survey between November 2006 and April 2007 on 400 individuals in Dakar. As far as we know, no survey comparable to this one has been realized, which makes our study original. One of the main contributions of this paper is that from a theoretical model, we study how preferences and expectations affect illegal migration decision and the willingness to pay a smuggler with a probability of success equal to 1. Then we evaluate theoretically a measure of time and risk preferences through the individual discount rates and the individual coefficients of absolute risk aversion that we calculate and we use them as independent variables in our estimations. Secondly, we test empirically our model and finally we analyze how preferences and expectations affect the choice of a method of migration.

The paper is organized as follows: the next section presents a model of the illegal migration decision and the willingness to pay a smuggler with a probability of success equal to 1. In Section 3 we evaluate, theoretically, the expressions of the individual discount

rates and the individual coefficients of absolute risk aversion that we calculate in order to make our estimations, while the different methods of migration are presented in Section 4. Then, we present the data, the descriptive statistics and the estimation strategy in Section 5. The empirical results are discussed in Section 6 and finally, concluding remarks and policy implications are provided in the last section.

2 Migration decision and Willingness to pay

2.1 The migration decision

Let the monthly wage in Senegal be denoted by w, and the expected wage in the destination country be denoted by w^*. The one-shot cost of reaching the destination will be denoted by C with associated probability of success p. Consider a simple present discounted value (PDV) calculation, in which t represents the current age of the individual, T his retirement age, and ρ his discount rate. Preferences are assumed to be represented by a utility function denoted by $u(.)$. Then the intertemporal welfare associated with an unsuccessful attempt at leaving Senegal at time 0, and therefore remaining there from time 0 until retirement at age T, while earning a constant monthly wage w is given by:

$$V^{UE} = u\left(w - C\right) + u\left(w\right) \sum_{\tau=1}^{\tau=T-t} \frac{1}{\left(1+\rho\right)^{\tau}} = u\left(w - C\right) + u\left(w\right) \frac{1 - \left(1+\rho\right)^{t-T}}{\rho}, \tag{1}$$

(where the superscript UE stands for unsuccessful emigration). Conversely, assume that the attempt at emigrating is successful, costs C and results in earning the foreign wage w^* starting at $\tau = 1$. This yields an intertemporal welfare given by:

$$V^{SE} = u\left(w - C\right) + u\left(w^*\right) \frac{1 - \left(1+\rho\right)^{t-T}}{\rho}, \tag{2}$$

(where the superscript SE stands for successful emigration). In what follows, we will refer to $\frac{1-(1+\rho)^{t-T}}{\rho}$ as the individual's "intertemporal discount rate". The expected value of the attempt at emigration is therefore given by $E\left[V\right] = pV^{SE} + \left(1-p\right)V^{UE}$. Substituting from (1) and (2) yields:

$$E\left[V\right] = u\left(w - C\right) + \left[pu\left(w^*\right) + \left(1-p\right)u\left(w\right)\right] \frac{1 - \left(1+\rho\right)^{t-T}}{\rho}. \tag{3}$$

Let the intertemporal welfare associated with remaining in Senegal and earning a wage w from $t = 0$ to $t = T$ be given by:

$$\overline{V} = u\left(w\right) \frac{\left(1+\rho\right) - \left(1+\rho\right)^{t-T}}{\rho} \tag{4}$$

An individual will attempt to emigrate when $E[V] > \overline{V}$, which can be written, by substituting from (3) and (4) and simplifying the ensuing expression, as:

$$u(w-C) - u(w) + p[u(w^*) - u(w)] \frac{1-(1+\rho)^{t-T}}{\rho} > 0. \tag{5}$$

The preceding model is, of course, extremely reminiscent of the standard approaches due to Todaro (1969) and Harris and Todaro (1970), and the comparative statics described in Proposition 1 are intuitively what one would expect.

What is the difference between legal and illegal migration in terms of the theoretical model? A first stylized fact is that the likelihood of success of legal migration out of Senegal is extremely low. In particular, perceptions by most individuals would be that this probability is significantly lower than the probability of success through illegal migration. A second characteristic of legal migration is that the associated administrative costs are very low (usually amounting to the cost of the visa application and the documents that must be submitted along with it), though the airfare to the potential destination country does increase the overall cost, particularly when compared with the cost of illegal migration methods.

If we allow the expression given in (3) to represent the case of illegal migration, and carry out a similar PDV calculation for legal migration,where the probability of success is denoted by $q < p$ and the cost is denoted by K, we obtain:

$$E\left[V^{illegal}\right] = u(w-C) + [pu(w^*) + (1-p)u(w)] \frac{1-(1+\rho)^{t-T}}{\rho},$$
$$E\left[V^{legal}\right] = u(w-K) + [qu(w^*) + (1-q)u(w)] \frac{1-(1+\rho)^{t-T}}{\rho}.$$

The individual will then prefer illegal over legal migration when $E\left[V^{illegal}\right] > E\left[V^{legal}\right]$, which can be written explicitly as:

$$u(w-C) - u(w-K) + (p-q)(u(w^*) - u(w)) \frac{1-(1+\rho)^{t-T}}{\rho} > 0. \tag{6}$$

Consider the two following second-order Taylor expansions:

$$u(w-C) \approx u(w) - Cu'(w) + \frac{C^2}{2}u''(w),$$
$$u(w-K) \approx u(w) - Ku'(w) + \frac{K^2}{2}u''(w).$$

Then one can rewrite (6) as:

$$\underbrace{(K-C)\,u'(w)\left[1+\frac{1}{2}(C+K)\left(-\frac{u''(w)}{u'(w)}\right)\right]}_{u(w-C)-u(w-K)}+(p-q)\,(u\,(w^*)-u\,(w))\,\frac{1-(1+\rho)^{t-T}}{\rho}>0. \tag{7}$$

One can then immediately establish the following Proposition by straightforward differentiation of (7):

Proposition 1 *The likelihood that an individual chooses to illegal over legal emigration is: (i) an increasing function of the intertemporal discount rate* $\frac{1-(1+\rho)^{t-T}}{\rho}$*, (ii) an increasing function of the expected foreign wage, (iii) a decreasing function of the cost of illegal migration, (iv) an increasing (decreasing) function of risk-aversion when* $K-C>(<)\ 0$

Proposition 1 establishes clear comparative statics results for all variables of interest, with the exception of risk-aversion, for which the comparative statics are ambiguous.

2.2 The Willingness to pay a smuggler

We consider the willingness to pay a smuggler with a probability of success equal to 1, which we denote by C^*. This willingness to pay is implicitly defined by the solution in C^* to the following equation:

$$u\,(w-C^*)-u\,(w)+[u\,(w^*)-u\,(w)]\,\frac{1-(1+\rho)^{t-T}}{\rho}=0.$$

By the same second-order Taylor expansion as above, this can be rewritten as:

$$[u\,(w^*)-u\,(w)]\,\frac{1-(1+\rho)^{t-T}}{\rho}-\left[u'(w)C^*-\frac{C^{*2}}{2}u''(w)\right]=0,$$

or

$$[u\,(w^*)-u\,(w)]\,\frac{1-(1+\rho)^{t-T}}{\rho}-u'(w)\left[C^*+\frac{C^{*2}}{2}\left(-\frac{u''(w)}{u'(w)}\right)\right]=0. \tag{8}$$

By the Implicit Function Theorem, one can then immediatley establish the following Proposition:

Proposition 2 *The price that an individual is willing to pay a smuggler for an illegal immigration attempt with probability 1 of success is: (i) an increasing function of the intertemporal discount rate* $\frac{1-(1+\rho)^{t-T}}{\rho}$*, (ii) an increasing function of the expected foreign wage, (iii) an ambiguous function of the domestic wage, (iv) a decreasing function of risk-aversion.*

Proof. See the Appendix for details. ■

The only ambiguity in the willingness to pay a smuggler for an illegal immigration attempt with probability 1 of success is associated with the effect of the domestic wage. All other comparative statics results for our model –including the effect of risk-aversion– are clearcut.

3 Infering preferences

Let the lump sum payment necessary to induce an individual not to leave Senegal be denoted by D. Indifference between remaining in Senegal and receiving the lump sum payment D at $\tau = 0$ (with associated intertemporal welfare $V^{LS} = u(w+D) + u(w)\frac{1-(1+\rho)^{t-T}}{\rho}$, where the superscript LS stands for lump sum), and the expected value of an attempt at emigration with cost C_j and probability of success p_j (with associated intertemporal welfare $E[V]$) therefore yields $0 = E[V] - V^{LS}$, which can be expressed more explicitly as:

$$0 = u(w - C_j) + [p_j u(w^*) - p_j u(w)] \frac{1-(1+\rho)^{t-T}}{\rho} - u(w+D). \tag{9}$$

The reason for indexing the pair (C_j, p_j) by j will become apparent in what follows. If retirement age is considered indefinitely far away by individuals ($T \to \infty$) and individuals are risk neutral ($u(w) = w$) then (9) simplifies to $D = \frac{p_j(w^*-w)}{\rho} - C_j$. Given the appropriate data, which include various values of the cost C_j individuals are willing to bear in order to achieve migration success with a given known probability p_j, equation (9) allows one to recover both the discount rate ρ and risk aversion in the context of the emigration decision. We show this in the following Proposition.

Proposition 3 *If the individual is willing to emigrate at cost C_j (C_k) with associated probability of success p_j (p_k), and is willing to forego emigration in return for a lump-sum payment D, then:*

(i) the individual's coefficient of absolute risk-aversion is given by

$$A(w) = 2\frac{p_j(C_k+D) - p_k(C_j+D)}{p_j(D^2 - C_k^2) - p_k\left(D^2 - C_j^2\right)};$$

(ii) the individual's discount rate is defined by

$$\frac{1-(1+\rho)^{t-T}}{\rho} = \frac{(C_j+D)(C_k+D)(C_k-C_j)}{\Delta w^*\left[p_j(C_k+D)(C_k+\Delta w^*-D) - p_k(C_j+D)(C_j+\Delta w^*-D)\right]}.$$

Proof. The proof follows from a second-order Taylor expansion of (9), and noticing that the ensuing expression holds for any two gambles (C_j, p_j) and (C_k, p_k). See the Appendix for details. ■

For each individual, we have five gambles (C_j, p_j). There are therefore 4+3+2+1 = 10 possible versions of the two expressions given in Proposition 3. For each individual, we can therefore compute a mean value of $A(w)$ and $\frac{1-(1+\rho)^{t-T}}{\rho}$, with an associated standard deviation.

4 Methods of migration

There are essentially three ways of going about an attempt at migration in Senegal. The first method is completely legal and we name it the "visa method". It consists to apply directly

for a legal visa and pay the visa fees and the airfare to reach the destination country. The second method of reaching a destination country is illegal and will be referred to as the "canoe method". This involves paying a fee to a "passeur" (literally, a smuggler of human beings). The "passeurs", using various types of motorized dugout canoes, large rubber dinghies, and various overland routes towards Morocco, Tunisia and Libya, attempt to get potential migrants to various destination countries, often Spain, Italy or France. The third, which involves obtaining what is, to all intents and purposes, a legitimate visa for a destination country, will be denoted as the "embassy method". This approach depends upon the existence of corrupt officials within the consular sections of many embassies in Dakar who, for a fee, will provide an entry visa for the country in question. This method has a very high likelihood of success, which we will assume for simplicity to be equal to 1, but which is the most expensive way to migrate. For obvious reasons, including the tenuous nature of the boats being used, as well as the perilous nature of the overland journey up the coast of West Africa, the probability of success of the canoe method is much lower than with the embassy method. The "passeur" price is, therefore, much lower than "embassy" price.

5 Data and estimates of preferences

5.1 Data

Because of the extent of illegal migration in Senegal these last years and the lack of economic data on the subject, we collected new data by making a field survey. A cross-section survey was gathered between November 2006 and April 2007. We interviewed 400 respondents met randomly in the selected neighborhoods. Among them, some are potential migrants and some are not. We consider only individuals who wish to migrate because this accounts for 92% of our total sample, i.e. 367 individuals. This value seems high but it is not very surprising. We have some variability in the different areas where we made the survey and the proportion of people who wish to migrate is high in all these areas. Many factors, particularly historical and sociological, can explain this result. Indeed, Dakar is a "europeanized" city compared with other West-African cities which were former French colonies. Dakar was the A.O.F (Afrique Occidentale Française) capital city and the links with the colonialists were very close[1]. In Senegal, both in rural and urban areas, in many households with good living conditions, there are one or many family members who have migrated. Migrants have an important economic power which sparks off the envy of those who remain in the origin country. They invest in buildings, business and social services for the community. Moreover, remittances sent to the family increase the gap between the reference group and those who do not have migrants in their family. Then, for the latter, the social comparison with the reference group increases the frustration and the relative feelings of deprivation. The third explanation is that the Eldorado myth still exists and the development of Information Technology, such as the Internet, increase the attractiveness of the destination countries. Therefore, for many people, migration is considered as the only way to succeed.

[1]For instance, Senegalese people who lived in some communes were French citizens.

Among the 367 individuals who wish to migrate, 222 are willing to migrate only legally and 145 are ready to migrate illegally (which represents 40% of potential migrants). We interviewed individuals who were still in Senegal and interviews were conducted face to face with closed questions. For more efficiency, we firstly defined Dakar, as the analysis unit for its accessibility and above all for the variety of its population. Subsequently, we made a sub-stratification firstly by picking several neighborhoods, then, within these areas, some individuals. Concentrating resources on a part of the population allows us a better quality of data and more precise results, even if it is an exploratory study because all the population of Dakar is not represented.

5.2 Descriptive Statistics

The summary statistics are presented in Table 1. The average expected wage of potential migrant is 1 567 466 Fcfa i.e. 2 389 Euros. This amount is far from the truth since we know that in France, for example, according to INSEE[2], the available income for a middle class household is between 1100 Euros and 1700 Euros in 2006. 80% of the French population earn between less than 1100 Euros and 2400 Euros every month. The wage in Senegal is approximated by the average monthly expenditures of the individuals, because people answer more easily about their expenditures and then there are less missing data for this variable. The latter is estimated at 76 055 Fcfa ie 115.94 Euros, which is very low compared to the expected wage.

Figure 1 shows the histogram of the mean value of individual coefficients of absolute risk aversion $A(w)$. We calculate these values from the proposition 3 of the theoretical model. We observe that the individual coefficients of absolute risk aversion are very close to 0, which means that the individuals are risk neutral. They do not care about risks they take with illegal migration, which is a strong signal of their tenacity. This is confirmed in Table 2 where we present the descriptive statistics of the willingness to pay a smuggler of those who wish to migrate illegally, associated with different probabilities of success. We observe that as the probability of success decreases, the less the part of individuals who are ready to migrate is important. But this proportion remains high compared to the risk taken. Indeed, with a probability of success of 5%, 53% of people are still willing to migrate illegally. Moreover, the difference between the amount they are ready to pay with a probability of success of 1 and a probability of success of 0.05 is quite low. It is estimated at only 216 356 Fcfa i.e. 329 Euros. These amounts can appear high in the case of Senegal, but they are very realistic. The willingness to pay a smuggler, with a probability equal to 1, corresponds approximately to the monthly expected wage of potential migrants. Indeed, the latter are well informed about different prices on the illegal migration market. Thus, it is likely that if they finance their migration by a loan, which is often the case, they plan to pay off the smuggler with their first salary earned in the host country.

[2]INSEE, Intitut National de la Statistique et des Etudes Economiques, is the national institute of Statistics in France (website:www.insee.fr).

5.3 Estimation Strategy

The aim of this section is first to show the effect of the discount rate, the expected foreign wage per capita and the risk aversion, which are our main variables of interest in the illegal migration decision. We also consider as control variables other factors which influence this decision. Secondly, we study empirically the effect of the individual preferences for time and risk and the expectations on the willingness to pay a smuggler with a probability of success equal to 1 as the dependent variable. Individuals will pay a smuggler only if they are ready to migrate illegally, thus the willingness to pay is observed only for the part of the sample that wishes to migrate. In this case, we do not have a random selection. Then, to avoid a selection bias and a specification error, we use a Heckman procedure (Heckman, 1979). The second reason to use this procedure is that, we cannot make directly a linear regression, by just replacing the value of the willingness to pay a smuggler by 0 for individuals who do not want to migrate, because it may induce confusion with potential illegal migrants who are not willing to pay anything to a smuggler. The Heckman procedure consists of a two-step estimation: a selection estimation which explains the participation and an outcome estimation where the correlation between the random disturbances is accounted for by including the Inverse of Mills Ratio (IMR). It is used in the outcome equation to estimate the coefficients of the model. If it is omitted, we will have an omitted variable bias (Greene, 2008). We estimate the selection equation by a probit model and the outcome equation by a linear model. Then we have:

Selection equation: $M_i^* = \alpha_i + \beta_{k1i} x_{ki} + \beta_{2i} z_i + \mu_i$, $M_i = 1$ if $M_i^* > 0$ and $M_i = 0$ otherwise

Outcome equation: $y_i = \eta_i + \gamma_{k2i} x_{ki} + \gamma_{2i} \lambda_i + \varepsilon_i$, y_i is observed only when $Mi = 1$

Where:

α_i and η_i are the intercepts; β and γ, represent the vectors of parameters; μ and ε are the random disturbances and λ_i is the Inverse of Mills Ratio (IMR).

$M_i = 1$ if the individual i is willing to migrate illegally and 0 if he is only willing to migrate legally (legal versus illegal).

y_i represents the logarithm of the willingness to pay a smuggler with a probability of success equal to 1.

x_{ki} is a vector of variables composed of the variables of interest and two groups of variables of control.

The variables of interest are:

- individual discount rates represented by $\frac{1-(1+\rho)^{t-T}}{\rho}$ and calculated from the proposition 3 in the theoretical model.

- logarithm of the expected foreign wage of potential migrants divided by the number of dependants, which gives the value per capita. The expected foreign wage is obtained from the question: *"How much would you expect to earn in the host country?"*. Through this variable, and more largely, through the income gap, we are interested in the expectations of individuals. More generally, in the literature, expectations are an important element which predicts migration decision-making. Van Dalen, Groenewold and Schoorl (2005) highlight the effect of expectations on migration intentions. Mckenzie, Gibson, and Stillman (2007)

consider the expectations of Tongan immigrants to New Zealand concerning their likely wage conditions upon arrival. De Jong (2000) is interested in the role of expectations on migration behavior in Thailand whereas Sabates-Wheeler, Natali and Taylor (2009), from a Ghanaian study show the importance of reliable information in the formation of realistic expectations and a positive migration experience. In our case, we consider expectations as a triggering factor in the decision to migrate illegally and assume that they play a decisive role in potential illegal migrants' plans.

- logarithm of the individual coefficients of absolute risk aversion A(w) calculated from the theoretical model.

- logarithm of the prices of the destination countries representing the migration costs

In the first group of the variables of control, we have the other factors which influence illegal migration:

- the variable "*stay if hardening of immigration policies*" which is a dummy equal to 1 if the potential migrant renounces migration and stays in Senegal if the immigration policies in the host countries were hardened. It allows us to see how the hardening of immigration policies in host countries would affect legal and illegal migration decision-making.

- the variable "*relatives*" a dummy equal to 1 if the individual has some members of his family, close friends or just relatives, who migrated. It allows taking into account the networks effects. Illegal migration can be explained by the fact that for people who do not get enough money or assets, networks become an important determinant for the propensity to migrate. Having relatives contributes to reduction in the costs related to migration. Indeed, there is a threshold from which migrants' numbers in receiving countries involves a decrease of migration costs (Carrington, Detragiache, Vishwanath, 1996). One of the reasons of this relation is that migrants, who have already gone, have an implicit obligation to help newcomers. Furthermore, the expected benefits depend on the productivity and the abilities of the migrants. But for illegal migrants, the benefits are also function of the probability not to be turned back (Borjas, 1987). We assume that this probability decreases if the migrant knows someone in the receiving country.

In the second group, we control for socio-demographics characteristics such as age and its squared, sex, matrimonial situation, education level, home occupation status (dummy equal to 1 if the individual is a home owner, in order to control for the assets), religious and ethnic dummies.

z_i is the exclusion variable represented by the share of male children on the total number of dependants that the individual has to support. We assume that the larger the number of male children relative to the number of dependants is, the lower will be the probability to migrate illegally; and it has no impact on the willingness to pay a smuggler with a probability of success equal to 1. Indeed, for purposes of responsability, we assume that generally, if the share of children who depends on the decision maker is high, it will decrease his propensity to migrate illegally. We are interesting in the male children because more male children in the household allow the decision maker to diversify his revenue stream. He can for instance send one of his sons to school, another can help him in his job and another can migrate[3].

[3]In Africa, in particular, illegal migration is essentially a masculine phenomenon, even if there are in-

He does not need to find "extreme" solution such as illegal migration. Then we think that this variable does not explain the willingness to pay a smuggler and is independent of the second-step estimation because potential illegal migrants are on the demand side and on the illegal migration market, prices are determined by the supply side represented by the smugglers. Contrary to Konseiga (2007), for example, who use the number of boys under 12 years old to identify a seasonal and non migrant household indicator, by assuming that this variable does not affect the household income, we think that in our case, the share of male children is a better exclusion variable than just the number of children.

6 Results

6.1 Estimation with the Heckman procedure

Table 3 reports the results of the Heckman procedure. The marginal effects of the probit estimation are reported in Table 4. The results show that our theoretical propositions are confirmed by our estimations. In accordance with our theoretical predictions, it appears in the two-step estimations, that the individual discount rates have a significant and positive effect on the propensity to migrate illegally and on the willingness to pay a smuggler with a probability of success equal to 1. An increase in the discount rate makes the illegal migration project more attractive and more profitable than the legal migration. Then, if the individual preference for the present is higher, the decision maker, to have an immediate income, will prefer illegal migration rather than waiting to have a better level of education or better qualifications which could make the achievement of a legal visa easier. Moreover, a legal procedure, can take a lot of time and many attempts before succeeding. Indeed, people who have the possibility to migrate legally are those who are educated and have a qualified job, in other words, individuals who have invested in human capital or in an activity, which allow them to have legitimate documents and to engage in legal migration.

An increase of 10 points of percentage of the log of the expected wage per capita increases the probability to migrate illegally by only 8.9 points of percentage while the discount rate increase the propensity to migrate illegally by 29.3% (Column (1) in Table 4). We also find that in accordance with the theory, the expectations and the discount rate increase the willingness to pay a smuggler with a probability of success equal to 1. However, the log of the wage earned in Senegal does not appear significant, which confirms the ambiguous function of this variable in our theoretical predictions. It appears that the differential income is significant and positive. Then, it is very likely that the decision maker compares what he gets, in Senegal, with the expected foreign earnings, a pull factor which plays a decisive role in illegal migration. We can also say that the higher expectations are, the higher will be the amount people are ready to pay to guarantee them a successful migration. The expected wage value can often be evaluated on what potential migrants think about the salaries of their relatives who have already migrated; that may be one of the causes of the gap between reality on the one hand and expectations on the other. The Eldorado myth

creasing numbers of women who attempt it.

persists and relatives keep it going. This is confirmed by the effect of the control variable "relatives" which increase the probability to migrate illegally. Firstly, networks are integrated in migration plans because they give assistance for housing or employment and they also help to reduce the psychological costs associated with migration. They are a source of information on the locations and affect the destination choice of those who wish to migrate and who take into account ethnic, cultural and social proximity (Fafchamps and Shilpi, 2009; Epstein and Gang, 2006). Besides, Azam and Gubert (2005) highlight in the case of Malian migrants, that remittances, associated with migration allow the family in the country of origin; not only an insurance against risks but they also help to reinforce the social status and the family's dignity. In illegal migration, this social aspect is very important. Remittances exacerbate frustration and social pressure on those who have stayed in the origin countries by improving the relative income of migrants' families compared to the other community members (Stark and Taylor, 1989).

The risk aversion is not significant at the first step, which can confirm the ambiguity of the comparative statistics concerning the effect of this variable on the probability to migrate illegally, but it is significant and decreases the willingness to pay a smuggler. Then, the less people are risk averse, the more they are willing to pay a smuggler with a probability of success equal to 1. Indeed, paying a smuggler induces de facto a financial risk associated with the nature of the project that only the most determined can take. Thus for the smugglers, the behavior of these less risked averse individuals can be a sort of signal to determine the most risky"clients" and therefore raise their prices for this category of people.

There is a negative relationship between the migration costs and the probability to be willing to migrate illegally. The main reason is that illegal migration is an expensive project, which requires large funds that the poorest cannot afford. These amounts often involve taking loans to finance migration or years of savings. But we note that this variable becomes insignificant at the second step, which shows that potential migrants once they are ready to migrate illegally, are strongly motivated and the migration costs no longer constitute a constraint in their willingness to pay.

For the control variables, if the immigration policies in host countries are hardened, the probability to stay in Senegal, and then to renounce migration, decreases for those who are willing to migrate illegally whereas it increases for those who would migrate only by a legal way. In other words, a hardening of migration policies to enter host countries would have a less important effect on individuals who are ready to migrate illegally than on those who want to migrate only legally, which is a very interesting result. Indeed, when immigration policies are hardened, individuals have more hurdles to go through legally, thus contrary to the initial objectives, these policies may have pernicious effects by discouraging legal migration and by involving an increased flow of illegal migrants. In addition, it will increase the willingness to pay a smuggler to have more chances to achieve the project, which is a very high probability. This result confirms a part of the Friebel and Guriev (2006) theory where strict immigration policies increase financial constraints and strengthen debt contracts between illegal migrants and smugglers.

The exclusion variable represented by the share of male children on the total number of dependants really identifies the selection equation since it is significant at 5% and decreases

the probability to migrate illegally. The IMR is not significant, which means that there is no selection bias.[4]

6.2 The Choice of the Method of Migration

The Heckman procedure allows us to show how preferences and expectations affect illegal migration decision and the willingness to pay a smuggler with a probability of success equal to 1. In this part, we are interesting in the effect of these variables on the choice of the method of migration. During the survey, we observed that there are three ways to migrate to the Northern destination countries: to go legally by applying directly for a legal visa and paying the airfare, we name it "visa method"; using "canoe method" which involves paying a fee to a smuggler or "embassy method", whereby one pay someone to have legitimate documents, the two latter being considered as illegal. Indeed, we consider the "embassy method" as an illegal method because even if people enter legally in the host country with legal documents, they use corruption, which is an illegal way to get legal documents. Moreover, the "embassy method" is very expensive, whereas if it was legal, it will cost nothing, except the visa fees and the price of the airfare. These methods are associated with different probabilities of success. Then, it is interesting to know what explains the choice of the method of migration. We use a conditional logit model given that we have three possible choices with some alternative characteristics called the attributes of the choice and some individual characteristics[5] (Greene, 2008). As a conditional logit is a random utility model, we suppose a decision maker, here the potential migrant i, who can choose from J alternatives. Then the utility of the choice j is:

$$U_{ij} = \beta' x_{ij} + \gamma'_j w_i + \epsilon_{ij}$$

We assume that i chooses j because U_{ij} is the maximum utility obtained from the different choices. Then we have:

$$Pr(U_{ij} > U_{ik}) \text{ for } k \neq j$$

Let Y_i the variable indicating the three alternatives. According to McFadden (1974), if the error terms of the different alternatives are independent and identically distributed with a Gumbell distribution, we have:

$$\Pr(Yi = j) = \frac{\exp(\beta' x_{ij} + \gamma'_j w_i)}{\sum_{j=1}^{J} \exp(\beta' x_{ij} + \gamma'_j w_i)}$$

Where:

[4] The observations are 281 instead of 367 at the fisrt step and 121 instead of 145 at the second step because of missing values due first to the wage in Senegal, even if we take the monthly expenditures as proxy of this variable, that already allows us to decrease the number of missing values. Second, it is due to indetermined discount rates and coefficients of absolute risk aversion for some individuals who decide to not migrate from a certain probability of success less than one. For these people we cannot form all the gambles (C_j, p_j) necessary to calculate the variables of preferences.

[5] Actually, it is a combination between a multinomial and a conditional logit, respectively to see the effects of the individual characteristics and the alternative characteristics on the probability to choose one category.

$Y_i = 1$ if the potential migrant wants to migrate only legally and would use the "visa method". It is the reference category.

$Y_i = 2$ if the potential migrant is willing to migrate illegally and would use the "canoe method".

$Y_i = 3$ if the potential migrant is willing to migrate illegally and would use the "embassy method".

w_i is a vector of individual variables which are the characteristics of the decision maker. w_i is composed of the same variables presented in the Heckman procedure. γ'_j is the vector of parameters of each alternative J associated with individual characteristics. As our model allows individual specific variables, we have to create interaction terms with dummy variables for the choice and we multiply them by the individual characteristics (Greene, 2008).

x_{ij} contains the attributes of the choice. In our case, we have one alternative specific variable which is the variable "log costs" representing the logarithm of the known prices for the destination countries for each alternative. β' is the vector of parameters associated to x_{ij}[6].

The conditional logit must respect the Independence from Irrelevant Alternatives (IIA) property. It requires that the odds ratio between two alternatives is independent of the other choices (Mc Fadden, 1974). It means that if we assume individuals have the choice between the "visa method" and the "canoe method" and if one introduced another method of migration such as the "embassy method", it would not affect the relative probability of an individual choosing either the "visa" or the "canoe" method. Our alternatives can be considered as different because the "canoe" and the "embassy" methods are very different: the "embassy method" is more expensive but safer and has a higher probability of success than the "canoe method". After a Hausman and McFadden (1984) test, we do not reject the hypothesis that the IIA property is valid and the specification of a conditional logit is correct (see Table 5).

The results presented in Table 5 show that individuals with high discount rates will prefer the "canoe" and the "embassy" methods over the "visa method". A high preference for the present involves people to find others means to migrate. Moreover, it is often the only possibility they have to reach the Northern countries. The more the expected wage is important, the more likely it is that individuals would choose the "embassy method" rather than the "visa method". Indeed, those who have high expectations of their migration project would maximize their probability of success by choosing to corrupt someone and increase their chances of getting legitimate documents rather than trying the legal way, knowing that the probability to get a visa is lower for them. The more immigration policies are hardened, the less likely it is that people will renounce their desire to migrate and the more they will use "canoe" or "embassy" methods, which confirms our previous results. The variable "log costs", is dropped because there is no within group variance. Indeed, the costs are, of course, different according to the destinations countries, but they do not vary according to the individuals. Then as robustness check, we choose to do a multinomial logit with only the individuals characteristics (Table 6) and the results of the conditional logit are confirmed.

[6] We add alternative constants, (except for the reference category) to capture choice probabilities relative to the reference alternative that cannot be attributed to the other explanatory variables.

7 Concluding remarks and Implications

In the context of an international economic crisis, issues related to illegal migration involve a lot of impassioned debates and controversies. In spite of the repressive policies, the management of the flow of illegal migrants continues to be one of the main challenges for many host countries. This highlights the problem of the efficiency of political measures regarding this type of migration.

One of the main contributions of this paper is the proposition of a theoretical model which allows us to measure empirically the time and risk preferences. We also study, both in theoretical model and the empirical part how these variables affect illegal migration decision and the willingness to pay a smuggler with a probability of success equal to 1, compared with a "classical" determinant of migration such as the expected wage. Our empirical results confirm the theoretical propositions. Indeed, it appears that if expectations remains a determinant of migration, particularly of illegal migration and a strong determinant of the willingness to pay a smuggler to succeed in the illegal migration project, the preference for the present, measured by the discount rate, also play an important role in the illegal migration decision and has a positive influence on the willingness to pay a smuggler and on the choice of "canoe" or "embassy" method rather than a "visa" method. In terms of politicy implications, it is important to take into account the individuals preferences all the more so because the hardening of immigration policies for entering host countries has a pernicious effect on illegal migration. It deters those who want to migrate legally and incites the potential migrants to turn to illegal methods such as paying a "passeur" or corrupting officials linked to the embassies and consular sections to get legal documents. Immigration policies, for more efficiency, must integrate the determination and "the emergency" that these people have to improve their living conditions. Then, policies have to be balanced with some measures which promote circular migration with, for example, specific visa and status for seasonal workers, or people who work in some sectors of services such as services to people.

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Table 1
Summary Statistics

Variables	Mean	Sd
Migrate illegally	0.40	0.49
Migration Method		
"Canoe method"	0.55	0.50
"Embassy method"	0.29	0.46
Willingness to pay (Fcfa)	1 480 556	2 004 192
Discount rate	0.41	2.27
Expected wage (Fcfa)	1 567 466	5 486 186
Expected wage per capita	893 918	5 332 343
Wage (Fcfa)	76 055	64699
Wage per capita	22 189	22 908
Wage differential (Fcfa)	1 539 478	5 677 601
Wage differential per capita	894 566	5516554
Risk aversion	3.03e-07	1.33e-06
Costs (Fcfa)	2 212 166	1 761 269
Stay if hardening of immigration policies	0.32	0.47
Relatives	0.74	0.44
Share of male children	0.18	0.24
Socio-demographic controls		
Male	0.88	0.33
Age	25.96	7.18
Married	0.26	0.44
Education level		
Secondary level	0.27	0.44
Higher level	0.16	0.37
Coranic school	0.15	0.36
Home owner	0.56	0.50
Mouride	0.45	0.50
Ethnic group		
Lebou	0.19	0.39
Hal Pular	0.11	0.32
Serere	0.23	0.42
Diola	0.05	0.23
Others	0.08	0.27

Notes: 1 Euro = 655.56 Fcfa. The reference category of the variable "Migration Method" is "visa method". The reference category of the variable "Education level" is Primary level. The reference category of the variable "Ethnic group" is Wolof.

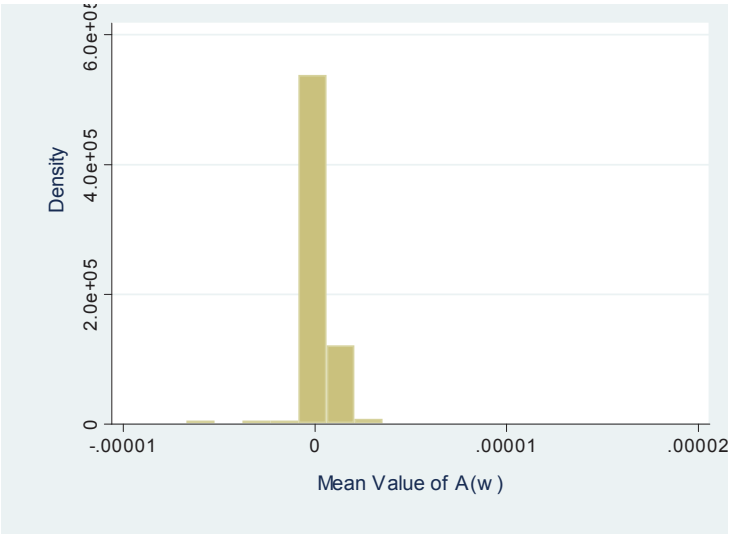

Figure 1: Individual Coefficients of Absolute Risk Aversion

Table 2
Willingness to pay a smuggler with different probabilities of success

	Mean	Sd	Obs
How much are you ready to pay if p = 1?	1 480 556	2 004 192	145
If p = 0.75, are you ready to migrate?	0.85	0.36	145
If yes, how much are you ready to pay?	1 351 829	1 952 752	123
If p = 0.50, are you ready to migrate?	0.77	0.43	145
If yes, how much are you ready to pay?	1 311 261	1 994 398	111
If p= 0.25, are you ready to migrate?	0.62	0.49	145
If yes, how much are you ready to pay ?	1 315 611	1 792 507	90
If p = 0.05, are you ready to migrate?	0.53	0.50	145
If yes, how much are you ready to pay?	1 264 200	1 592 063	75

Note: 1 Euro=656.56 Fcfa

Table 3
Illegal Migration decision and Willingness to Pay: Heckman procedure

	Migrate illegally (Selection equation)	Willingness to pay	Migrate illegally (Selection equation)	Willingness to pay
	(1)	(2)	(3)	(4)
Discount rate	0.744**	0.132***	0.721**	0.131***
	(2.41)	(3.45)	(2.46)	(3.66)
Log expected wage per capita	0.227**	0.303***		
	(2.22)	(3.06)		
Log wage per capita	-0.191	-0.188		
	(1.16)	(1.60)		
Log wage differential per capita			0.179**	0.225***
			(2.09)	(2.86)
Log risk aversion	0.037	-0.090*	0.044	-0.079*
	(0.69)	(1.92)	(0.84)	(1.70)
Log costs	-1.015***	0.103	-1.010***	0.121
	(7.51)	(0.53)	(7.41)	(0.65)
Stay if hardening of immigration policies	-0.620**	0.768***	-0.606**	0.764***
	(2.51)	(3.10)	(2.45)	(3.03)
Relatives	0.510*	-0.069	0.463*	-0.121
	(1.87)	(0.22)	(1.70)	(0.38)
Share of male children	-0.948**		-0.818*	
	(2.23)		(1.82)	
Socio-demographic controls	Yes	Yes	Yes	Yes
IMR		-0.030		-0.072
		(0.07)		(0.18)
Constant	11.093***	7.536***	10.175***	6.935***
	(4.16)	(2.89)	(4.16)	(2.80)
Observations	281		281	
Pseudo R^2	0.54		0.54	
Log pseudolikelihood	-88.41		-88.59	

Notes: Robust z-statistics in parentheses: * significant at 10%;** significant at 5%; *** significant at 1%.

Table 4
Marginal Effects

	Dependant variable: Migrate illegally	
	(1)	(2)
Discount rate	0.293**	0.283**
Log expected wage per capita	0.089**	
Log wage per capita	0.075	
Log wage differential per capita		0.070**
Log risk aversion	0.014	0.017
Log costs	-0.40***	-0.397***
Stay if hardening of immigration policies	-0.234***	-0.229***
Relatives	0.192**	0.175*
Share of male children	-0.373**	-0.321*
Socio-demographic controls	Yes	Yes
Observations	281	281

Notes: * significant at 10%;** significant at 5%; *** significant at 1%.

Table 5
Conditional Logit: the choice of the method of migration

	Canoe method			Embassy method		
	(1)			(2)		
	Coef.	Odds Ratio	z-stat	Coef.	Odds Ratio	z-stat
Discount rate	1.083**	2.953**	2.29	1.129**	3.091**	2.37
Log expected wage per capita	0.254	1.290	0.44	1.342**	3.825	2.10
Log wage per capita	-1.070	0.343	1.23	-1.504	0.222	1.60
Log risk aversion	0.174	1.190	1.02	-0.243	0.784	1.14
Log costs	dropped					
Stay if hardening of immigration policies	-1.672*	1.188*	1.69	-3.000**	0.050***	2.40
Relatives	3.299**	27.10**	2.31	2.323	10.21	1.46
Share of male children	0.188	1.207	0.08	-2.860	0.057	0.98
Socio-demographic controls		Yes			Yes	
"canoe method"	-0.174	0.841	0.02			
"embassy method"				-33.78**	0.000**	2.01
Observations	396					
Pseudo-R^2	0.55					
Log likelihood	-64.64					
Hausman and McFadden Test	Chi2(15)=9.06					
	Prob>Chi2=0.8745					

Notes: The reference category is "visa method". We multiply each alternative by the number of observations and the explanatory variables are some interaction terms between the individual characteristics and the variables of choice. * significant at 10%; ** significant at 5; *** significant at 1%.

Table 6
Robustness check: Multinomial Logit

	Canoe Method	Embassy Method
	(1)	(2)
Discount rate	1.525**	1.619**
	(2.00)	(2.11)
Log expected wage per capita	0.841	2.177*
	(0.71)	(1.76)
Log wage per capita	-2.050	-2.680
	(0.91)	(1.17)
Log risk aversion	0.215	-0.221
	(1.13)	(0.93)
Stay if hardening of immigration policies	-1.078	-2.942*
	(0.74)	(1.81)
Relatives	6.841**	5.895**
	(2.44)	(2.04)
Share of male children	-3.776	-7.159*
	(1.01)	(1.79)
Socio-demographic controls	Yes	Yes
Constant	0.135	-46.155**
	(0.01)	(2.08)
Observations	132	
Peudo-R^2	0.50	
Log likelihood	-55.36	
Hausman Test (IIA test)	Canoe method: Prob>Chi2=1.000	
	Embassy method: Prob>Chi2=0.997	

Note: Robust z-statistics in parentheses. * significant at 10%; ** significant at 5; *** significant at 1%.

A Proofs

A.1 Proof of Proposition 2

Applying the Implicit Function Theorem to (8) yields:

$$\frac{dC^*}{d\left(\frac{1-(1+\rho)^{t-T}}{\rho}\right)} = -\frac{u\left(w^*\right)-u\left(w\right)}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} > 0,$$

$$\frac{dC^*}{dw^*} = -\frac{u'\left(w^*\right)\frac{1-(1+\rho)^{t-T}}{\rho}}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} > 0,$$

$$\frac{dC^*}{dw} = -\frac{-u'\left(w\right)\frac{1-(1+\rho)^{t-T}}{\rho}-\left[u''(w)C^*-\frac{C^{*2}}{2}u'''(w)\right]}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} \lessgtr 0,$$

$$\frac{dC^*}{d\left(-\frac{u''(w)}{u'(w)}\right)} = -\frac{-u'(w)\frac{C^{*2}}{2}}{\underbrace{-\left[u'(w)-C^*u''(w)\right]}_{<0}} < 0. \ [QED]$$

A.2 Proof of Proposition 3

Consider second-order Taylor expansions of the elements of (9): $u\left(w-C\right) \approx u(w)-Cu'(w)+\frac{C^2}{2}u''(w)$; $u\left(w^*\right) = u\left(w+\Delta w^*\right) \approx u(w)+\Delta w^*u'(w)+\frac{\Delta w^{*2}}{2}u''(w)$, $u\left(w+D\right) \approx u(w)+Du'(w)+\frac{D^2}{2}u''(w)$. Substitution into (9) then yields:

$$\begin{aligned}
0 = & \underbrace{u(w)-C_ju'(w)+\frac{C_j^2}{2}u''(w)}_{u(w-C_j)} \\
& + \left[p_j\underbrace{\left(u(w)+\Delta w^*u'(w)+\frac{\Delta w^{*2}}{2}u''(w)\right)}_{u(w^*)}+\left(1-p_j\right)u\left(w\right)\right]\frac{1-(1+\rho)^{t-T}}{\rho} \\
& - \left[\underbrace{u(w)+Du'(w)+\frac{D^2}{2}u''(w)}_{u(w+D)}+u\left(w\right)\frac{1-(1+\rho)^{t-T}}{\rho}\right].
\end{aligned}$$

Dividing by $u'(w)$ and letting $A(w) = -\frac{u''(w)}{u'(w)}$ allows one to simplify this expression to:

$$0 = -C_j-\frac{C_j^2}{2}A(w)+p_j\Delta w^*\left[1-\frac{\Delta w^*}{2}A(w)\right]\frac{1-(1+\rho)^{t-T}}{\rho}-\left[D-\frac{D^2}{2}A(w)\right]. \quad (10)$$

Now this indifference relationship holds for any gamble $.(C_j, p_j)$. It follows, for gambles (C_j, p_j) and (C_k, p_k), that $-C_j - \frac{C_j^2}{2}A(w) + p_j\Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w)\right] \frac{1-(1+\rho)^{t-T}}{\rho} = -C_k - \frac{C_k^2}{2}A(w) + p_k\Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w)\right] \frac{1-(1+\rho)^{t-T}}{\rho}$, and thus that:

$$0 = C_j - C_k + \left(\frac{C_j^2}{2} - \frac{C_k^2}{2}\right) A(w) + (p_k - p_j)\,\Delta w^* \left[1 - \frac{\Delta w^*}{2}A(w)\right] \frac{1-(1+\rho)^{t-T}}{\rho}. \quad (11)$$

Combining equations (10) and (11) then allows one to solve for the discount rate ρ and the coefficient of absolute risk-aversion $A(w)$ as given in the Proposition. $[QED]$