Risk preferences and refugee migration[*]
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Abstract

This paper uses an experimental setup to study refugees' risk preferences. Employing a cumulative prospect theory risk parameter elicitation method, we measure utility convexity, loss aversion and probability distortion of asylum seekers. Our estimations show that the cumulative prospect theory framework provides a better fit for explaining refugee choices than expected utility theory. Refugees' risk parameter values show significantly lower levels of distortion than those in comparable studies. Moreover, we find that trauma influences all parameters of risk. FWe propose two theoretical models, based on expected utility theory and cumulative prospect theory, respectively, which are calibrated with the data from the experiment and simulated. The theoretical and simulation results show that the choice of type of model significantly influences migration predictions for a given set of parameter values. The simulation suggests a self-selection of refugees over their preference parameters. Traumatized persons are more likely to renounce migration than others.

Keywords: Asylum seekers, risk attitudes, experimental economics, cumulative prospect theory

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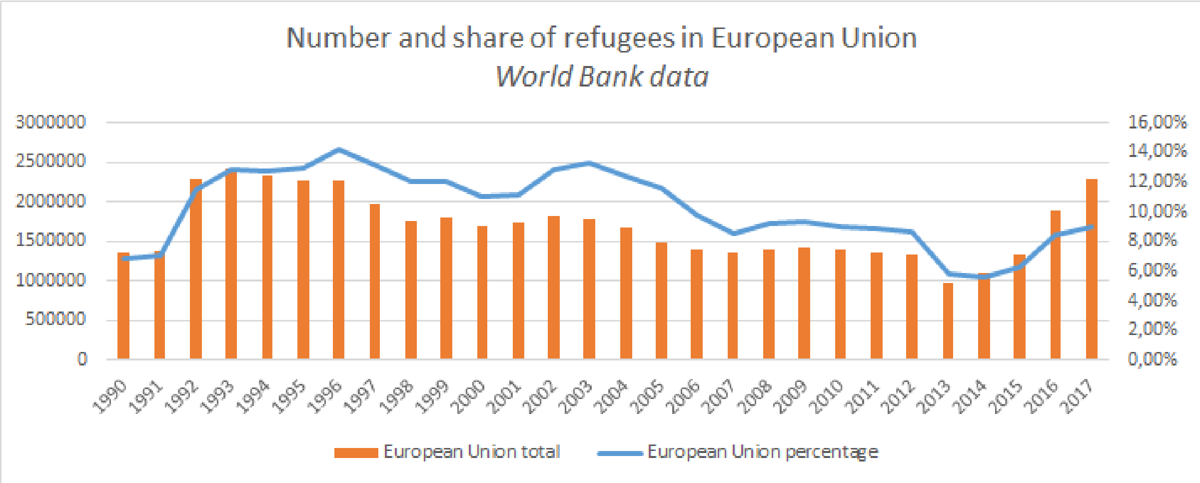
Contents

1 Introduction

Currently, around 70 million people worldwide are forcibly displaced.[1] High income countries such as the Member Countries of the European Union have experienced a significant increase in numbers of asylum seekers. However, as Figure 1 shows, their share in the total number of refugees has varied considerably over time. At 9 %, it is lower than it was in the 1990s.[2]



Host countries that are signatories of the 1951 Refugee Convention[3] aim to provide protection for those in need, while simultaneously preventing irregular immigration. Thus, in its *Policy Plan on Asylum*, the Commission of the European Communities (2008), states its objectives for those in need of protection as the following:

> *[E]nsure access for those in need of protection: asylum in the EU must remain accessible. Legitimate measures introduced to curb irregular migration and protect external borders should avoid preventing refugees' access to protection in the EU while ensuring a respect for fundamental rights of all migrants. This equally translates into efforts to facilitate access to protection outside the territory of the EU.*[4]

However, unintended consequences hamper existing measures' effectiveness. For example, Czaika & Hobolth (2014) show that restrictive asylum policies have lead to an increase of irregular migration in the European Union.[5] In order to avoid designing ineffective policies, it is therefore necessary to better understand the determinants of the migration destinations of persons in need.

While there is an extensive literature on models of migration[6], refugee migration has distinctive features. Unlike other migrants, refugees do not freely choose to leave their homes. Further, many have suffered psychological trauma, which may interfere with their decision making processes, especially when taking decisions involving risk.

[1]See UNHCR (2019).
[2]Graph compiled with data from Bank (2019).
[3]United Nations High Commissioner for Refugees (1951).
[4]Commission of the European Communities (2008, p.3). Other objectives concern a common procedure, uniform statuses, gender considerations, practical cooperation, responsibility and solidarity and coherence with other policies the harmonization of asylum policies in Europe.
[5]See also Brekke *et al.* (2017) on deflection effects.
[6]See for example Constant & Zimmermann (2013).

Existing models of refugee migration[7] address the forced migration specificity of refugees. However, the implicit process of decision making in these models is based on expected utility theory (Von Neumann & Morgenstern, 1945). It has been shown that in risky environments, expected utility theory has less predictive capacity than prospect theory (Kahneman & Tversky, 1979), and that prospect theory is a good fit for other migration data (Czaika, 2015). Further, prospect theory allows to take into account different components of decision making that can be affected by the experience of psychological trauma. It is therefore possible that models based on expected utility theory do not allow for a sufficiently detailed understanding of refugees' destination decisions to accurately predict migration and asylum policy effects.

In order to close the gap in the modelling of refugee migration, this paper 1/ tests whether prospect theory is a better modelling choice for refugee decisions than expected utility theory, 2/ proposes a model of refugee migration based on prospect theory, and 3/ simulates the effects of asylum policies on refugee migration, in particular with respect to self-selection.

Using original experimental data, we find that refugees show decision-making biases that are compatible with cumulative prospect theory rather than expected utility. It is found that refugees' risk preferences indeed have characteristics that clearly distinguish them from other populations found in the literature: they are shown to be less loss averse, to distort probabilities less and to put a higher weight on very good outcomes in their decision-making process. Traumatic experiences and memories are shown to significantly influence the preference parameters.

We propose a model of refugee migration that allows us to compare expected utility and prospect theory predictions, with both exponential and hyperbolic discounting. In the following simulation, we show that the choice of model indeed influences refugee migration predictions. Simulation of the empirically based cumulative prospect theory model show that the effect of migration and asylum policies may in some cases be to deter psychologically traumatized persons more than others from migrating to the West - in opposition to the stated aims of host countries. Deterrence effects are shown to depend crucially on the individuals' decision making characteristics.

In what follows, we will situate our contribution within the literature (section **??**), explain the experimental design (section 2.1), present the results (section 3). The theoretical model of refugee migration and a numerical simulation of the model are presented in sections 4 and 5. Section 6 concludes.

[7] See Czaika (2009); Djajić (2014); Schaeffer (2010).

2 Experiment

2.1 Experimental design

The field study is designed to gather information about the migration decisions of refugees. For this, we study the attitudes towards risk of refugees, as well as their socio-demographic characteristics.

We elicited preferences from 218 asylum seekers in Luxembourg during the procedure of recognition of their asylum claim in autumn and winter 2017-2018. The interview design was approved by the French Research Ethics Board[8] as well as the Ethics Review Panel of the University of Luxembourg (ERP)[9]. Interviews were completely anonymous and took place at the university of Luxembourg, as this setting conveyed a sense of safety to the interviewers and the interviewees. It also underlined the scientific nature of the study.

Asylum seekers were randomly recruited by a research assistant using the interception sampling technique in refugee reception centers and mosques. Persons under the age of 18 and who indicated being aware of having psychological problems were excluded from the study. The interviews were conducted face-to-face by the research assistant. Prior to the field work, the research assistant was tested on his comprehension of the questionnaire in Arabic and in English. The entire interview protocol was translated from English into Arabic, and back into English by a different translator. The research assistant, accompanied by a member of the research team, registered the answers online. Interviews took approximately 3/4 hour and included initial consent, questions on demography, education, language, work, income, networks and conditions before departure, migration path and conditions and future plans. This part of the interview was followed by the experimental protocols described in section 2.4.

2.2 Descriptive statistics

As Table 1 shows, the largest group of subjects originates from Syria (56%), followed by Iraqis (22%). These nationalities are also the main countries of origin in Luxembourg and in the European Union.[10] A majority of refugees in the sample (74 %) are male and the average age is 33 years. Since according to Eurostat, 75 % of asylum seekers in the the 18-34 age group arriving in the EU in 2016 were male, our sample is representative. The participants are well educated: 85 % have completed at least secondary education and 36 % have a college or university degree. Only 53 % are married, and only 51 % have ever worked. A minority of subjects earned low incomes in their countries of origin, while 35 % declare to have earned more than 600 €a month before fleeing. The latter are relatively wealthy: for comparison, the average monthly income in Syria before the war was 234 €, in Iraq (2017) it is 413 €, and in Afghanistan 42 €.[11]

[8]Comité d'Evaluation de l'Éthique de l'INSERM, CEEI-IRB, CEEI-IRB opinion number 17-366.

[9]ERP opinion on research project ERP 17-22. The collection of data was declared to both the French and the Luxembourg Commissions for Data Protection. France: CNIL reference 2039994 v 0 of 23 March 2017; Luxembourg: CNDP reference R009671/T012217. The researchers each passed the NIH certificate for completing the course "Protecting Human Research Participants".

[10]Statistics from Eurostat (ec.europa.eu).

[11]Data taken from the IMF Datamapper. Last data for Syria from 2010.

Table 3 summarizes the answers received for 3 questions on psychological trauma experienced in different situations. In total, 177 subjects (81 %) answered, of which 79 % indicate that they lost someone close to them during the war, 63 % had another traumatic experience during the war, and 33 % lost someone close to them during the journey. All 177 subjects had at least one type of traumatic experience, 41 % had two types and 23 % indicate to have experienced all three types of trauma.

2.3 Methods for estimating individual preferences

Cumulative prospect theory (CPT), developed as an alternative to standard Von Neumann & Morgenstern (1945)'s expected utility theory (EUT) by Tversky & Kahneman (1992) is the predominantly endorsed theory of behaviour under risk. It accounts for a number of cognitive biases backed by a substantial amount of neuroscience data (Fox & Poldrack, 2009). CPT features two original key factors. Reference dependence allows outcomes to be classified as either gains or losses with respect to a reference point, and people can behave differently in each of the two outcome domains. In particular, it enables people to be more sensitive to losses than gains. Probability weighting refers to people's tendency to distort objective probabilities, which is accounted for in CPT through a non-linear valuation of outcomes with respect to objective probabilities.

We adopt common functional forms to model CPT behaviour, with risk attitudes resulting from the interplay of three strictly positive parameters: utility curvature σ, loss aversion λ and probability weighting γ. The first two parameters determine the shape of a power utility function exhibiting a different slope in the gain and the loss domains (Tversky & Kahneman, 1992):

$$u(y) = \begin{cases} y^{\sigma} & \text{if } y > 0 \\ 0 & \text{if } y = 0 \;. \\ -\lambda(-y)^{\sigma} & \text{if } y < 0 \end{cases} \tag{2.1}$$

In this specification, σ is an anti-index of utility concavity for gains (respectively anti-index of utility convexity for losses) and λ represents the decision maker's coefficient of loss aversion . The decision maker is more (resp. less) sensitive to losses than to gains when $\lambda > 1$ (resp. $\lambda < 1$). The usual empirical finding is $\lambda > 1$, along with $\sigma < 1$ (concave utility in the gain domain).

Following Tversky & Kahneman (1992), decision weights defined over cumulative probabilities are also introduced. The value of any binary lottery $(y_1, p; y_2)$ is as follows:

$$PU(y_1, p; y_2) = \begin{cases} \omega(p).u(y_1) + [1 - \omega(p)].u(y_2) & \text{if } y_1 \geq y_2 \geq 0 \text{ or } y_1 \leq y_2 \leq 0 \\ \omega(p).u(y_1) + \omega(1-p).u(y_2) & \text{if } y_1 < 0 < y_2 \end{cases} \tag{2.2}$$

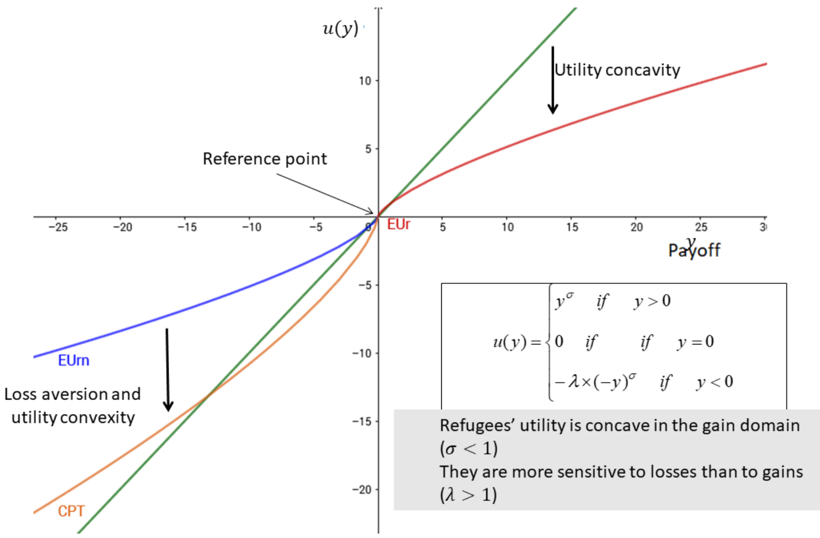
where $\omega(.)$ is a probability weighting function which is strictly increasing from the unit interval into itself, and satisfies $\omega(0) = 0$ and $\omega(1) = 1$. Following Tanaka *et al.* (2010), we choose Prelec (1998)'s specification for the weighting function:

$$\omega(p) = \exp\ [-(-\ln p)^{\gamma}] \tag{2.3}$$

where γ is a third parameter controlling the curvature of the probability weighting function. This parameter can be interpreted as an index of likelihood sensitivity, with $\gamma = 1$ reflecting the absence of probability distortion. It means that, as γ decreases below 1, the distinction between different levels of probability gets more and more blurred, and at the extreme probabilities tend to be perceived as all being equal (i.e., 0.5 in the case of a binary prospect such as a lottery). A value lower than 1 is the normal assumption, giving the weighting function an 'inverse S-shape'. For binary prospects, it characterises an overweighting of the low-probability outcome and an underweighting of the high-probability outcome. If $\gamma > 1$, the function takes the less conventional 'S-shape'. At the other extreme, if γ is very high, probabilities tend to be extremely contrasted and perceived as either 0 or 1.

Figures 1 and 2 illustrate the difference between the utility functions in the EU-power model (with a reflected utility function at 0) and the CPT model specified above. Note that the latter reduces to the former if $\lambda = 1$ and $\gamma = 1$. In Figure 1, the bisectrix designates the utility function of a risk neutral individual, for which utility is a linear function of payoff. Incorporating a decreasing marginal utility of payoff, the utility function becomes concave (EUr). If we assume reference dependence and a reference point at the origin, we obtain a convex form for utility in the loss domain ($EUrn$). Further, CPT adds a different sensitivity to losses (CPT): losses have an increased negative impact on utility compared to the positive impact of gains of a similar magnitude. The CPT curve in the domain of negative payoffs combined with the EUr curve in the domain of positive payoffs gives the curve for the CPT utility function we use in this paper. It has a S-shape.

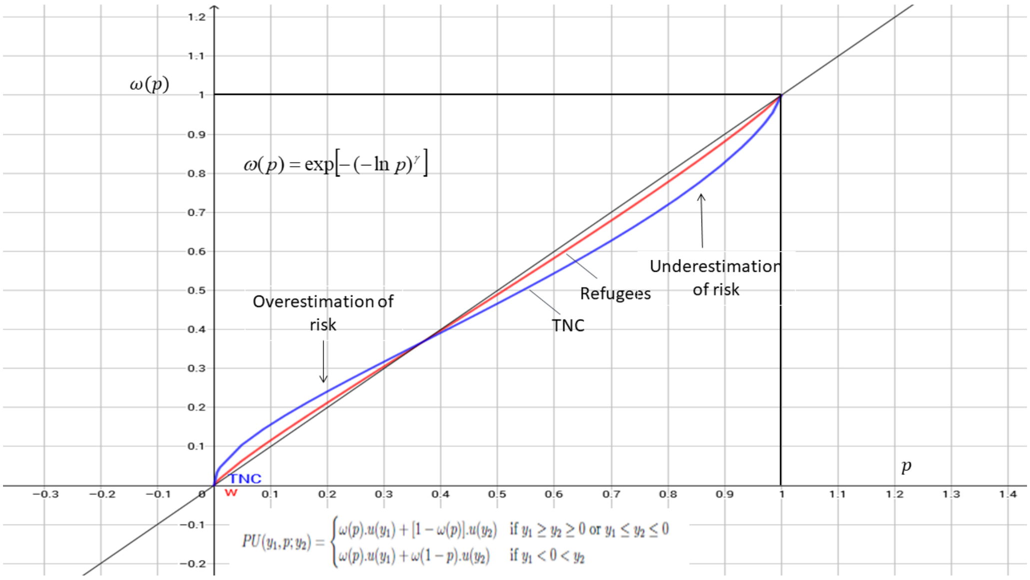
Figure 1: CPT Utility Curvature and Loss Aversion



Source: Author's Elaboration.

Figure 2 reflects the probability distortion we account for in our CPT model. While the bisectrix represents an objective perception of risk (perceived probability is equal to actual probability), the inverse S-shaped weighting functions TCN and ω reflect the overestimation of low probabilities and the underestimation of high probabilities.

Figure 2: CPT Probability Distortions



Source: Author's Elaboration.

2.4 Experimental protocol of risk and time tasks

Description of risk task We adapt Tanaka *et al.* (2010)'s risk task which elicits subjects' risk preference parameters under CPT, by estimating all three parameters σ, λ and γ.

The risk task consists of a succession of pairs of binary lotteries, each pair being composed of a relatively safe lottery (option A) and a risky lottery (option B) (see Table 2). The monetary values are expressed in *experimental currency units* or *ecus* (10 *ecu* = 1 €). Initially, the expected value of lottery A is higher than that of lottery B. As one proceeds down the rows, the expected value of lottery B increases and surpasses that of lottery A. In the EUT framework, risk neutral subjects are expected to choose lottery A first and switch to lottery B as soon as B's expected value is higher than that of A (see column 4 in Table 2, not visible to participants). Very risk averse individuals will never switch, but prefer the safe lottery A even when it has a lower expected value. Risk lovers will switch to the risky lottery B even before its expected value is higher than that of A.

The first two series of lotteries involve only positive payoffs while the third series mixes positive and negative payoffs. The combination of the switching points of series 1 and 2 in Table 2 are used to estimate the curvature of the utility function σ and the nonlinear probability weighting parameter γ for each interviewee. We then use the switching point from series 3 to estimate the loss aversion parameter λ, conditional on σ value.[12]

Tanaka *et al.* (2010)'s design is based on multiple price lists which are among the more complex methods for eliciting risk preferences [13]

[12]For a more detailed explanation of the parameter elicitation technique, see Tanaka *et al.* (2010). We also estimated the parameters using the joint estimation approach of Andersen *et al.* (2008) and can provide the results on demand.

[13]For a discussion of advantages and drawbacks of different designs for risk elicitation see Charness *et al.* (2013). This drawback was partly avoided by a one-to-one interview setup, in which the

Subjects received an initial endowment of 10 €in shopping vouchers[14] for participation. This endowment is interpreted as the reference point when calculating parameter values (see Harrison & Rutström (2009).) In addition, to ensure motivation, subjects earned a payment that depended on their choices in the lotteries: at the end of the interview, one lottery row was randomly selected and the corresponding lottery was played for vouchers. The theoretical payment was comprised between 8 €and 180 €.[15] An average of 14.5 €was paid at the end of the interviews (between 8 and 32 €).Given that asylum seekers in Luxembourg receive 25 €per month (in addition to housing and meals)[16], we believe this payment gave them strong incentives to make thoughtful and careful decisions. Interviewees were informed that they could abandon the interview at any time and still receive the initial 10 €payment.

Description of time task We also elicit the time preferences of the refugees in order to be able to make the numerical simulation in section **??**. Unlike the framework used in Tanaka *et al.* (2010), we summarize time preferences in a single parameter, which is the present bias. The time task consists of choices made between two hypothetical payoffs that are set six months apart. Subjects must make 20 choices between dated payoffs labeled in euros. In the first series, the first hypothetical payment occurs now, the second in six months. In series 2, the first payment occurs in one month, and the second in seven months. These series are based on the experimental setup in Andersen *et al.* (2008). [17]

Unlike the risk tasks, we did not incentivise subjects in the time tasks, i.e., make their payments dependent on their choices. It was not feasible since it was not possible for either the enumerator or the asylum seeker to predict how they could be contacted, and thus paid, in the future. Asylum seekers in Luxembourg have no bank accounts, and do not know how long they might stay in the country.

2.5 Psychological priming

Before starting the tests, the subjects were asked to remember either something sad, something happy or something neutral. This treatment is taken from Callen *et al.* (2014) in order to detect whether trauma induced difference in risk choices come from a long term change in preferences (in which case all subjects who have experienced

interviewer could make sure that the method was understood prior to beginning the experiment. A comprehensive introduction of the method was given, including examples, and subjects were shown colored balls to represent the probabilities of the payoffs of the lotteries.

[14]These SODEXO vouchers are valid in major supermarkets in Luxembourg, as well as other shops that are accessible to asylum seekers. Their validity is one year, and the goods that can be bought cover most commodities.

[15]Monetary outcomes were rounded to the next full euro value for payment in vouchers.

[16]See "Règlement grand-ducal du 8 juin 2012 fixant les conditions et les modalites d'octroi d'une aide sociale aux demandeurs de protection internationale", *Journal Officiel du Grand Duché du Luxembourg* 2012, vol. A123, pages 1585–1588 for more information on the support given to asylum seekers in Luxembourg.

[17]We do not specify an interest rate. Specifying the interest rate would be helpful to compare investments in the experiments with outside options and their annual interest rates. However, in our model, no outside options are possible. We want to test only the sensitivity of individuals to waiting (and to making sacrifices) for a future payoff, without trade-offs between different alternatives. Coller & Williams (1999) suggest that when the implicit interest rate is not stated, the discount rates tend to be higher. Thus, it may be that our experiment elicits an upper range of the discount rate.

trauma should show the specific behaviour), or whether it is induced by a short-term trigger effect, such as remembering something sad.

In an adaptation of the experimental setup of Callen *et al.* (2014), we use field psychological methods to ask all subjects to describe an event of their lives prior to the experiment. We randomized three treatments[18] accross subjects, asking questions with the following formulation:[19]

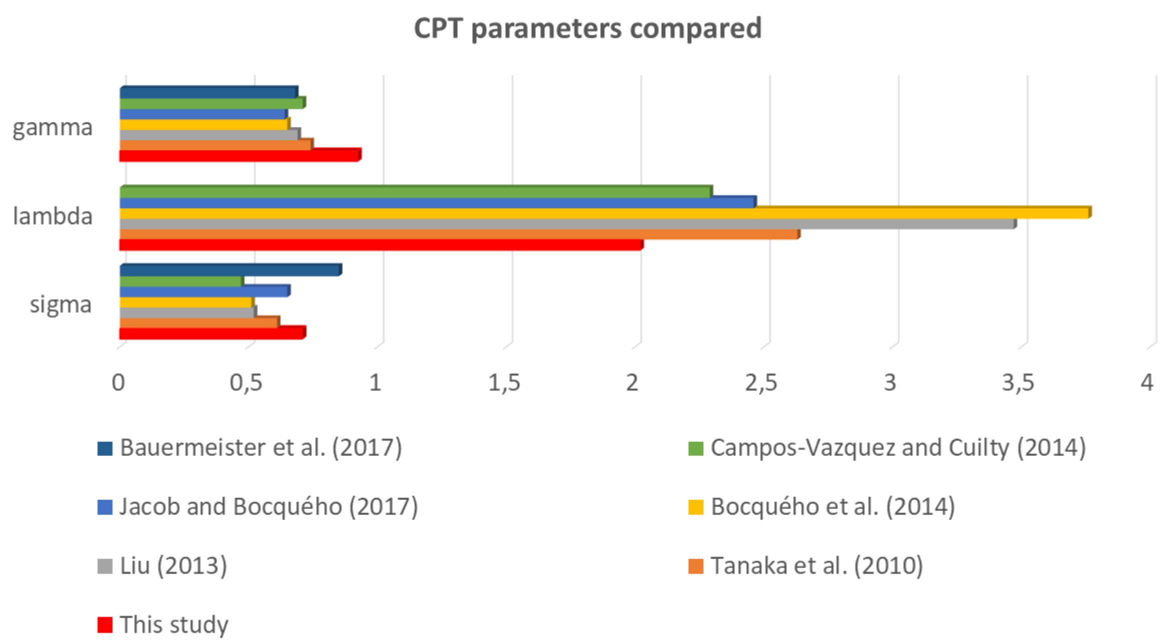
- We are interested in understanding your daily experiences that may make you fearful or anxious. This could be anything, for example getting sick, experiencing violence, losing a job, etc. Could you describe one event in the past year that caused you fear or anxiety? (FEAR)
- We are interested in understanding your general daily experiences. This could be anything. Could you describe an event from the past year that was important or significant for your life? (NEUTRAL)
- We are interested in understanding your daily experiences that make you happy or joyous. This could be anything, for example birth of child, marriage of a relative, or success in your job. Could you describe an event in the past year that caused you happiness? (HAPPY)

We add the treatment group as a explanative variable in the regression of the parameter values to test whether the short term psychological primer has a significant effect.

[18] A randomization test shows that the differences between the subjects allotted to the three priming treatments are not significant.

[19] Questions adapted from Callen *et al.* (2014).

Figure 3: Comparison of CPT parameter values across studies



3 Experimental results

3.1 Baseline parameter estimates

For each subject, we calculate the CPT parameters and derive estimates of mean values for the underlying population (first column of Tables 7, 8 and 9 for σ, λ and γ respectively). We find that, on average, parameter σ controlling utility curvature has a value of 0.702, the loss aversion parameter λ has a value of 2.210, and the likelihood sensitivity parameter γ is 0.941 on average. All three parameter values lie in the expected intervals and are significantly different from 1 at the 1% level, meaning that CPT is a more appropriate framework for describing risk attitudes of asylum seekers than EUT. [20]. More precisely, it provides evidence of a concave utility function in the gain domain (convex in the loss domain), of loss aversion, and of over weighting of low-probability extreme events. The corresponding CPT functions are the ones represented in Figures 1 and 2.

Figure 3 compares the CPT parameter values of our sample of asylum seekers with those obtained from other populations, using a similar experimental setup, identical assumptions on CPT functional forms and parameter specification, and an identical estimation procedure (interval approach). [21]

XXXcheck similar spec and estimation proc?

Asylum seekers exhibit a higher σ parameter than the other populations (except Bauermeister *et al.* (2017)'s German students). In other words, they are less risk averse

[20]Estimating the parameters using a structural model leads to the same conclusion. Estimations available on request.

[21]Tanaka *et al.* (2010) on rural Vietnamese people, Bauermeister *et al.* (2017) on German students, Jacob *et al.* (2017) on French students, Liu & Huang (2013) on Chinese farmers, Campos-Vazquez & Cuilty (2014) on Mexican students, and Bocqueho *et al.* (2014) on French farmers.

with respect to gains and less risk seeking with respect to losses. Our estimates also show that asylum seekers tend to be less sensitive to losses than others as their λ parameter is comparatively lower. Regarding the third parameter γ, it seems that its value is higher for asylum seekers than for other populations, meaning that the former are more sensitive to likelihood, i.e., perceive more contrast between probabilities. At sample level, that is in the domain where γ ¡ 1, it can be interpreted as a comparatively low degree of probability distortion from asylum seekers, and a perception of probabilities close to the true values.

Table A compares the parameter values of this study with that of two others for which we have the full dataset: that of Bocqueho *et al.* (2014) on French farmers and that of Jacob *et al.* (2017) on French students. We use a Mann-Whitney test to determine whether the distributions of the risk parameter values in these two last samples are the same than in the refugee sample. We find that they are significantly different, except the students' utility curvature (σ) and loss aversion (λ). Consistent with this result, we find that being a farmer significantly alters all CPT parameter values, even when controlling for individual characteristics (age, gender, education, religion), and being a student only affects γ.The direction of the sample effect is as described above. Being a woman is a characteristic which significantly modifies all three parameters, while age modifies λ only. It suggests that the difference between refugee's risk parameters and that of other populations may be larger or lower than appears at first glance, because of the differences in the demographic composition of samples.

3.2 Regression results

Tables 7, 8 and 9 provide the estimations of the parameters including a set of exogenous individual characteristics in columns 2, 3 and 4.

Parameter σ is relatively lower (i.e., utility concavity with respect to gains is higher) for women and those who have ever lived abroad before becoming refugees. Coming from Iraq, having studied in a madrasa and having worked before significantly increase parameter σ (i.e., decrease utility concavity with respect to gains). These results are consistent with the work of Fehr *et al.* (2006) who find that the willingness to take risks varies across countries, as well as studies that show that the more educated are more willing to take risks.[22] Loss aversion λ increases in age but is reduced for subjects who have attended madrasas (religious schools). Subjects who have attended alternative education systems and who have worked in their country of origin exhibit a lower γ, i.e., are less sensitive to probability values.

In line with the findings of Jaeger *et al.* (2010) who suggest that women are more risk averse than men, we find a significance difference in the risk attitudes of men and women for σ. Men have lower utility concavity with respect to gains than women, which contributes to a lower risk aversion.

In order to make sure that risk preferences do not change significantly over time, we ran the parameter estimation separating subjects into those who had arrived within the last year before the interview (in 2017 or 2018) and those who had arrived before. The groups were of approximately equal size (101 versus 116 observations). We found no significant difference between the parameter values of these two groups, thus confirming that the arrival date does not significantly influence the estimation of the risk parameters.

[22]See Dohmen *et al.* (2006), Dohmen *et al.* (2011) and Jaeger *et al.* (2010).

Further, we check whether the migration route has an impact on the preference parameters. Refugees who have experienced hardship during their migration may have different risk profiles to those whose migration was comparatively easy, possibly because the experience of a difficult migration has influenced their risk attitudes. To test this effect, we separated the group into persons whose migration took 1 day (20 observations) from those whose migration took longer (197 observations). We found no significant difference between the risk parameters of the two groups, with the exception of loss aversion, which is higher for individuals who experienced the more protracted migration route.This finding suggest that at least after the journey they are more sensitive to negative outcomes. We find no evidence of self-selection into different migration paths on the basis of risk attitudes.

We further test specifically whether refugees migrated with a visa (31 observations) or illegally. If there is a self-selection into illegal and legal migrants, risk preferences should be different between these groups, in line with Arcand & M'Baye (2013). We find that the parameter estimates are significantly different between the sub-groups for probability distortion only. Subjects who migrated with a visa distorted probabilities less than subjects without. This result is in line with Bah & Batista (2017), who find that persons who are willing to migrate illegally overestimate the probability of dying en route and of obtaining a residence permit more than persons who are not willing to migrate illegally.

3.3 Trauma effects

We distinguish between long term trauma effects on the CPT parameter values that are correlated to stated experience from the three types of trauma listed in Table 3, from short term effects that are induced by psychological priming from remembering a sad event.

Table 7 shows the regression results for the utility curvature parameter σ including long term trauma (column 2), short term trauma (or psychological priming, column 3) and both (column 4). We find that there is a consistent long-term effect of one type of long-term trauma: having lost someone close in the war consistently and significantly increases utility curvature (σ is decreased in columns 2 and 4). No other long term effect nor the short term psychological priming affect utility curvature.

We find the same result in the regression analysis of the loss aversion parameter λ.[23] Again, the long-term effect of having lost someone during the war is the only significant parameter, increasing loss aversion in columns 2 and 4 of Table 8. The short term effects are not significant.

However, for probability distortion γ, the picture is quite different. There are no significant long term effects of trauma. There is a short term effect of remembering something sad: this reduces probability distortion in the model of column 3 in Table 9 (significant at a 10 % level). This effect however disappears when the other covariates are included in the model.

The regressions were reproduced reducing to the sample to the 114 recent arrivals, defined as arrived in 2017 or 2018. The trauma effects on σ and λ do not change (see Tables **??** and **??**), however, the psychological priming effect on lambda is slightly different. Indeed, for recent arrivals, there is again only a short term effect on γ. However,

[23] Table 8 shows that λ loses its significance when trauma is introduced, suggesting that trauma effects capture most of the variation of loss aversion.

it occurs only when both types of trauma are included in the regression (column 4 of Table **??**). Also, it is not the negative memory that is significant, but remembering a happy moment. Further, here the effect is to increase, rather than decrease, probability distortion.

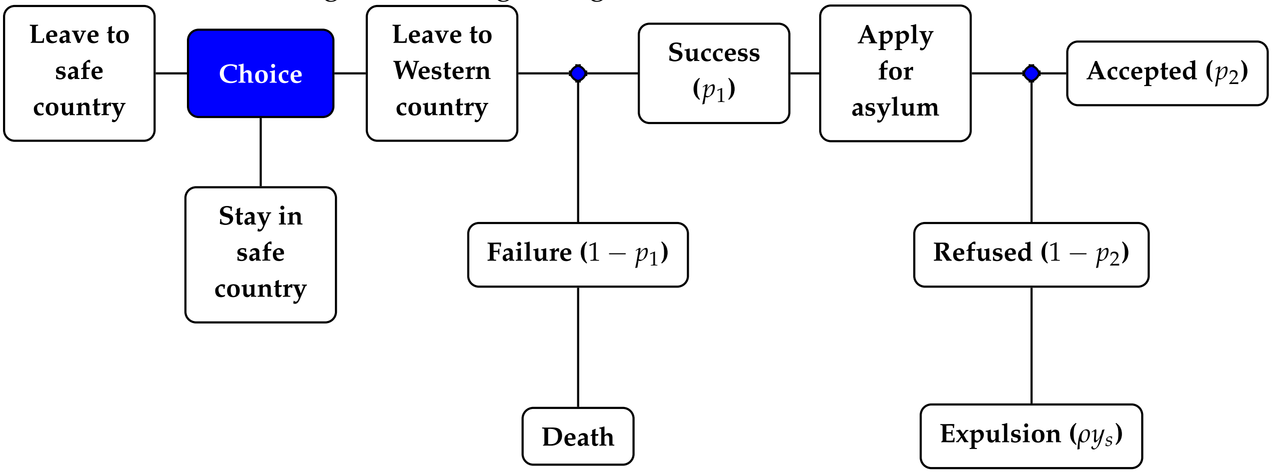
Therefore, while we can conclude on long-term effects of having lost someone close to the war (increasing utility curvature and loss aversion) the effect of the short term psychological primer is ambiguous. Emotions, be they positive or negative, seem to affect probability distortion, though not other aspects of decision making under risk. Note that in the case of refugees it is not necessarily easy to distinguish between positive and negative memories, as happy events may be tinged by the subsequent upheavals in life such as war, loss and flight.

3.4 Time preferences

We find a discount rate of 0.44 in series 1 and 0.42 in series 2 of the experiment (Table 6). These results are withing the span of average discount rates reported by Harrison *et al.* (2002) (28%) and Benhabib *et al.* (2010) (472 %). As expected, the implicit interest rate in the second series, which involves only future payments, is slightly but significantly lower than that in the first series (see Table 6. There is thus proof of a present bias and the need for a hyperbolic discounting model.[24]

[24]Note that a high number of individuals never switched in any of the two time tasks (148 individuals out of 2017).

Figure 4: Refugee migration decision model



4 Refugee Migration Model

A complete decision tree of the migration decision would resemble Figure **??**, in which a person decides whether to flee to a safe country or not, whether to continue to a Western country, and whether, once arrived, to apply for asylum. Each option involves different possible outcomes subject to probabilities.

In this section, we choose to focus on the decision of a refugee once a safe third country is attained. Indeed, the first decision about whether to stay or leave may be more or less rational - it is possible that a flight instinct kicks in, limiting the scope for economic analysis of the decision. In contrast, many refugees pass through countries in which they are not persecuted and decide not to stay there. This is for example the case of Syrian refugees in Lebanon or Turkey who wish to move on to the European Union. We therefore focus on this decision in our model of refugee migration and simplify the migration decision to Figure 4.1.

In what follows, we outline theoretical models of refugee migration. In a first version, we use the (standard) expected utility approach. We then however propose a cumulative prospect theory version, and allow for hyperbolic time discounting.

4.1 Basic assumptions

We consider a decision-maker (DM) who lives in a developing country. His[25] initial living-conditions are sufficiently good to not push him to leave for another country. Subsequently, a violent conflict suddenly occurs, so as the DM's life is in danger. The DM is therefore obliged to (urgently) leave his country and to seek refuge in a safe country close by.

Leaving for a neighboring safe country is free of any cost[26], and it allows the DM to perceive an annual revenue[27] y_S. We suppose that this revenue is lower than the one

[25]We use the masculine pronoun because a majority of asylum seekers who arrive in Europe are male. The model however also applies to women.

[26]This is equivalent to reducing the annual revenue by the migration cost

[27]We suppose that all aspects of living conditions have a revenue equivalent. The "revenue" that we

he earned at home before the conflict[28], but it is higher than the one he could currently receive at home, in times of conflict.[29]

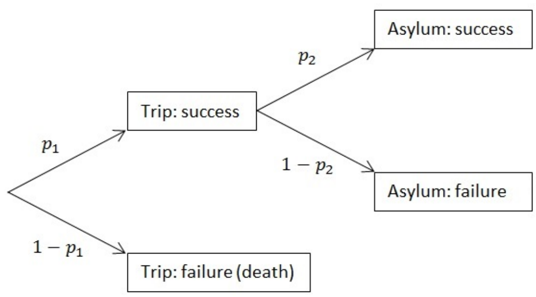
Hence, the DM is in safety in a neighboring country. He has now the possibility to (more or less serenely) think of which alternative to choose next. We suppose the DM faces two alternatives:

1/ Staying in this neighboring safe country and earning y_S for the rest of the time horizon.

2/ Trying to migrate to a western country. This alternative is costly (see later), but it is also a risky alternative in the sense that different outcomes can be obtained, depending on the realization of (probabilistic) lotteries. Both a very good outcome (a new life in a wealthy country) and very bad outcomes (rejection or even death) must be envisaged.

This second alternative can be summarized by the following figure.

Figure 1. Going to the West: a risky alternative



As described by Figure 4.1, if the DM decides to try to leave in a western country, this alternative does not ensure him a high payoff. It depends on the realization of different lotteries. First, with a probability $(1 - p_1)$, migration to the West fails. This may be because of a fatal accident, due to internment in a reception camp, capture into slavery etc.. In this case, his "revenue" falls to zero.[30] With probability p_1 the trip is successful. In this case, we suppose the DM applies for asylum. This leads to a second lottery: with a probability p_2, the DM is granted asylum and obtains an annual revenue of y_W^T for the rest of the time horizon. With the complementary probability $(1 - p_2)$, the DM's claim is rejected. Here, we suppose a generic scenario in which the DM has to leave the western country for a third place in which he will receive a lower revenue than in the safe neighbouring country: $y_T = \rho y_S$, with ρ being a degree of suffering in this third place, $0 \leq \rho < 1$.[31]

are talking about in this paper is not only the a monetary income, but it is a global monetary equivalent of the DM's material and immaterial living conditions.

[28]For instance, the access to the labour market could be restricted, so that foreigners have fewer chances to use their skills. Further, their income may be reduced by the equivalent of the discomfort of not being at home and being separated from his family. Further, it may be that refugees are confined to a camp, with access only to minimum services.

[29]Indeed, the labor market may have collapsed, or even if this is not the case, the discomfort from acute danger reduces the quality of life in the conflict-torn home country.

[30]In an extension of the model, we could create another branch in the case of unsuccessful migration: a non-zero option with very low payoffs for survival with hardship.

[31]For $\rho = 0$, the revenue equivalent falls to zero, meaning a state of death. Other values of ρ make it possible to express different degrees of suffering. The DM is always worse off than in the first safe

We suppose a time horizon of T periods (one period equals one year), and we suppose that annual revenues are constant during all periods. However, the DM discounts future incomes. To be more precise, considering as an example the case of leaving in a neighboring safe country, the DM's lifetime expectation of revenue is:

$$y_S^T = \int_0^T y_S.D(r,t).dt$$

with t being a period (one year), T being the time horizon (i.e. the last period which the DM takes into account), and r the discount rate.
We note $D(r,t)$ the discounting function, which can take one of the two main forms found in the literature: exponential discounting or hyperbolic discounting (see Benhabib *et al.* (2004); Carrillo & Mariotti (2000); Phelps & Pollak (1968) and Tanaka *et al.* (2010)). The exponential discounting function is $D(r,t) = e^{-rt}$, and the corresponding interest rate is r. A hyperbolic discounting function is $D(r,t) = \frac{1}{1+rt}$, with a corresponding interest rate of $\frac{r}{1+rt}$. So, in case of hyperbolic discounting, the interest rate declines over time t, which can lead to time-inconsistent preferences. While we retain the general notation for the discounting function, in section 5 we simulate both types of discounting functions, using the interest rates found in the survey.

Applying for asylum is a legal proceeding which, depending on the countries, may last a long time (from 6 months to 1 or even 2 years or more until a final decision is felled). We denote by T_A the response time to the asylum application. During this time, the applicant perceives an (equivalent-annual) subsidy: y_{AA}, which may be higher or lower than y_S.[32]
As a consequence, taking into account this response time leads to the following different lifetime expectations. As regards the expected payoff in case of being granted asylum in a western country, we have:

$$y_W^T = \int_0^{T_A} y_{AA}.D(r,t).dt + \int_{T_A}^T y_W.D(r,t).dt \tag{4.1}$$

and in case of an unsuccessful asylum application, and deportation to a third place, we obtain:

$$\begin{aligned} y_T^T &= \int_0^{T_A} y_{AA}.D(r,t).dt + \int_{T_A}^T y_T.D(r,t).dt \\ &= \int_0^{T_A} y_{AA}.D(r,t).dt + \int_{T_A}^T \rho y_S.D(r,t).dt \end{aligned} \tag{4.2}$$

with $0 \leq \rho < 1$.

As said before, we suppose that y_{AA} may be higher or lower than y_S. However, as regards the discounted lifetime expectations y_S^T, y_W^T and y_T^T, we assume: $y_T^T < y_S^T < y_W^T$. Therefore, we consider that $y_{AA} > y_S$ cannot lead to $y_T^T > y_S^T$: suffering in the third

neighbouring country. The country the DM is sent to may be the country of origin, the safe neighbouring country or a third country, in which cases $1 - \rho$ may present the psychological cost of the unsuccessful migration.

[32]For example, in France, the "allocation pour demandeur d'asile" is of 6.80 euros per day for a single adult (see the French central administration website: https://www.service-public.fr/particuliers/vosdroits/F33314).

country ensures $y_T^T < y_S^T$ (i.e. the value of ρ is sufficiently low). On the contrary, $y_{AA} < y_S$ cannot lead to $y_W^T < y_S^T$: enjoying y_W (which is higher than y_S) in case of success in the asylum application ensures $y_W^T > y_S^T$.

Trying to move to a western country is costly: we suppose that the DM has to pay an amount C that he may have to borrow.[33] As a consequence, choosing this alternative supposes to repay the loan, and this reduces the lifetime expectaction of this alternative by an amount:

$$C^{Te} = \int_0^{Te} c.D(r,t).dt$$

with Te being the repayment horizon, $c = \frac{C}{Te}$ the annual amount of repayment (for each period of one year). It is important to note that this repayment has to be made whatever the outcome of the asylum process (i.e. whatever the DM ultimately lives in the western country or was sent back to a third place).

In the following sections, we will identify the migration thresholds using the expected utility and the cumulative prospect theory frameworks. This approach will allow us to compare the predicitions of the two models for in section 5.

4.2 Expected Utility

Consider first that the DM is a Von Neumann - Morgenstern Expected Utility (EU) maximizer. In this case, he values the different alternatives as follows:

$$V_{EU}(West) = p_1.p_2U(y_W^T - C^{Te}) + p_1.(1-p_2)U(y_T^T - C^{Te}) + (1-p_1)U(0)$$

$$V_{EU}(Safe) = U(y_S^T)$$

with $U(x)$ being the VNM - Utility function, from enjoying a payoff x (with x being a final wealth, so that $x \geq 0$).
We assume the DM has a power utility function: $U(x) = x^\alpha$, with $\alpha > 0$ This kind of utility function englobes cases of risk aversion(if $\alpha < 1$), risk-neutrality ($\alpha = 1$) and risk-loving DM ($\alpha > 1$). The use of the power function is widely recognized in the economic literature, and it has the advantage to giving us the ability to directly interpret α as an indicator of risk aversion.[34]

Applying these specifications, we get the following values for the three alternatives:

$$V_{EU}(West) = p_1.p_2(y_W^T - C^{Te})^\alpha + p_1.(1-p_2)(y_T^T - C^{Te})^\alpha + (1-p_1)(0)^\alpha \tag{4.3}$$

$$V_{EU}(Safe) = (y_S^T)^\alpha \tag{4.4}$$

and, by comparing these values we obtain:

[33] In our sample, 51 % of the first 100 respondents did not finance their journey using their own resources. 15 % were financed by their family.

[34] The Arrow-Pratt indicator of absolute risk aversion ($-\frac{u''(c)}{u'(c)}$) associated with a utility function $U(x) = x^\alpha$ reduces to $-\frac{(\alpha-1)}{x}$. α is directly linked to the degree of risk aversion, and the DM exhibits a decreasing absolute risk aversion: the wealthier he is, the less he is affected by an additional risk on his wealth.

Proposition 1.

(i) In the case where $y_{AA} < y_S$, the following condition is a sufficient (but not necessary) condition for a VNM-DM to prefer trying to leave to the West over keeping in the safe neighbouring country:

$$\alpha > \frac{-ln(p_1) - ln(p_2)}{ln(y_W^T - C^{Te}) - ln(y_S^T)}$$

(ii) For a given probability of success in the asylum application (p_2), the effect of a variation in the waiting time for status of asylum application (T_a) depends on both the degree of risk aversion and the revenue y_W.
The higher y_W, the more likely risk-averse individuals ($\alpha < 1$) (risk-loveing individuals ($\alpha > 1$))will be positively (negatively) affected by an increase in T_a.

(iii) Increasing the revenue when waiting for status of asylum application y_{AA} always increases the value of $V_{EU}(West)$. However, for a given degree of risk aversion (α) the strength of this effect depends on the probability of success in the asylum application (p_2).
The higher the value of p_2, the lower the positive effect for a risk-averse individual ($\alpha < 1$) and the higher the positive effect for a risk-lover one ($\alpha > 1$). The reverse holds: the lower the value of p_2, the higher the positive effect for a risk-averse individual ($\alpha < 1$) and the lower the positive effect for a risk-lover one ($\alpha > 1$).

(iv) An increase in the conditional probability of obtaining asylum (once arrived in West), p_2, provides higher incentives to go to the West. However, the comparison of this sole effect depending on the degree of risk aversion is not conclusive.

Proof: see Appendix.

Point (i) highlights that having a low degree of risk-aversion (i.e. high value of α) is a sufficient condition for deciding to migrate to the West. Indeed, even if the expected revenue of going to the West can be much higher than that of staying in the safe neighbor country, this first alternative is a risky one while the latter one is a safe one. Knowing that risk-averse individuals are ready to decrease their expected outcome to enjoying a safe outcome instead of a random one, only a sufficiently low level of risk aversion can lead individuals to choose the West option.
Point (ii) is a consequence of the evolution of marginal utility of wealth, depending on the degree of risk aversion. Risk-averse individuals exhibit decreasing marginal utility of wealth. Hence, these individuals are more positively affected by an increase in wealth in bad states than they are negatively affected by a decrease in wealth in good states. Yet, increasing the waiting time T_a decreases the value of the (best) perspective of succeeding in obtaining asylum (because of fewer periods for enjoying y_W, given a time horizon T), and it increases the (worst) perspective of not succeeding in obtaining asylum (because of fewer periods for suffering y_T).
Point (iii) is also a consequence of the different marginal utilities of wealth with different degrees of risk aversion. Risk-averse individuals are more sensitive to a variation in wealth when they are poor than when they are wealthy. As a consequence, an increase in y_{AA} has a higher (positive) impact if the bad state (not obtaining asylum) is likely, i.e. when p_2 is low. The reverse holds for risk-lover individuals.

As a general remark, we observe that the degree of risk aversion is of paramount importance when deciding whether going to the West or not (point (i)), and has also a great importance in the way of how individuals are affected by a change in some asylum policies conditions (y_{AA}, T_A and p_2, points (ii) and (iii)). It is shown that an increase in T_A can better deter risk-lovers than risk-averse individuals from going to the West. Moreover, a variation in the waiting revenue y_A also affects more risk-loving individuals when combined with a high probability of obtaining asylum. However, varying the conditional probability of obtaining asylum contributes to the effect of a variation in the revenue y_{AA}, but its direct effect, which is always positive, cannot be distinguished depending on the degree of risk aversion.

4.3 Cumulative Prospect Theory

Under VNM-expected utility, individuals' preferences towards risky perspectives are entirely captured by the degree of concavity of the utility function $U(x)$ (i.e. the value of α, for $U(x) = x^{\alpha}$). Following the observations made by Kahneman and Tversky (1979, 1992), Cumulative Prospect Theory (CPT) takes into account three additional features that many individuals seem to exhibit when facing (risky) perspectives:

(i) valuations, relative to a reference point

(ii) loss aversion: a loss of X (relatively to the reference point) is more painful than a gain of X is enjoyable

(iii) difficulties to correctly assess probabilities.

Assuming that (i) the DM has had to suddenly leave her country of origin, (ii) he then has to take a decision on his final destination in the safe neighbouring country (which is a sure alternative) and (iii) there is no hope that the conflict will end during the time horizon. As a consequence, we choose to define as the reference point the living-condition in the neighbor-safe country, i.e. y_S^T.

The values the different alternatives for a DM having CPT preferences are:

$$V_{CPT}(West) = \omega(p_1.p_2)v((y_W^T - C^{Te}) - y_S^T) + \omega(1 - p_1p_2)v(0 - y_S^T)$$
$$+\omega(p_1(1-p_2))\left[v((y_T^T - C^{Te}) - y_S^T) - v(0 - y_S^T)\right]$$

$$V_{CPT}(Safe) = v(y_S^T - y_S^T)$$

Note $v(x - z)$ the valuation of a payoff x relative to the reference point z. In case of $x > z$ (positive perspective), the DM values the perspective as: $(x - z)^{\sigma}$, with $\sigma > 0$. In case of $x < z$ (negative perspective), the DM values the perspective as: $(-\lambda)(-(x - z))^{\sigma}$, with $\sigma > 0$ and $\lambda \geq 1$. σ represents the concavity of the value function, and λ represents loss aversion: in case of $\lambda > 1$, a loss of $z - x$ is more painful that a gain of a similar absolute value. Here, both perspectives y_T^T and 0 represent losses with respect to the reference point y_S^T ($y_T^T - y_S^T < 0$, $0 - y_T^T < 0$).

$\omega(p)$ is the weighting function of probabilities, knowing that p represent the cumulative probability of the perspective within the concerned domain (gain or loss). It takes the following form $\omega(p) = exp[-(ln(1/p))^{\gamma}]$ (see Prelec (1998)). γ is defined in the interval $[0, +\infty]$: if $\gamma = 0$, then all probabilities are equally weighted (i.e. all values of p lead to the same value of $\omega(p)$). If $\gamma = 1$ then $\omega(p) = p$: there is no probability distortion. If $\gamma > 1$, then probabilities below a given threshold Z are under-weighted and probabilities above this threshold are over-weighted (i.e. $\omega(p) < p$ for $p < Z$, $\omega(p) > p$ for $p > Z$, $0 < Z < 1$). Hence, depending on the value of γ the DM can either perfectly perceive the different probabilities ($\gamma = 1$), or he can be unable to distinguish them (and thus attributing a similar weight to all states of Nature, when $\gamma = 0$, or attributing a similar weight to the least likely states and attributing another similar weight to the most likely states when $\gamma \to +\infty$). The further the value of γ is from 1, the more the perception of the probability is distorted.

Succeeding in obtaining asylum in a western country leads to a positive perspective: as said before, even in the case where the subsidy y_{AA} that the DM perceives (when waiting about the status of its application for asylum) is lower than the revenue he can earn in the safe neighbouring country y_S, we assume that earning y_W the rest of time horizon always ensures $y_W^T > y_S^T$.[35] However, in the case of a rejected asylum application, going to a third place may lead to a loss (relatively to staying in a safe neighbouring country): *a fortiori*, to die during the trip to the West is a loss relatively to living in a safe neighbouring country.

The values of the two alternatives for a CPT Decision-Maker are:

$$V_{CPT}(West) = \omega(p_1.p_2)((y_W^T - C^{Te}) - y_S^T)^\sigma + \omega(1-p_1p_2)(-\lambda)(-(0-y_S^T))^\sigma$$
$$+\omega(p_1(1-p_2))\left[(-\lambda)(-((y_T^T - C^{Te}) - y_S^T))^\sigma - (-\lambda)(-(0-y_S^T))^\sigma\right]$$

$$\begin{aligned} V_{CPT}(West) = \omega(p_1.p_2)((y_W^T - C^{Te}) - y_S^T)^\sigma + \\ [\omega(1-p_1p_2) - \omega(p_1(1-p_2))](-\lambda)(-(0-y_S^T))^\sigma \\ +\omega(p_1(1-p_2))(-\lambda)(-((y_T^T - C^{Te}) - y_S^T))^\sigma \end{aligned} \tag{4.5}$$

$$V_{CPT}(Safe) = (y_S^T - y_S^T)^\sigma \tag{4.6}$$

with $\omega(p) = exp[-(ln(1/p))^\gamma]$ and $\omega(1-p) = exp[-(ln(1/(1-p)))^\gamma]$.
We remark that $V_{CPT}(Safe)$ simplifies, and is normalized to 0 because the neighbouring safe country is the reference point.

A comparison of these values allows us to state the three following Propositions.

Proposition 2.

The following condition is a necessary (but not sufficient) condition for a CPT-DM to prefer trying to leave to the West over going to a safe neighbouring country:

$$\sigma > \max\{A, B\} \tag{4.7}$$

with:

$$A = \frac{ln\,(\omega(p_1(1-p_2))) + ln\,(\lambda) - ln\,(\omega(p_1p_2))}{ln\,\left((y_W^T - C^{Te}) - y_S^T\right) - ln\,\left(-((y_T^T - C^{Te}) - y_S^T)\right)}$$
$$B = \frac{ln\,(\omega(1-p_1p_2) - \omega(p_1(1-p_2))) + ln\,(\lambda) - ln\,(\omega(p_1p_2))}{ln\,\left((y_W^T - C^{Te}) - y_S^T\right) - ln\,\left(-(0-y_S^T)\right)}$$

Proof: see Appendix.

[35] In other words, the asylum claim treatment time, T_A, is not so long as to ensure $y_W^T < y_S^T$ in the case where $y_{AA} < y_S$.

In the two following Propositions, we attempt to distinguish between different effects. For that purpose, the first proposition is made in the specific case where no probability distortion holds (i.e. $\gamma = 1$), and the second one highlights the effects of probability distortions.

Proposition 3. *In the case where no probability distortion holds (i.e. $\gamma = 1, \omega(p) = p$):*

(i) The higher the loss aversion parameter λ, the fewer incentives an individual has to migrate to the West.

(ii) Increasing the waiting time for asylum application (T_a) has different effects, the importance of which depend on the value of σ: the higher y_W, the more likely an individual characterized by $\sigma < 1$ ($\sigma > 1$) will be positively (negatively) affected by an increase in T_a.

(iii) Increasing the revenue when waiting during asylum application (y_{AA}) increases the value of $V_{CPT}(West)$. In the case of an individual characterized by $\sigma < 1$, the magnitude of this effect is high when p_2 is low and the loss aversion parameter λ is high. When $\sigma > 1$, this effect is high when p_2 is high.

Proof: see Appendix.

Proposition 4.

(i) When $\gamma < 1$, a variation in the conditional probability of success in the asylum application (p_2) has a lower impact on $V_{CPT}(West)$ than if no probability distortions existed, only in cases where the concerned states of Nature are associated with an objective probability lying in a given interval of values (see details in the Appendix). Otherwise, the effect is higher.
However, the impact of a variation in payoffs (e.g. through a variation in y_{AA} or in T_a) crucially depends on the value of the objective probabilities which are associated to them (see details below).

(ii) When $\gamma > 1$, a variation in the conditional probability of success in the asylum application (p_2) has a higher impact on $V_{CPT}(West)$ than if no probability distortions existed, only in cases where the concerned states of Nature are associated with an objective probability lying in a given interval of values (see details in Appendix). Otherwise, the effect is lower.
The impact of a variation in payoffs (e.g. via a variation in y_{AA} or in T_a) crucially depends on the value of the objective probabilities which are associated to them (see details below).

Proposition 3 highlights the pure effect of a variation in payoffs (via a variation in y_{AA} or in T_a), and in their perception (loss aversion parameter λ), independent from any probability distortion. The effect of a variation in λ is trivial, since it only affects one among the two possible alternatives (the second alternative, the safe neighbouring country, being the reference point). Concerning the (pure) effects of variations in y_{AA} or in T_a, we remark that these effects are very similar to those highlighted under EUT: they crucially depend on the concavity/convexity of the value function, here represented by the parameter σ. Individuals with a concave value function (i.e. $\sigma < 1$) exhibit a decreasing marginal valuation of wealth: they are more affected by a variation in wealth when the initial wealth is low than when it is high. So we find again that the higher y_W, the more likely an individual with $\sigma < 1$ will be positively affected by an increase in T_a, which allows him to reduce the number of periods of suffering y_T. This effect is reinforced by the loss aversion parameter λ which is associated to this perspective.
As regards the effect of an increase in y_{AA}, again, this effect always increases the value

of the perspective of going to the West. Increasing y_{AA} implies an increase in the payoff associated with the perspective of not obtaining asylum is highly, and this takes high values for an individual characterized by $\sigma < 1$. As in the case of EUT, this effect is reinforced if p_2 is low but here, under CPT, this effect is even more reinforced if λ is high: to improve wealth in the worst perspectives leads to high values under CPT.

While the effects highlighted by Proposition 3 hold in case of no probability distortions (i.e. $\gamma = 1$), these effects may be distinctly altered by how individuals perceive probabilities. The Proposition 4 underlines the role of the weighting function in the individuals' perceptions of (variations in) other variables. In Point (i), note that in case of $\gamma < 1$, individuals tend to over-estimate low probabilities and to under-estimate high probabilities (inverse S-shaped weighing function). All probabilities tend to be equally perceived (i.e. to all have a weigh of $\frac{1}{n}$, with n the number of states of Nature. This is strictly the case for $\gamma = 0$). Consider as an example the case of objective probabilities which are lower than $\frac{1}{n}$. These probabilities are over-estimated. As a consequence they also lead the associated payoffs to be more weighted in the individuals' valuation functions than if no probability distortions existed. As a result, a variation in these payoffs has a higher impact on individuals than in case of no probability distortion. The opposite reasoning holds for objective probabilities higher than $\frac{1}{n}$, which are under-estimated. For our study under consideration, we have $n = 3$: in case of $\gamma < 1$, any variation in payoffs which are associated with objective probabilities lower than $\frac{1}{3}$ has a higher impact on individuals than if no distortion existed.
In Point (ii), in case of $\gamma > 1$, the weighing function is S-shaped: small objective probabilities are lowered, and high objective probabilities are raised. In the extreme case of $\gamma \to \infty$, all objective probabilities lower than a threshold Z are perceived as zero, and all objective probabilities higher than the threshold Z are perceived as one ; with Z being approximately equal to 0.368 with the Prelec's specification ($\gamma = 1000$). Let us denote by m the number of states of Nature which are associated with an objective probability higher than Z. Because objective probabilities higher than Z are raised and tend to be similar (equal to 1 when $\gamma \to \infty$), the states of Nature (and their payoffs) associated with objective probabilities lower than $\frac{1}{m}$ tend to be over-weighted in the individuals' valuation function, while states with objective probabilities higher than $\frac{1}{m}$ tend to be under-estimated relatively to the no probability distortion case. States associated with objective probabilities lower than Z are under-weighted (and tend to be weighted by zero for $\gamma \to \infty$): a variation in their payoff has low impact on individuals.

About the impact of a variation in the conditional probability of obtaining asylum (p_2) in case of $\gamma > 1$, all the different possible cases are discussed in Appendix. Nevertheless, we can note that when $\gamma < 1$, changing probabilities close to 0 or 1 has a higher impact than when no probability distortion holds (while changing "medium" probabilities has a lower impact). Conversely, when $\gamma > 1$ a variation in "extreme" probabilities (close to 0 or 1) is almost not perceived by an individual, while a variation in "medium" probabilities has a high impact. Hence, for instance, when $\gamma < 1$, tightening the policy of access to asylum (i.e. reducing p_2) has an impact when this policy is already strict, and a low impact when the policy is "lax". The opposite holds when $\gamma > 1$.

The EUT and CPT conditions for migration to a Western country are now introduced, and we have also highlighted the impact of some features of preferences (curvature of value function, loss aversion, probability distortion) on the relative value of each alternative. In what follows, we compare the DM's choice, for a given context, depending on the decision model he considers.

5 Numerical simulations

In this section, we simulate the different versions of the model using, where possible, the data collected in our study.

The numerical calculations aim at comparing choices made under EUT and CPT for a given context, comparing both exponential and hyperbolic discounting models, and to simulate how a change in the context and/or in preferences may affect predicted refugees' migration decisions. We study the sensitivity of the threshold values of refugee migration to the West in order to illustrate the differences between the models, and to pinpoint which variables have a particularly high, or low, effect on refugee migration.

5.1 Baseline

To set a baseline, we calibrate our models with data from different surveys.[36] . As a consequence, we consider the following context variables.

Table 1. Values for simulation

Name of variable	Notation	Unit	Value
Time horizon	T	years	10
Repayment horizon	T_e	years	5
Duration asylum claim	T_A	years	1.5
Discount rate*	r	%	42%
Prob. success migration	p_1	%	0.9
Prob. asylum	p_2	%	0.78
Income in Safe	y_S	euros/year	150
Income after rejection	$y_T = \rho * y_S$	euros/year	0.7*150 = 105
Income in West during asylum claim	y_{AA}	euros/year	1,650
Income in West after asylum	y_W	euros/year	10,000
Cost of trip to West*	C	euros	4,000

The mean cost of trip to West in our sample is 4000 euros, while the probability to succeed in arriving in West and obtaining refugee status $(p_1 * p_2)$ is 0.7[37]. Values are expressed in euros. However, our model allows for payoffs to be both financial and non-financial (such as benefits from not being separated from family, or speaking the language of the country). Since the subjective evaluation of these benefits can vary considerably, we abstract from them in the baseline scenario. The sensitivity analysis below shows the impact of increasing the values of outcomes by non-financial benefits.

We set the following values of preference parameters. They result from the estimations in our study.[38]

[36]The values of the parameters are based on our field study are marked with *

[37]The average acceptance rate for the top 6 countries of origin in Luxembourg was 79% in 2017 and 2018 Q1 (see `http://popstats.unhcr.org/en/asylum_seekers`). For a sensitivity analysis to acceptance rates, see below. For the probability of reaching the destination, see Mbaye (2014).

[38]For the sake of comparison, we assume the EUT risk aversion parameter α to be equal to σ, the utility convexity parameter calculated in the CPT framework.

Table 2. Preferences

Name of variable	Notation	Value
VNM-Utility concavity*	α	0.7
CPT-value concavity*	σ	0.7
CPT loss aversion*	λ	2.2
CPT prob. weighting parameter*	γ	0.9

Figure 5 shows the value of moving to the West (in euros) net of the value of staying in a safe third country according to four different model specifications: Expected Utility versus Cumulative Prospect Theory, combined with exponential time discounting versus hyperbolic time discounting. Here, while all models predict a move to the West (all values are positive for the given parameter values), the four decision models do not provide the same net value of moving to the West compared to staying in a safe third country. The hyperbolic models predict a considerably higher net value of the West than the CPT models. For a given discounting function, the EUT models predict a higher net value of the West than the CPT models.

The net values of moving to the West and staying in a safe third country are sensitive to the parameter values. In what follows, we make a sensitivity analysis by studying the impact of a variation in parameters, *ceteris paribus*. First, for a given context, we make a sensitivity analysis on the preference parameters on the prediction of a type of model. Then we analyse the sensitivity of the migration decision to the parameter values, based on the CPT hyperbolical model. Finally, we provide a sensitivity analysis based on context parameters that can be influenced by policy.

5.2 Preference parameters and choice of model

Figures 6, 7, 8 and 9 show the sensitivity of the net value of migration to the West as a function of the risk and time preference parameters for the different models.

The simulation values are very similar and not very sensitive to values of utility curvature σ for high utility curvature (low values of σ, see Figure 6). Above a threshold value of approx 0.7, the values become very sensitive to variations in σ: the lower the utility curvature, the higher the net value of migration to the West. This relation is exponential. The sensitivity is higher in the models with hyperbolical discounting than in the exponential discounting variant. **Thus, ignoring the hyperbolical form of the discounting function may underestimate the sensitivity of the value of migration to σ for low utility curvature.**

The EUT model does not include loss aversion and probability distortion. Its results are therefore not dependent on these parameter values. Figure 7 shows that the CPT model valuation of migration to the West depends negatively on loss aversion λ. The hyperbolic CPT model shows a greater sensitivity to λ. **Thus, EUT models ignore the effects of loss aversion on the valuation of the West. CPT models with exponential discounting tend to underestimate the effect of loss aversion on migration choices.**

Probability distortion γ also lowers the value of migration to the West. Indeed, Figure 8 shows that for a high level of probability distortion (i.e. a low value of gamma), the net value of migration to the West becomes negative. In other words, the more an individual distorts the probabilities, the lower the value of migrating to the West, and the more attractive staying in the safe country becomes. The hyperbolical discounting model shows a greater sensitivity to probability distortion than the exponential discounting model. **Thus, EUT models ignore the effects of probability distortion on the valuation of the West, and CPT models with exponential discounting tend to underestimate the effect of probability distortion on migration choices.**

Finally, the valuation of migration to the West is also sensitive to discount rate *r*: the higher the discount rate, the lower the net value of the West (Figure 9). This is true for both CPT and EUT models. However, hyperbolic discounting here leads to a lower sensitivity than exponential discounting. **Thus, the use of exponential discounting may lead to an overestimation of the impact of the discount factor on the migration decision.**

5.3 Preference parameters and choice of migration

Based on the findings in section 3, we now retain the CPT model with hyperbolic discounting in order to study the cross effects of the parameter variables on the net value of migration to the West. Figure 10 shows that the sensitivity to sigma is higher the lower the loss aversion, the lower the probability distorsion and the lower the discount rate. The sensitivity of the net value of migration to the West with respect to loss aversion is higher the lower the utility curvature and the lower the discount rate. Sensitivity to probability distortion is higher the lower the utility curvature, the higher the loss aversion and the lower the discount rate.

Generally speaking (and with one exception), the closer the parameter values are to unity, the more sensitively the net value of migration depends on them. We have found in section 3 that refugee parameter values are closer to unity than that of other populations. This finding accentuates the importance of taking the parameter variables into account, the resulting migration decisions depending highly on their values.

5.4 Asylum policy impacts

Consider now the implications of our findings for policy making. Take the stated objectives of securing borders (i.e. preventing access of refugees through channels other than resettlement agreements) and providing protection dignified to "true" refugees: Do policies aiming at decreasing the attraction of the West, at reducing the success of migration and at increasing the appeal of the Safe Country reduce the value of migration especially (or only) for persons who are in lesser need of protection, i.e. who are not "true" refugees, while maintaining the protection of those who need it most?

To answer these questions, we will study to which degree there is self-selection of refugees into groups who migrate to the West (i.e. whose net value of further migration is positive) and groups who do not migrate, on the basis of their risk and time preferences. If traumatic experiences correlate to the validity of an asylum claim, the results in Section 3.3 indicate that persons who are more likely to have a valid claim to asylum also have higher utility curvature and higher loss aversion than others. As a consequence, we will study the effects of policies on the net value of migration as a function of utility curvature and loss aversion.

5.4.1 Policies impacting life in the West

Figure 11 shows that while an increase in expected income once one is a recognized refugee does increase the attraction of migrating to the West, this effect is negligible for persons who do not have very low utility curvature. This implies that "true" refugees, i.e. **persons who have experienced a trauma, are less sensitive to living conditions after the obtention of the refugee status than persons who have not experienced trauma**. Further, because these earnings are so far in the future and therefore discounted, one must be careful **not to overstate the overall "pull" effect of refugee income**. The same is true for income during the asylum claim.[39] Note that e**xpulsion of rejected asylum seekers has an indiscernable impact on the migration decision**, independent of utility curvature and loss aversion and therefore of trauma (Figures 19 and 20.

What about the selection and discouragement effects of other aspects of refugee migration that can be influenced by policies ? The appeal of asylum could be reduced by reducing the probability of a successful asylum claim (p_2), and by reducing the value of the outcome 'expulsion' (i.e., reducing ρ). **Persons with high loss aversion (for example persons who have experienced psychological trauma) are more sensitive to (i.e. they are more likely to be discouraged by) a reduction in the probability of obtaining asylum status and a reduction in the expulsion conditions.**[40]

Persons who have little utility curvature (i.e. high σ) are expecially sensitive to the probability of obtaining the refugee status. In this respect, r**educing the probability of refugee status impacts "true" refugees less than others, on the condition that they are not too loss averse**.[41]

5.4.2 Policies on the migration process

In our model, we distinguish two variables that have an effect on the migration process : p_1 is the probability of successful migration, and C represents the migration costs. Both can be indirectly influenced by policies. Indeed, by cooperating with third country border guards and by influencing the work of rescue boats, destination countries are able to impact the probability of migration success. More generally, measures securing borders make access to the West more difficult, and therefore more expensive.

Our simulations show that reducing the probability of migration success has an impact only on persons with low utility curvature (high levels of σ, see Figure 21), in that it decreases the higher net value they have for migrating. The migration value of persons with high utility curvature (low σ) are not impacted. Thus, the impact of the probability of migration success p_1 on the migration decision of traumatized persons is lower than that for other persons, although the migration success rate is reduced for both.

There may however be a certain degree of self-selection according to loss aversion (Figure 22): the higher the loss aversion, the higher the necessary probability of migration success for a positive net value of migration. The costs of migration, i.e. the amount of fees charged by traffickers, have a higher deterrent effect on persons who

[39]See Figures 13 and 14. Increased loss aversion decreases the value of income with refugee status very little (Figure 12).

[40]See Figures 17 and 18.

[41]See Figures 19 and 20.

have higher levels of loss aversion and higher utility curvature (lower levels of σ, Figures 23 and 24).

In summary, these results imply that policies making the migration process more difficult, if they have any effect at all, may deter more traumatized persons from migration than others.

5.4.3 Policies with effect on life in Safe Country

So far, we can conclude that most policies aiming at conditions in the destination and the migration process, when they have an effect, act as higher deterrents to traumatized persons than to others. The picture is slightly different when regarding the effects of policies that aim to increase the living conditions in Safe Countries (see Figures 25 and 26), such as the ESSN cards.[42]

We find that an increase in income in the Safe oountry y_s decreases the the net value of migration for all levels of utility curvature and loss aversion. The decrease is stronger for persons with lower utility convexity, indicating that the migration deterrent effect of an increase in Safe Country income is lower for traumatized persons than for others. As a consequence, **unlike the previous policies, the self-selection based on utility curvature does not deter "true" refugees more than others from migrating**. However, this is not true with respect to loss aversion: persons with higher loss aversion are more sensitive to changes is Safe Country income than others.

5.4.4 Illustration of self-selection on the basis of risk parameters

In order to illustrate the difference of the effects of asylum policies on individuals, let us study the net value of migration for two individuals from our experiment. Individual 45 in our database is a 41 year old Iraqi married father who migrated without a visa over 30 days to reach Luxembourg, who lost someone close during the war and had other traumatic experiences. He left his Iraq because of political or religious problems. Person 45 has relatively low utility curvature ($\sigma = 0.8$), high probability distortion ($\gamma = 0.2$) and high loss aversion ($\lambda = 7$).

Figure 28 shows that Person 45's net value of migration, if he were still in a Safe Country other than in the West, would depend both on the probability of migration success p_1 and on the income in the Safe Country y_s. The relative values of these variable would make migration worthwhile or not. As expected, the higher the Safe Country income, the lower the net value of migration. Also, the higher the probability of migration success, the higher the net value of migration. Further, the higher the income in the Safe Country, the higher the impact of the probability of succes on the net value of migration. Conversely, the lower the probability of migration success, the higher the impact of a change in the Safe Country income. Note that when the Safe Country income is equal to zero, the net value of migration is positive for any probability of migration success superior to 0.

In other words, if living conditions in the safe country are sufficiently bad, the probability of successful migration has no impact on the decision of person 45 to migrate to the West. An increase in living conditions in the Safe Country would

[42] Emergency Social Safety net (ENNS) debit cards provide refugees in Turkey with a monthly amount of money with which to cover their needs, such as food, fuel, rent, medicine and bills. It is funded by the European Union. See `https://www.essncard.com/about-card/`.

make it preferable to stay there, expect if the probability of migration success was high.

Now compare the net value of migration between persons 45 to person 164. Person 164, born in 1962, is married with children, migrated without a visa for 90 days to reach Luxembourg and flee civil insecurity in Syria. He has also lost someone close in the war, as well as other traumatic experiences. Person 164 has higher utility curvature (lower σ) than Person 45. Thus, for Person 164, the net value of migration becomes positive only when the future gains are extremely high, whereas for Person 45 these future gains render migration worth while from quite a low yearly income. ***Ceteris paribus*****, the sensitivity to, and impact of, a change in income of refugees in the West are therefore very different for these two profiles**.

6 Conclusion

In conclusion, we find that Expected Utility Theory, though the standard model used in the literature, is not as well adapted to modelling refugee choices as Cumulative Prospect Theory. Our study provides evidence that refugees show loss aversion, probability distortion and utility concavity, compatible with Cumulative Prospect Theory. An estimation of subjects' discount rate suggests hyperbolical discounting.

The estimated parameter values are within the expected intervals. However, compared to other populations, refugees' utility functions are less marginally decreasing, they exhibit a lower loss aversion and are more objective when taking probabilities into account.

Utility concavity is increased for women, persons who lived abroad prior to fleeing, for persons who suffer psychological trauma before fleeing and for those who scored high for cognitive reflection. It is decreased for persons who are from Iraq, and who had worked before fleeing. We find significant differences between women and men (women are more risk averse) and between persons who had arrived in Luxembourg within the last year as opposed to those whose flight was more distant : the more recent cohort is shown to be more risk averse. **Loss aversion** is shown to increase in age, and it is higher when someone has suffered psychological trauma before fleeing. Persons who attended madrases were less loss averse. In the separate study of subsamples, it emerges that women are more loss averse than men and that loss aversion is higher for persons whose migration lasted longer than one day. **Probability distortion** is reduced for persons who attended a madrase and increased for persons who remember something sad just before the experiment. Legal migrants and women distort probability less than persons who travelled without a visa and men. **Traumatic experiences** increase utility concavity and loss aversion. They have only a short-term effect on probability distortion.

We further propose **theoretical models** of refugee migration to the West based on Expected Utility Theory and Cumulative Prospect Theory respectively, to which both exponential and hyperbolical time discounting are applied. We show that the value of migrating to the West is sensitive to risk and time parameter values, leading to differences in prediction between Expected Utility Theory and Cumulative Prospect Theory models. Ignoring the hyperbolical form of the discounting function may lead an underestimation of the sensitivity of the value of migrating to the West to all three risk parameters and the discount factor.

Our **simulations** predict some self-selection of refugees, influenced by asylum policies. Thus, there is generally a higher deterrent effect on migration to the West of policies on persons who were traumatized, because they tend to have higher utility concavity and higher loss aversion. Only aid to refugees in a safe third country does not deter "true" refugees more than others. However, for certain risk profiles and within boundaries, there is no deterrence effect from the difference asylum policies.

W**hich lessons can one take for policy making?** First of all, refugees take their decisions differently from other populations. Our study suggests that policy makers cannot deduce refugees' choices from their own preferences. In practice, this means that coercive measures such as the expulsion of unsuccessful asylum claimants may have a negligible discouraging effect on refugees.

In order to evaluate the consequences of policies, to avoid unintended consequences, and to further the protection of "true" refugees, policy makers need to test policies with appropriate models. Indeed, policies may, or may not, succeed in deterring more refugees from travelling to the West illegally. Their effects are not intuitive, but depend on the interaction of a number of factors influencing persons who perceive and value them according to individually different characteristics.

Further, rather than concentrate on numbers, policy makers should pay special attention to the self-selection process that their policies generate. Even if policies have the desired quantitative effects, instead of discouraging persons who do not have a valid claim to asylum from migrating, the reduction in numbers may well mean that it is especially ”true” refugees renounce migration.

Finally, our paper suggests that only one type of measure will enable policy makers to both secure borders and reduce the self-selection of ”true” refugees out of migrating to the West: increasing living conditions in the Safe Country makes migration to the West less valuable to all risk profiles. The marginal effect of such measures is highest for persons with high loss aversion. Western destinations may therefore be well advised to expand programms increasing the living conditions for refugees in Safe Third Countries.

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Appendices

A Tables

Table 1: Descriptive statistics of covariates

	Description	Mean	Std. Dev.
Age%	Age (in years)	33.70	9.59
Sex %	Dummy if female	0.26	0.46
Married %	Marital Status	0.55	0.50
Number of children	how many children do you have	1.62	1.99
Muslim	of muslim religion	0.84	0.36
Iraq	country of birth==Iraq	0.22	0.41
Syria	country of birth==Syria	0.58	0.50
Other Country	country of birth==other	0.30	0.46
Migration duration	years since flee the country	2.84	4.18
Primary	Primary education	0.12	0.32
Secondary	Secondary education	0.50	0.50
College (University)	College or University	0.35	0.48
Other education	Other education	0.02	0.13
Ever worked	Ever worked	0.50	0.50
No income	income_range== 0.0000euros	0.28	0.45
Income Range (less than 200)	income_range==less than 200 euros	0.05	0.21
Income Range (200-400)	income_range==200-400 euros	0.12	0.32
Income Range (400-600)	income_range==400-600 euros	0.21	0.41
Income Range (over 600)	income_range==over 600 euros	0.34	0.47
Lived abroad	have you lived in other countries	0.51	0.50
Emotional State (worse)%	After arriving in Luxembourg	0.19	0.40
Trauma (journey)	Lose someone close during journey	0.34	0.47
Trauma (family)	Lose someone close to you during the war	0.80	0.40
Ever experienced a trauma	Experienced other trauma during your life	0.64	0.48
Visa	How did you reach Luxembourg	0.14	0.02
Year of arrival	When did you arrive in Luxembourg	2006	0.06
Duration of migration (days)	How long did your journey from outside the EU take (in days)	37.39	5.86
Nb. of obs.		218	

Table 2: Tables for TCN game

SERIES 1	Option A: 3 pink + 7 blue	Option B: 1 pink + 9 blue	Exp. payoff difference (A-B)
1	40 ecu if pink or 10 ecu if blue	68 ecu if pink or 5 ecu if blue	7.7
2	40 ecu if pink or 10 ecu if blue	75 ecu if pink or 5 ecu if blue	7
3	40 ecu if pink or 10 ecu if blue	83 ecu if pink or 5 ecu if blue	6.2
4	40 ecu if pink or 10 ecu if blue	93 ecu if pink or 5 ecu if blue	5.2
5	40 ecu if pink or 10 ecu if blue	106 ecu if pink or 5 ecu if blue	3.9
6	40 ecu if pink or 10 ecu if blue	125 ecu if pink or 5 ecu if blue	2
7	40 ecu if pink or 10 ecu if blue	150 ecu if pink or 5 ecu if blue	-0.5
8	40 ecu if pink or 10 ecu if blue	185 ecu if pink or 5 ecu if blue	-4
9	40 ecu if pink or 10 ecu if blue	220 ecu if pink or 5 ecu if blue	-7.5
10	40 ecu if pink or 10 ecu if blue	300 ecu if pink or 5 ecu if blue	-15.5
11	40 ecu if pink or 10 ecu if blue	400 ecu if pink or 5 ecu if blue	-25.5
12	40 ecu if pink or 10 ecu if blue	600 ecu if pink or 5 ecu if blue	-45.5
13	40 ecu if pink or 10 ecu if blue	1,000 ecu if pink or 5 ecu if blue	-85.5
14	40 ecu if pink or 10 ecu if blue	1,700 ecu if pink or 5 ecu if blue	-155.5
SERIES 2	**Option A: 9 pink + 1 blue**	**Option B: 7 pink + 3 blue**	**Exp. payoff difference (A-B)**
15	40 ecu if pink or 30 ecu if blue	54 ecu if pink or 5 ecu if blue	-0.3
16	40 ecu if pink or 30 ecu if blue	56 ecu if pink or 5 ecu if blue	-1.7
17	40 ecu if pink or 30 ecu if blue	58 ecu if pink or 5 ecu if blue	-3.1
18	40 ecu if pink or 30 ecu if blue	60 ecu if pink or 5 ecu if blue	-4.5
19	40 ecu if pink or 30 ecu if blue	62 ecu if pink or 5 ecu if blue	-5.9
20	40 ecu if pink or 30 ecu if blue	65 ecu if pink or 5 ecu if blue	-8
21	40 ecu if pink or 30 ecu if blue	68 ecu if pink or 5 ecu if blue	-10.1
22	40 ecu if pink or 30 ecu if blue	72 ecu if pink or 5 ecu if blue	-12.9
23	40 ecu if pink or 30 ecu if blue	77 ecu if pink or 5 ecu if blue	-16.4
24	40 ecu if pink or 30 ecu if blue	83 ecu if pink or 5 ecu if blue	-20.6
25	40 ecu if pink or 30 ecu if blue	90 ecu if pink or 5 ecu if blue	-25.5
26	40 ecu if pink or 30 ecu if blue	100 ecu if pink or 5 ecu if blue	-32.5
27	40 ecu if pink or 30 ecu if blue	110 ecu if pink or 5 ecu if blue	-39.5
28	40 ecu if pink or 30 ecu if blue	130 ecu if pink or 5 ecu if blue	-53.5
SERIES 3	**Option A: 5 pink + 5 blue**	**Option B: 5 pink + 5 blue**	
29	receive 25 ecu if pink or lose 4 ecu if blue	receive 30 ecu if pink or lose 21 ecu if blue	6
30	receive 4 ecu if pink or lose 4 ecu if blue	receive 30 ecu if pink or lose 21 ecu if blue	-4.5
31	receive 1 ecu if pink or lose 4 ecu if blue	receive 30 ecu if pink or lose 21 ecu if blue	-6
32	receive 1 ecu if pink or lose 4 ecu if blue	receive 30 ecu if pink or lose 16 ecu if blue	-8.5
33	receive 1 ecu if pink or lose 8 ecu if blue	receive 30 ecu if pink or lose 16 ecu if blue	-10.5
34	receive 1 ecu if pink or lose 8 ecu if blue	receive 30 ecu if pink or lose 14 ecu if blue	-11.5
35	receive 1 ecu if pink or lose 8 ecu if blue	receive 30 ecu if pink or lose 11 ecu if blue	-13

Notes: 10 ecu = 1 euro; Table adapted from Tanaka *et al.* (2010); baseline treatment DEL0ASC.

Table 3: Statistics of questions on trauma

Description	Number of answers	Percentage of answers
Total number of answers to all questions on trauma	177	81 % of 218 subjects
Number of ″yes″: ″Did you lose someone close to you during your journey to Luxembourg″	58	33 %
Number of ″yes″: ″Did you lose someone close to you during the war in your home country″	139	79 %
Number of ″yes″: ″Did you have any other traumatic experience during the war″	112	63 %
Number of ″yes″ to at least one question on trauma	177	100 %
Number of ″yes″ to one question on trauma	42	24 %
Number of ″yes″ to two questions on trauma	72	41 %
Number of ″yes″ to three questions on trauma	41	23 %

Table 4: Calculation of CPT parameters using the interval approach

	Baseline			
	Mean	Std. Err.	95% Conf. Int.	Wald test: parameter=1
sigma	0.702***	0.033	0.638,0.766	0.000***
lambda	2.210***	0.180	1.856,2.564	0.000***
gamma	0.941***	0.024	0.893,0.988	0.015***
Nb. of obs.	217			

For Wald tests, the number displayed is the p-value.
* p<0.1, ** p<0.05, *** p<0.01

Table 5: Tables for Time Preferences game

SERIES 1	Option A: Payment Today	Option B: Payment In 6 Months
1	500 EUR	512,35 EUR
2	500 EUR	524,40 EUR
3	500 EUR	536,19 EUR
4	500 EUR	547,72 EUR
5	500 EUR	559,02 EUR
6	500 EUR	570,09 EUR
7	500 EUR	580,95 EUR
8	500 EUR	591,61 EUR
9	500 EUR	601,08 EUR
10	500 EUR	612,37 EUR
SERIES 2	**Option A: Payment in 1 Month**	**Option B: Payment in 7 Months**
11	500 EUR	512,35 EUR
12	500 EUR	524,40 EUR
13	500 EUR	536,19 EUR
14	500 EUR	547,72 EUR
15	500 EUR	559,02 EUR
16	500 EUR	570,09 EUR
17	500 EUR	580,95 EUR
18	500 EUR	591,61 EUR
19	500 EUR	601,08 EUR
20	500 EUR	612,37 EUR

Notes: Hypothetical values were given in Euro terms

Table 6: Time Preferences Estimation

Discount Rate	Coef.	SE
i_1	0.449	0.006
i_2	0.424	0.010
Test $(i_1 - i_2 = 0)$		
Mean	0.024	0.006
$p.value = 0.003$		

Notes: i_1 Mean annual interest rate in series 1, i_2 Mean annual interest rate in series 2

Table 7: Regression of **sigma** on several sets of covariates-Baseline

Covariate	(1) Coef.	Std. Err.	(2) Coef.	Std. Err.	(3) Coef.	Std. Err.	(4) Coef.	Std. Err.
Constant	0.702***	(0.033)	0.949***	(0.344)	0.725***	(0.062)	0.983***	(0.366)
Age (in years)			-0.006	(0.006)			-0.006	(0.006)
Female			-0.180*	(0.107)			-0.187*	(0.111)
Married			-0.057	(0.103)			-0.058	(0.104)
Number of Children			0.029	(0.029)			0.031	(0.030)
Muslim			-0.035	(0.112)			-0.037	(0.113)
Iraq			0.302**	(0.137)			0.300**	(0.138)
Syria			0.074	(0.104)			0.074	(0.105)
Years since flee the country			-0.015	(0.015)			-0.015	(0.015)
Primary education			0.047	(0.219)			0.047	(0.231)
Secondary level=1			0.025	(0.221)			0.021	(0.232)
College or University			0.115	(0.223)			0.118	(0.233)
Other education			0.728***	(0.269)			0.738***	(0.280)
Ever Worked			0.312***	(0.096)			0.309***	(0.097)
No income			0.219	(0.156)			0.223	(0.157)
Income Range (less than 200)			0.193	(0.217)			0.186	(0.222)
Income Range (200-400)			0.011	(0.132)			0.003	(0.132)
Income Range (400-600)			0.097	(0.115)			0.101	(0.116)
Have lived abroad before			-0.206***	(0.075)			-0.206***	(0.076)
Emotional state worse after journey			-0.007	(0.098)			-0.004	(0.101)
Trauma during journey			-0.021	(0.082)			-0.015	(0.086)
Trauma losing someone close in war			-0.291***	(0.101)			-0.287***	(0.103)
Experience a trauma			-0.036	(0.082)			-0.042	(0.083)
2. Sad frame					-0.021	(0.078)	-0.036	(0.092)
3. Happy frame					-0.050	(0.090)	-0.040	(0.108)
Model R-squared	0.000		0.270		0.001		0.271	
Nb. of obs. /clusters	217/217		167/167		217/217		167/167	
Specific Wald tests on estimated coefficients (p-values)								
Constant=1	0.000							

*, ** and *** stand for significance at the 10, 5 and 1% level respectively.
Reference category for education is no education; for income ranges is income over 600; for country is other country.
For the Life Experience reference is Neutral Emotions
All monetary terms are in Euros.

Table 8: Regression of **lambda** on several sets of covariates-Baseline

Covariate	(1) Coef.	Std. Err.	(2) Coef.	Std. Err.	(3) Coef.	Std. Err.	(4) Coef.	Std. Err.
Constant	2.210***	(0.180)	0.896	(2.183)	2.049***	(0.346)	1.244	(2.260)
Age (in years)			0.074**	(0.036)			0.072*	(0.037)
Female			0.130	(0.626)			0.067	(0.657)
Married			0.175	(0.595)			0.161	(0.597)
Number of children			0.071	(0.187)			0.091	(0.194)
Muslim			-0.766	(0.738)			-0.782	(0.739)
Iraq			0.847	(0.930)			0.827	(0.940)
Syria			0.468	(0.549)			0.473	(0.563)
Years since flee the country			0.032	(0.095)			0.030	(0.098)
Primary education			-1.025	(1.538)			-1.047	(1.585)
Secondary education			-1.148	(1.457)			-1.206	(1.513)
College or University			-0.956	(1.443)			-0.956	(1.494)
Other education			-2.849*	(1.722)			-2.774	(1.764)
Ever worked			-0.513	(0.536)			-0.539	(0.543)
No income			-0.140	(0.905)			-0.107	(0.914)
Income Range (less than 200)			-0.968	(1.015)			-1.025	(1.047)
Income Range (200-400)			-0.706	(0.740)			-0.787	(0.764)
Income Range (400-600)			-0.233	(0.665)			-0.198	(0.676)
Have lived abroad before			-0.698	(0.440)			-0.691	(0.439)
Emotional state worse after journey			-0.020	(0.599)			0.005	(0.604)
Trauma during journey			0.255	(0.483)			0.309	(0.495)
Trauma losing someone close in war			1.480***	(0.546)			1.521***	(0.571)
Experience a trauma			-0.796	(0.527)			-0.851	(0.531)
2. Sad frame					0.146	(0.434)	-0.344	(0.602)
3. Happy frame					0.358	(0.496)	-0.340	(0.696)
Model R-squared	0.000		0.237		0.002		0.240	
Nb. of obs. /clusters	217/217		167/167		217/217		167/167	
Specific Wald tests on estimated coefficients (p-values)								
Constant=1	0.000							

*, ** and *** stand for significance at the 10, 5 and 1% level respectively.
Reference category for education is no education; for income ranges is income over 600; for country is other country.
For the Life Experience reference is Neutral Emotions
All monetary terms are in Euros.

Table 9: Regression of **gamma** on several sets of covariates-Baseline

Covariate	(1) Coef.	Std. Err.	(2) Coef.	Std. Err.	(3) Coef.	Std. Err.	(4) Coef.	Std. Err.
Constant	0.941***	(0.024)	1.141***	(0.284)	0.876***	(0.048)	1.034***	(0.295)
Age (in years)			-0.003	(0.004)			-0.002	(0.004)
Female			0.002	(0.085)			0.015	(0.088)
Married			0.008	(0.075)			0.013	(0.075)
Number of Children			0.016	(0.019)			0.013	(0.019)
Muslim			0.020	(0.090)			0.019	(0.089)
Iraq			-0.056	(0.110)			-0.055	(0.109)
Syria			0.020	(0.088)			0.016	(0.088)
Years since flee the country			-0.007	(0.008)			-0.007	(0.008)
Primary education			-0.216	(0.201)			-0.182	(0.204)
Secondary education			-0.180	(0.192)			-0.135	(0.198)
College or University			-0.206	(0.198)			-0.170	(0.204)
Other education			-0.565**	(0.228)			-0.540**	(0.229)
Ever Worked			-0.105	(0.072)			-0.104	(0.072)
No income			0.073	(0.128)			0.077	(0.127)
Income Range (less than 200)			-0.140	(0.134)			-0.143	(0.132)
Income Range (200-400)			-0.024	(0.090)			-0.010	(0.089)
Income Range (400-600)			0.066	(0.091)			0.062	(0.091)
Have lived abroad before			0.084	(0.064)			0.078	(0.064)
Emotional state worse after journey			0.127	(0.085)			0.139	(0.088)
Trauma during journey			-0.018	(0.069)			-0.015	(0.071)
Trauma losing someone close in war			0.043	(0.079)			0.036	(0.081)
Experience a trauma			0.032	(0.063)			0.040	(0.066)
2. Sad frame					0.106*	(0.059)	0.067	(0.074)
3. Happy frame					0.057	(0.066)	0.001	(0.085)
Model R-squared	0.000		0.151		0.016		0.159	
Nb. of obs. /clusters	217/217		167/167		217/217		167/167	
Specific Wald tests on estimated coefficients (p-values)								
Constant=1	0.000							

*, ** and *** stand for significance at the 10, 5 and 1% level respectively.
Reference category for education is no education; for income ranges is income over 600; for country is other country.
For the Life Experience reference is Neutral Emotions
All monetary terms are in Euros.

Table 10: Mean Value test of the parameters with the other studies

		(1)	(2)	(3)
Parameters		Farmers	Students	Refugees
sigma		0.540	0.646	0.702
lambda		3.523	2.456	2.210
gamma		0.671	0.636	0.941
Observations		107	191	217
Two-tailed Mann Whitney test : z statistics				
sigma	Farmer vs Refugees	2.774*		
sigma	Students vs Refugees	-0.825		
lambda	Farmer vs Refugees	-4.934***		
lambda	Students vs Refugees	-1.453		
gamma	Farmer vs Refugees	3.583***		
gamma	Students vs Refugees	6.170***		

* p<0.1, ** p<0.05, *** p<0.01

B Graphs

Figure 5: Simulation of the net euro value of West with different models

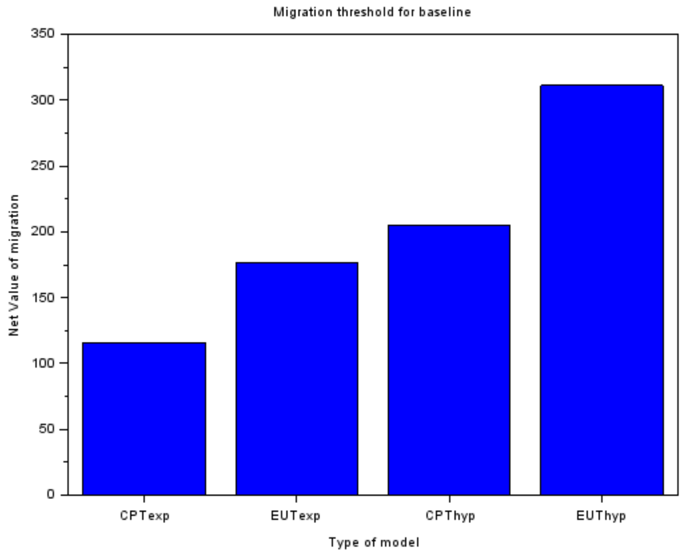


Figure 6: Simulation of the net euro value of West with different models as a function of utility curvature

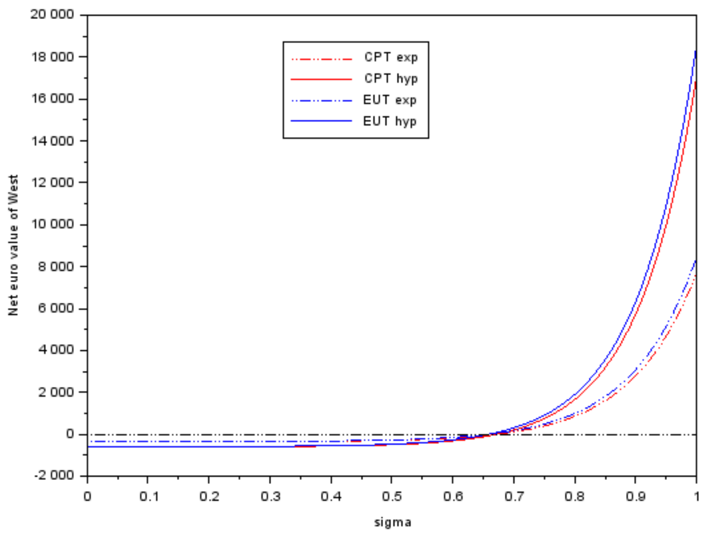


Figure 7: Simulation of the net euro value of West with different models as a function of loss aversion

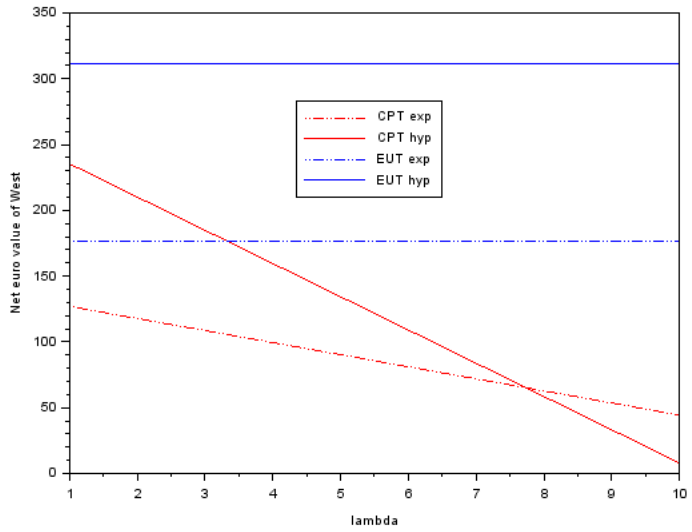


Figure 8: Simulation of the net euro value of West with different models as a function of probability distortion

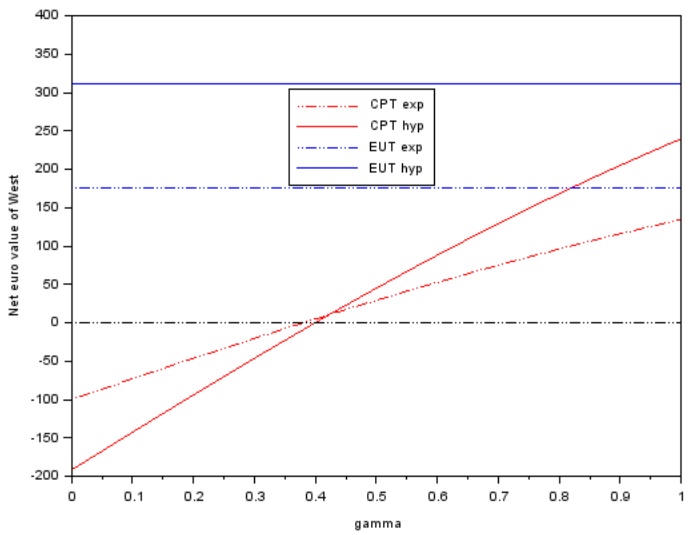


Figure 9: Simulation of the net euro value of West with different models as a function of the discount rate

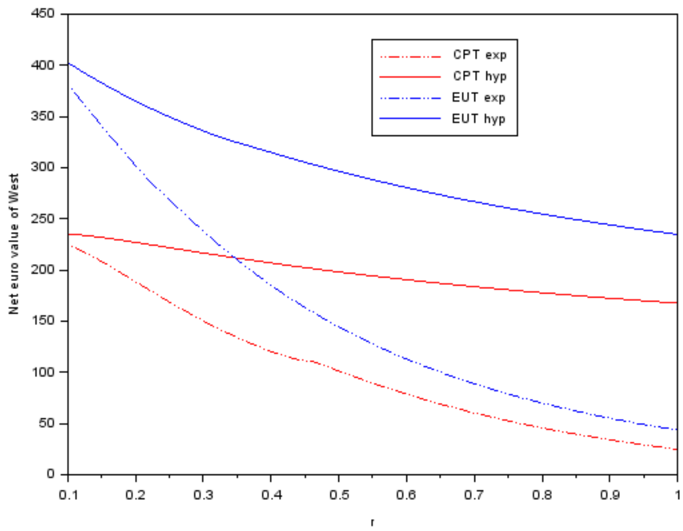


Figure 10: Simulation of the CPT hyperbolic net euro value of West as a function of utility curvature and loss aversion

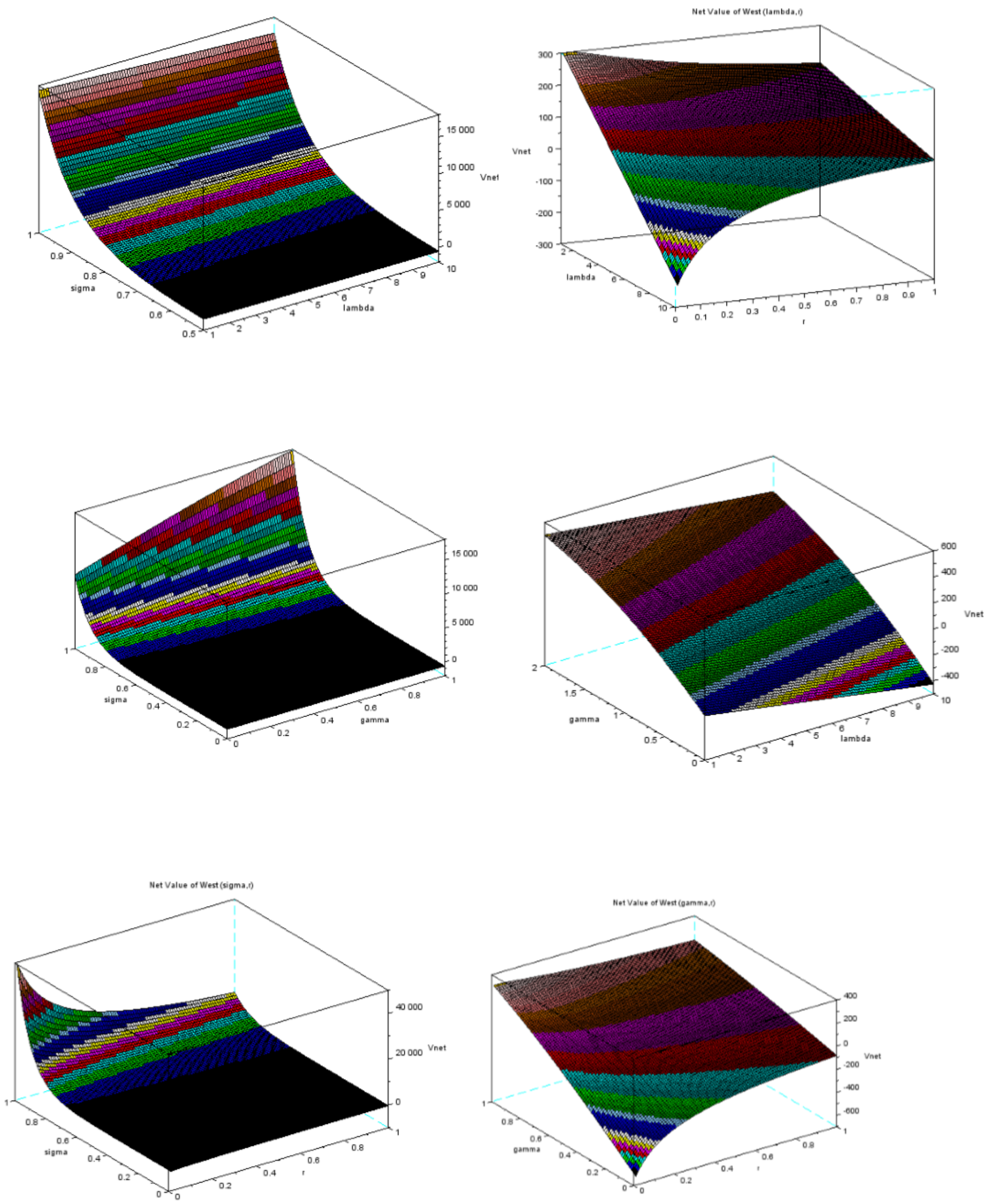


Figure 11: Effect of Income after Refugee Status obtention of net value of migration as function of utility curvature

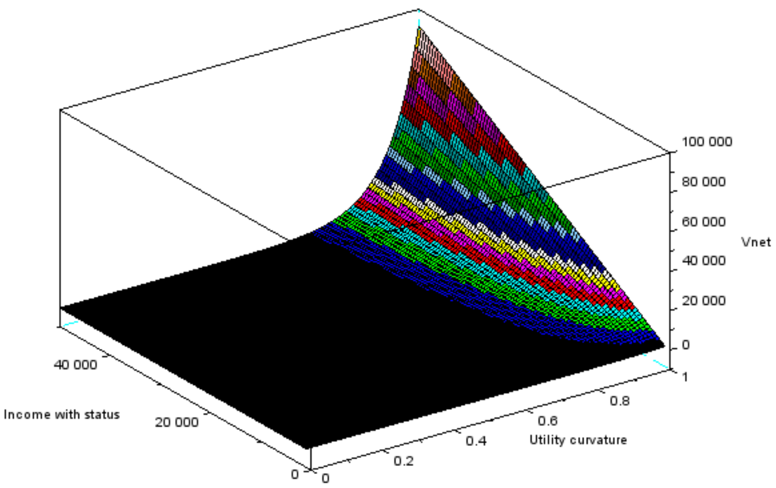
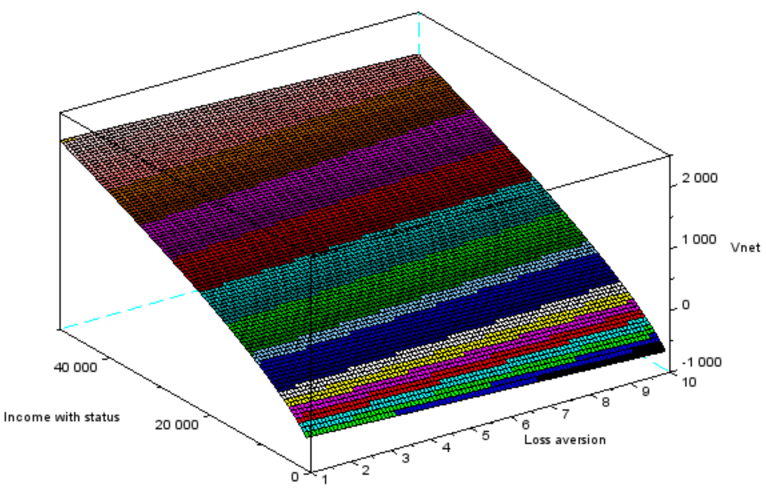
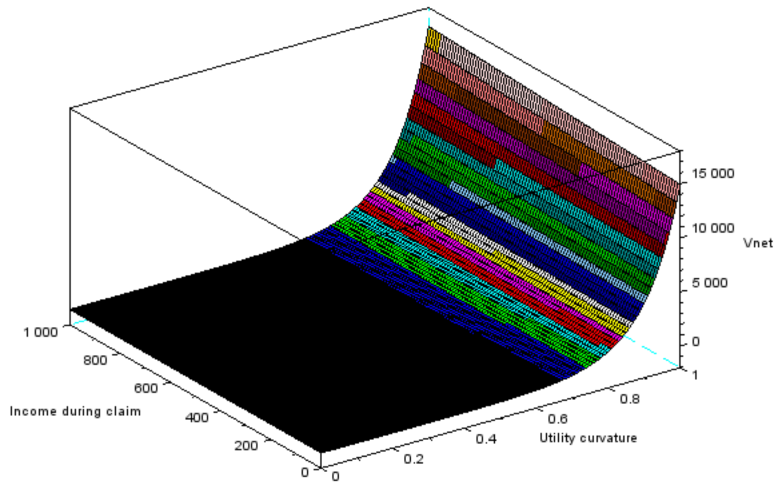


Figure 12: Effect of Income after Refugee Status obtention on net value of migration as function of Loss Aversion



Loss Aversion increases in the value of λ. Income after Refugee Status corresponds to the value of the variable y_w. Read: The Net Value of Migration increases in Income after Refugee status y_w and decreases in Loss Aversion λ.

Figure 13: Effect of Income during Asylum procedure on Net Value of Migration as function of Utility Curvature



Utility Curvature decreases in the value of σ: the higher the value of sigma, the more high outcomes are valued. Income after Refugee Status corresponds to the value of the variable y_{aa}. Read: The Net Value of Migration increases slightly in Income During Claim y_{aa} for high values of σ (low Utility Curvature) and increases in σ (as Utility Curvature decreases).

Figure 14: Effect of Income during Asylum procedure on Net Value of Migration as function of Loss Aversion

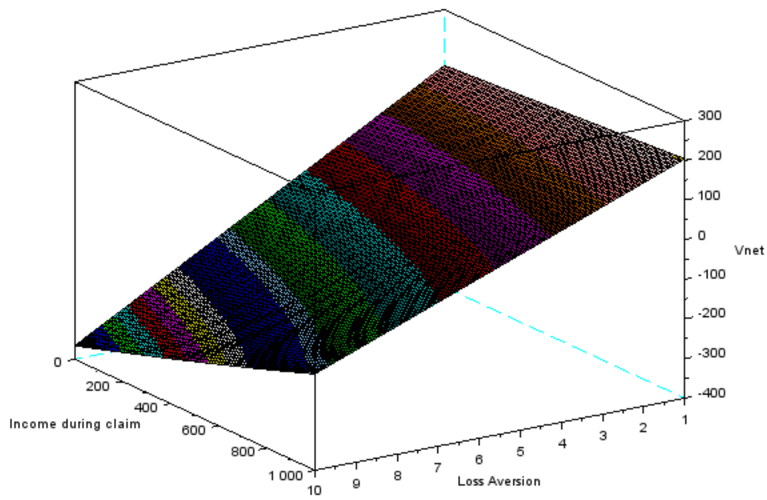


Figure 15: Effect of Expulsion Scenario on Net Value of Migration as function of Utility Curvature

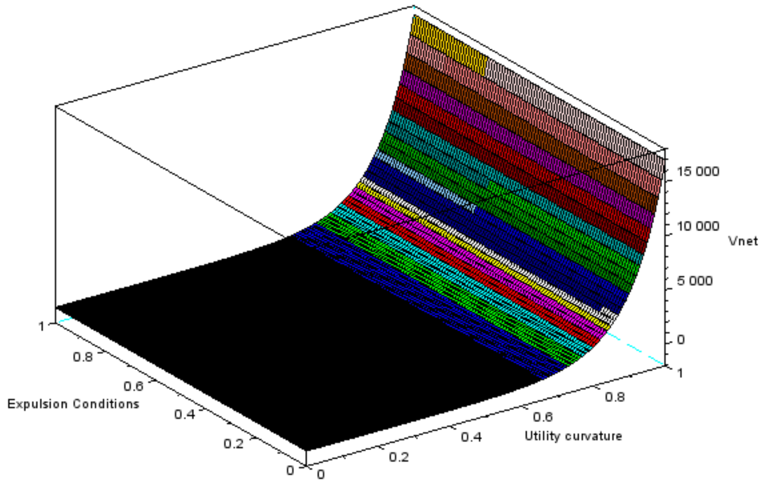


Figure 16: Effect of Expulsion Scenario on Net Value of Migration as function of Loss Aversion

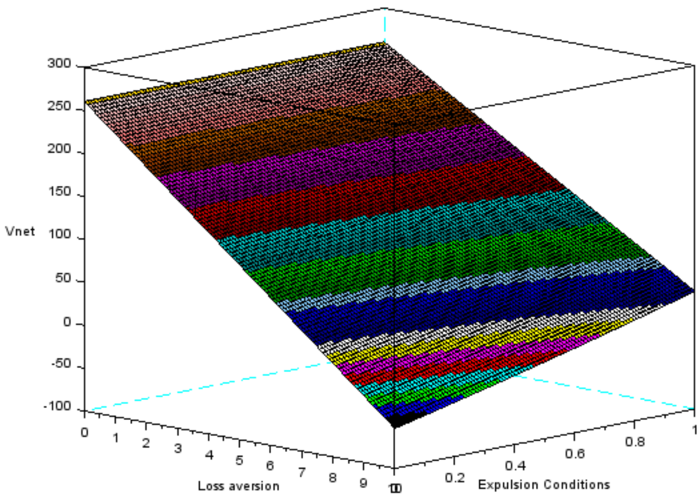


Figure 17: Effect of Probability of Refugee Status on Net Value of Migration as function of Utility Curvature

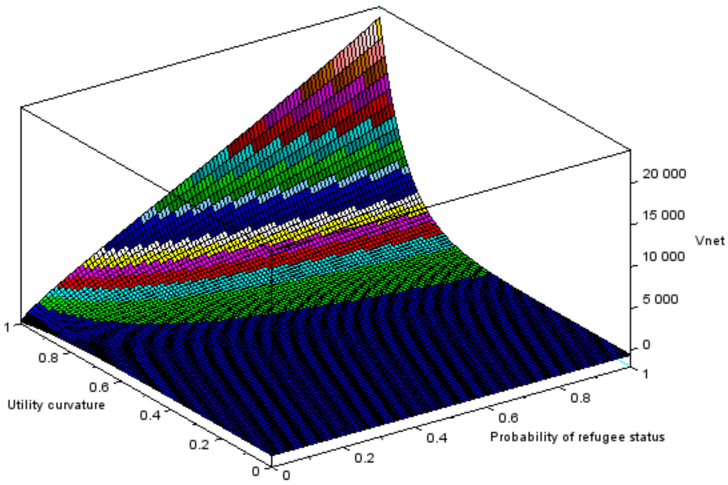


Figure 18: Effect of Probability of Refugee Status on Net Value of Migration as function of Loss Aversion

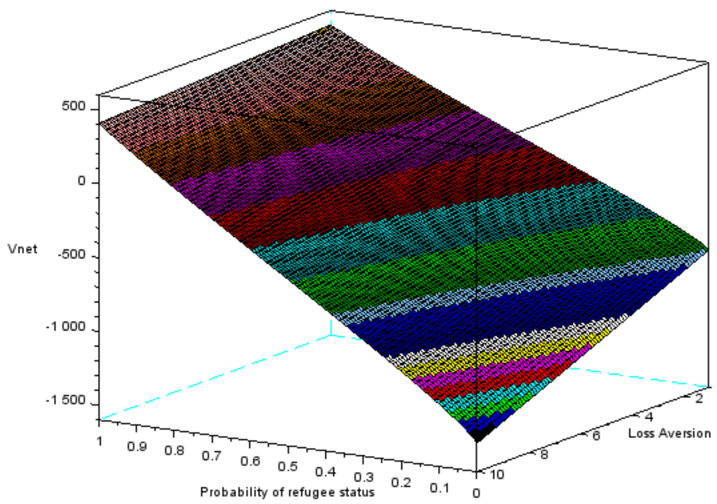


Figure 19: Effect of Expulsion Outcome on Net Value of Migration as function of Utility Curvature

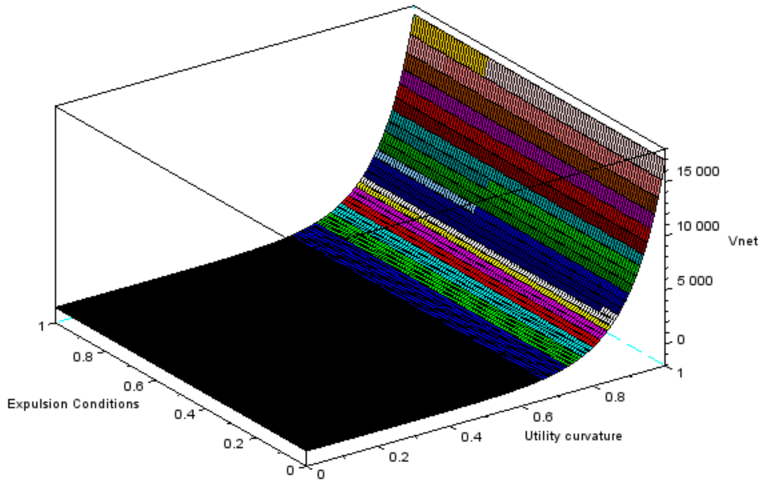


Figure 20: Effect of Expulsion Outcome on Net Value of Migration as function of Loss Aversion

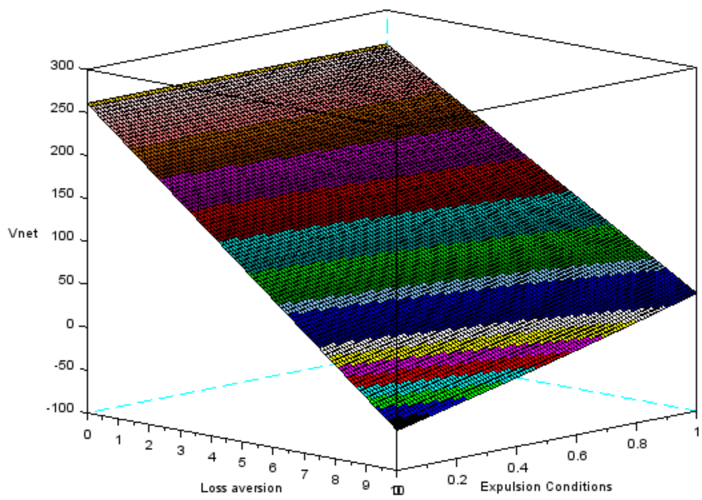


Figure 21: Effect of Probability of migration success on Net Value of Migration as function of Utility Curvature

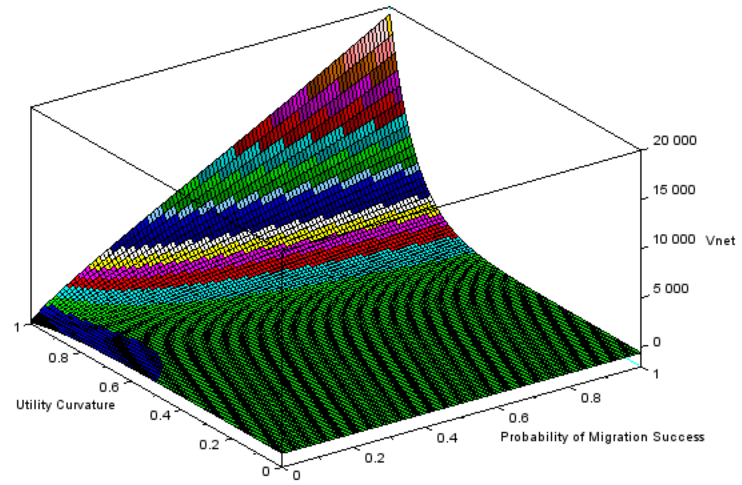


Figure 22: Effect of Probability of migration success on Net Value of Migration as function of Loss Aversion

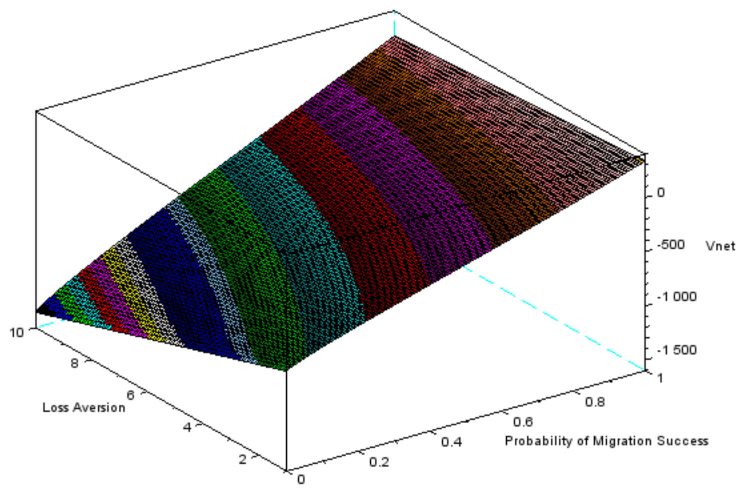


Figure 23: Effect of Migration Cost on Net Value of Migration as function of Utility Curvature

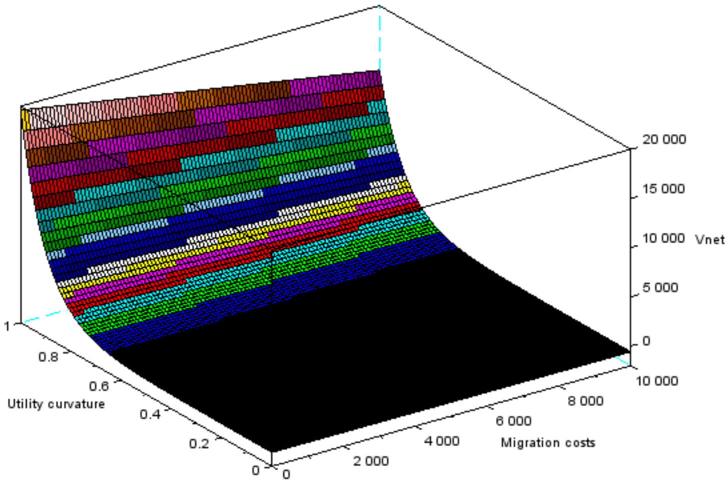


Figure 24: Effect of Migration Cost on Net Value of Migration as function of Loss Aversion

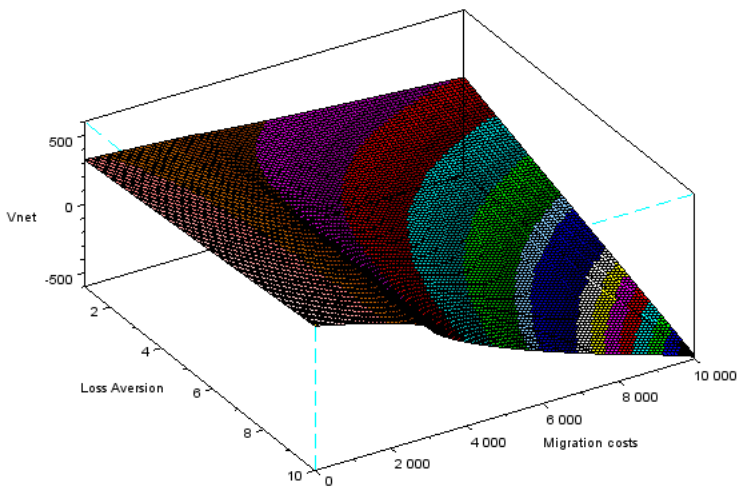


Figure 25: Effect of Living Conditions in Safe Country on Net Value of Migration as function of Utility Curvature

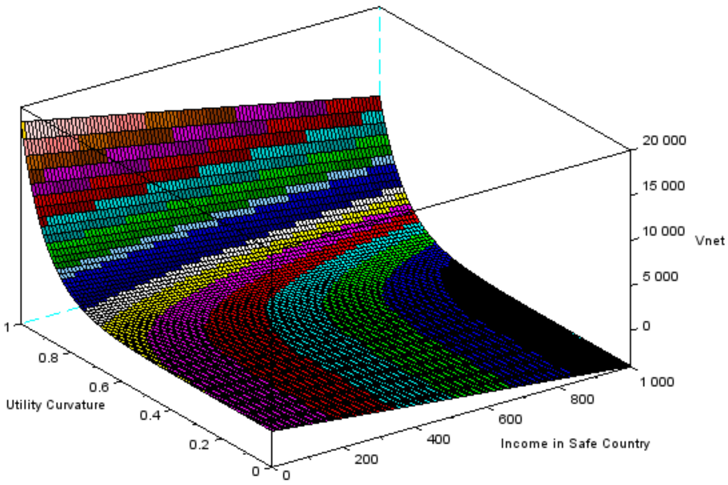


Figure 26: Effect of Living Conditions in Safe Country on Net Value of Migration as function of Loss Aversion

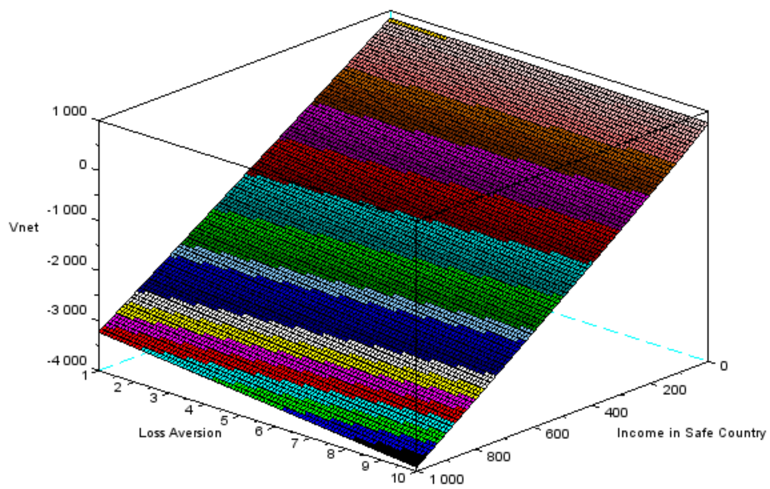


Figure 27: Effect of income in safe country and migration success probability on net migration value for Person 45

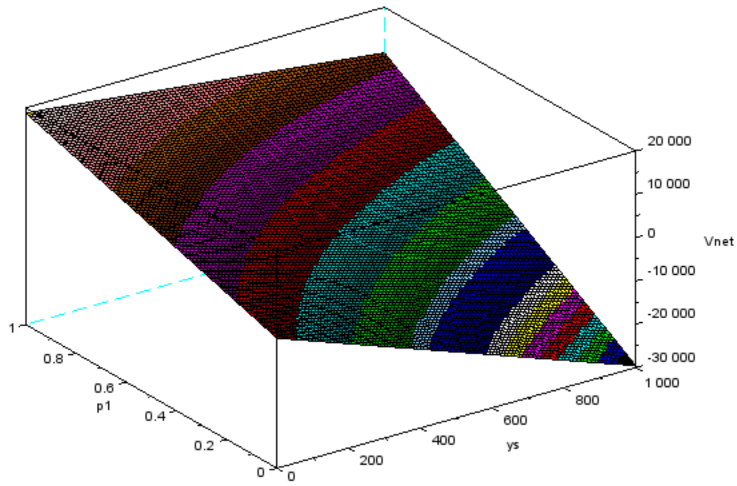
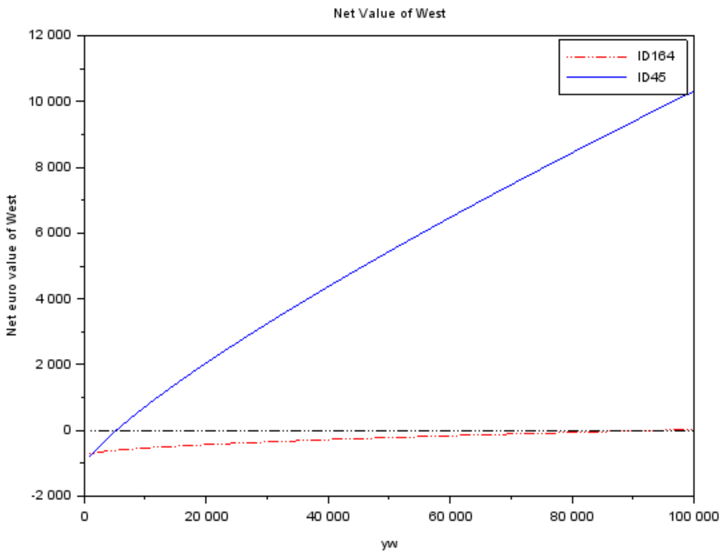


Figure 28: Effect of income in West with Refugee status on net migration value for Persons 45 and 164



ID164 has higher utility curavture (lower σ than ID45. For ID164, the net value of migration becomes positive only when the future gains are extremely high, whereas for ID45 these future gains render migration worth while from quite a low yearly income.

C Formal proofs

Proof of Proposition 1

Point (i):

A VNM-DM prefers trying to leave to West instead of going to a safe-neighbor country iff:

$$V_{EU}(West) > V_{EU}(Safe)$$
$$\Rightarrow p_1.p_2(y_W^T - C^{Te})^\alpha + p_1.(1-p_2)(y_T^T - C^{Te})^\alpha$$
$$+(1-p_1)(0)^\alpha > (y_S^T)^\alpha$$

We know $(y_T^T - C^{Te})$ to be lower than y_S^T. If we pose $(y_T^T - C^{Te})$ equal to zero in order to make more difficult to be satisfied the condition for West to be preferred over staying in the safe-neighbor country, then we obtain the sufficient (but not necessary) condition:

$$p_1.p_2(y_W^T - C^{Te})^\alpha > (y_S^T)^\alpha$$
$$\Rightarrow ln(p_1) + ln(p_2) + \alpha ln(y_W^T - C^{Te}) > \alpha ln(y_S^T)$$

After manipulations we obtain Point (i).

Point (ii): the waiting time for asylum application, T_A, only holds in the West option. As a result, it is sufficient to study the sign of $\frac{dV_{EU}(West)}{dT_A}$. We have:

$$\frac{dV_{EU}(West)}{dT_A} = p_1 p_2 \alpha \left[D(r,T_A)(y_{AA} - y_W)\right](y_W^T - C^{Te})^{(\alpha-1)} \tag{6.1}$$
$$+p_1(1-p_2)\alpha\left[D(r,T_A)(y_{AA} - \rho y_S)\right](y_T^T - C^{Te})^{(\alpha-1)}$$

with $D(r,T_A) = e^{-rT_A}$ in case of exponential discounting, and $D(r,T_A) = \frac{1}{1+rT_A}$ in case of hyperbolic discounting.

We know: $y_{AA} - y_W < 0$ and $y_{AA} - \rho y_S > 0$. So, the first-line effect is negative (less periods for benefiting from y_W when obtaining asylum) and the second-line effect is positive (less periods in suffering ρy_S when the asylum application fails). Remark that $\alpha(y_W^T - C^{Te})^{(\alpha-1)}$ and $\alpha(y_T^T - C^{Te})^{(\alpha-1)}$ are the marginal utilities of having earning $y_W^T - C^{Te}$ and $y_T^T - C^{Te}$ respectively (given the α-power function utility that we assume). In case of risk-averse individual ($\alpha < 1$), the marginal utility in wealth is decreasing. We verify that the higher y_W^T, the lower $\alpha(y_W^T - C^{Te})^{(\alpha-1)}$ and so the first-line effect is reduced. The opposite result holds for a risk-loving individual ($\alpha > 1$) because of increasing marginal utility of wealth. This is Point (ii).

Point (iii): the revenue the individual earns when waiting for asylum application, y_{AA}, only exists in the option "West". As a result, it is sufficient to study the sign of $\frac{dV_{EU}(West)}{dy_{AA}}$. We have:

$$\frac{dV_{EU}(West)}{dy_{AA}} = p_1 p_2 \alpha \left[\int_0^{T_A} D(r,t)dt\right](y_W^T - C^{Te})^{(\alpha-1)} \tag{6.2}$$
$$+p_1(1-p_2)\alpha\left[\int_0^{T_A} D(r,t)dt\right](y_T^T - C^{Te})^{(\alpha-1)}$$

The value of $\frac{dV_{EU}(West)}{dy_{AA}}$ is undoubtedly positive: the two parts of this equation are positive. But their relative importance differ depending on the individual's degree of risk aversion (α), and the value of p_2 has a crucial impact on the weight of each part in the value of $\frac{dV_{EU}(West)}{dy_{AA}}$. For risk-averse individuals ($\alpha < 1$), the marginal utility is decreasing in wealth so as to obtain: $\alpha(y_W^T - C^{Te})^{(\alpha-1)} < \alpha(y_T^T - C^{Te})^{(\alpha-1)}$. The opposite result holds for risk-loving individuals. Knowing that high values of p_2 provide high weight on the first part, and low values of p_2 provide high weight on the second part of the equation, we can deduce that the value of $\frac{dV_{EU}(West)}{dy_{AA}}$ is the lowest (highest) possible for risk-averse individuals when p_2 is high (low). And the reverse holds for risk-loving individuals. This is Point (iii).

Point (iv): the conditional probability of getting asylum, p_2, only holds in the West option. As a result, we focus on the value of: $\frac{dV_{EU}(West)}{dp_2}$. We have:

$$\frac{V_{EU}(West)}{dp_2} = p_1 \left[(y_W^T - C^{Te})^\alpha - (y_T^T - C^{Te})^\alpha \right] > 0$$

This value is undoubtedly positive because $y_W^T > y_T^T$. We also observe that it is increasing in α. However, to the extent that we only have one (positive) effect and that increasing α also increases the value of the second alternative $(y_S^T)^\alpha$, we are unable to conclude about how a variation in p_2 may differently affect the value of $V_{EU}(West)$, relative to the value of $V_{EU}(Safe)$, depending on the risk-aversion parameter α.
Q.E.D

Proof of Proposition 2
A CPT-DM prefers trying to leave to West instead of going to a safe-neighbor country iff:

$$\begin{gathered} V_{PT}(West) > V_{PT}(Safe) \\ \Longrightarrow \omega(p_1.p_2)((y_W^T - C^{Te}) - y_S^T)^\sigma + \omega(1 - p_1.p_2)(-\lambda)(-(0 - y_S^T))^\sigma \\ +\omega(p_1(1-p_2)) \left[(-\lambda)(-((y_T^T - C^{Te}) - y_S^T))^\sigma - (-\lambda)(-(0 - y_S^T))^\sigma \right] > (y_S^T - y_S^T)^\sigma = 0 \end{gathered}$$

It is impossible to rank $[\omega(1 - p_1.p_2) - \omega(p_1(1-p_2))]\,(-\lambda)(-(0 - y_S^T))^\sigma$ relatively to $\omega(p_1(1-p_2))(-\lambda)(-((y_T^T - C^{Te}) - y_S^T))^\sigma$ because it is likely to have $[1 - \omega(p_1(1-p_2))] > \omega(p_1(1-p_2))$ and we have $(0 - y_S^T) < (y_T^T - C^{Te}) - y_S^T)$.
As a result, two necessary conditions (for West to be preferred over Safe) can be found. The first one is:

$$\begin{gathered} \omega(p_1.p_2)((y_W^T - C^{Te}) - y_S^T)^\sigma \\ +\omega(p_1.(1-p_2))(-\lambda)(-((y_T^T - C^{Te}) - y_S^T))^\sigma > 0 \\ \Rightarrow \sigma > \frac{ln\left(\omega(p_1(1-p_2))\right) + ln\left(\lambda\right) - ln\left(\omega(p_1 p_2)\right)}{ln\left((y_W^T - C^{Te}) - y_S^T\right) - ln\left(-((y_T^T - C^{Te}) - y_S^T)\right)} = A \end{gathered}$$

and the second one is:

$$\omega(p_1.p_2)((y_W^T - C^{Te}) - y_S^T)^\sigma$$
$$+ \left[\omega(1-p_1.p_2) - \omega(p_1(1-p_2))\right](-\lambda)(-(0-y_S^T))^\sigma > 0$$
$$\Rightarrow \sigma > \frac{ln\left(\omega(1-p_1.p_2) - \omega(p_1(1-p_2))\right) + ln\left(\lambda\right) - ln\left(\omega(p_1p_2)\right)}{ln\left((y_W^T - C^{Te}) - y_S^T\right) - ln\left(-(0-y_S^T)\right)} = B$$

We only keep the more restrictive condition: $\sigma > \max\{A, B\}$. This is Point (i).

Q.E.D

Proof of Proposition 3
Recall that we suppose $\gamma = 1 \Rightarrow \omega(p) = p$.

Point (i) is straightforward, since $\frac{V_{CPT}(West)}{d\lambda} = (1-p_1)(-1)(-(0-y_S^T))^\sigma + p_1(1-p_2)(-1)(-((y_T^T - C^{Te}) - y_S^T))^\sigma < 0, \forall\sigma$, and $\frac{V_{CPT}(Safe)}{d\lambda} = 0$.

Point (ii): the waiting time of asylum application, T_A, only holds in the West option. As a result, it is sufficient to study the sign of $\frac{dV_{CPT}(West)}{dT_A}$. We have:

$$\frac{dV_{CPT}(West)}{dT_A} = p_1p_2\sigma\left[D(r,T_A)(y_{AA} - y_W)\right]\left[(y_W^T - C^{Te}) - y_S^T\right]^{(\sigma-1)} \tag{6.3}$$
$$+p_1(1-p_2)(-\lambda)\sigma\left[D(r,T_A)(-1)(y_{AA} - \rho y_S)\right]\left[-((y_T^T - C^{Te}) - y_S^T)\right]^{(\sigma-1)}$$

with $D(r,T_A) = e^{-rT_A}$ in case of exponential discounting, and $D(r,T_A) = \frac{1}{1+rT_A}$ in case of hyperbolic discounting.
We know: $y_{AA} - y_W < 0$ and $y_{AA} - \rho y_S > 0$. So, the first-line effect is negative (fewer periods for benefiting from y_W when obtaining asylum) and the second-line effect is positive (fewer periods in suffering ρy_S when the asylum application fails). Remark that $(y_W^T - C^{Te})^{(\sigma-1)}$ and $(y_T^T - C^{Te})^{(\sigma-1)}$ are decreasing in y when $\sigma < 1$, and are increasing in y when $\sigma > 1$. As a result, we can verify that the higher y_W^T, the lower $(y_W^T - C^{Te})^{(\sigma-1)}$ and so the first-line effect is reduced. The opposite result holds when $(\sigma > 1)$. This is Point (ii).

Point (iii): the revenue the individual earns when waiting for asylum application, y_{AA}, only holds in the West option. As a result, it is sufficient to study the sign of $\frac{dV_{CPT}(West)}{dy_{AA}}$. We have:

$$\frac{dV_{CPT}(West)}{dy_{AA}} = p_1p_2\sigma\left[\int_0^{T_A} D(r,t)dt\right]\left[((y_W^T - C^{Te}) - y_S^T)\right]^{(\sigma-1)} \tag{6.4}$$
$$+p_1(1-p_2)\sigma(-\lambda)\left[(-1)\int_0^{T_A} D(r,t)dt\right]\left[-((y_T^T - C^{Te}) - y_S^T)\right]^{(\sigma-1)}$$

The value of $\frac{dV_{CPT}(West)}{dy_{AA}}$ is undoubtedly positive: the two parts of this equation are positive. But their relative importance differ depending on the degree of concavity σ, and the value of p_2 has also a crucial impact. For $\sigma < 1$, we have: $\sigma\left[((y_W^T - C^{Te}) - y_S^T)\right]^{(\sigma-1)} <$

$\sigma\left[-((y_T^T - C^{Te}) - y_S^T)\right]^{(\sigma-1)}$. The opposite result holds for $\sigma > 1$. Knowing that high values of p_2 provide a high weight on the first part, and low values of p_2 provide a high weight on the second part of the equation, we can deduce that the value of $\frac{dV_{CPT}(West)}{dy_{AA}}$ is the lowest (highest) possible for individuals with $\sigma < 1$ when p_2 is high (low). This effect is reinforced for high values of loss aversion parameter λ. The reverse holds for individuals with $\sigma > 1$. This is Point (iii).

Q.E.D

Proof of Proposition 4

Point (i): the first part of Point (i) states that, when $\gamma < 1$, any variation in p_2 has a lower impact on V_{CPT} than when $\gamma = 1$ if the objective probability p which is associated to the concerned state(s) of Nature lies in a given interval of values (say $[p^1_{min}, p^1_{max}]$). Otherwise, the impact is higher. To illustrate, p is $p_1 p2$ for the state "travelling to West with success (p_1), and obtaining asylum (p_2)".
When no probability distortion holds, a marginal variation in a probability p has an impact of 1 (times the payoff(s) which is/are associated to it). When a weighting function $\omega(p)$ holds, we have to consider $\omega'(p)$. Here we have :

$$\omega'(p) = \frac{\gamma}{p}\left[ln(\frac{1}{p})\right]^{\gamma-1} exp\left(-\left[ln(\frac{1}{p})\right]^{\gamma}\right) \tag{6.5}$$

and so, for $\gamma < 1$ and $p \in]0,1[$ (because $p = 0$ and $p = 1$ are never subject to distortion) we obtain:

$$\omega'(p) = \begin{cases} > 1 & if \quad p < p^1_{min} \\ < 1 & if \quad p \in [p^1_{min}, p^1_{max}] \\ > 1 & if \quad p > p^1_{max} \end{cases}$$

The values of $[p^1_{min}, p^1_{max}]$ vary with γ. $[p^1_{min}, p^1_{max}]$ tends to $]0,1[$ for $\gamma \to 0$: all probabilities are equally weighted, so that the marginal variation in $\omega(p)$ is null.
Some examples: for $\gamma = 0.1$ we have: $[p^1_{min} = 0.007, p^1_{max} = 0.965]$; for $\gamma = 0.2$ we have: $[p^1_{min} = 0.017, p^1_{max} = 0.935]$; for $\gamma = 0.5$ we have: $[p^1_{min} = 0.05, p^1_{max} = 0.9]$; for $\gamma = 0.8$ we have: $[p^1_{min} = 0.09, p^1_{max} = 0.8]$.
As the value of γ approaches 1, the interval $[p^1_{min}, p^1_{max}]$ is reduced (it is not defined for $\gamma = 1$) and values of $\omega'(p)$ for $p \notin [p^1_{min}, p^1_{max}]$, which are higher than 1, tend to reduce to 1 (recall that $\omega(p) = p$ for $\gamma = 1$).

Point (ii): the first part of Point (ii) states that, when $\gamma > 1$, any variation in p_2 has a higher impact on V_{CPT} than when $\gamma = 1$ if the objective probability p which is associated to the concerned state(s) of Nature lies in a given interval of values (say $[p^2_{min}, p^2_{max}]$). Otherwise, the impact is lower.
As in Point (i), we have to consider $\omega'(p)$:

$$\omega'(p) = \frac{\gamma}{p}\left[ln(\frac{1}{p})\right]^{\gamma-1} exp\left(-\left[ln(\frac{1}{p})\right]^{\gamma}\right)$$

and so, for $\gamma > 1$ and $p \in]0,1[$ we obtain:

$$\omega'(p) = \begin{cases} < 1 & if \quad p < p^2_{min} \\ > 1 & if \quad p \in [p^2_{min}, p^2_{max}] \\ < 1 & if \quad p > p^2_{max} \end{cases}$$

The values of $[p^2_{min}, p^2_{max}]$ vary with γ. $[p^2_{min}, p^2_{max}]$ tends to reduce to $p^2_{min} = p^2_{max} = Z$ as $\gamma \rightarrow +\infty$ (Z approximates 0.368 for $\gamma = 1000$): all probabilities lower than Z are weighted by 0, and all probabilities higher than Z are weighted by 1. Except for Z, marginal variations in $\omega(p)$ are null.
Some other examples: for $\gamma = 1.1$ we have: $[p^2_{min} = 0.116, p^2_{max} = 0.75]$; for $\gamma = 1.2$ we have: $[p^2_{min} = 0.125, p^2_{max} = 0.745]$; for $\gamma = 1.5$ we have: $[p^2_{min} = 0.15, p^2_{max} = 0.715]$; for $\gamma = 2$ we have: $[p^2_{min} = 0.179, p^1_{max} = 0.674]$.