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Is there a "pessimistic" bias in individual beliefs ?  
Evidence from a simple survey  
Running Head : Pessimistic bias in individual beliefs

Selima Ben Mansour, Elyès Jouini and Clotilde Napp

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**Abstract**

It is an important issue for economic and finance applications to determine whether individuals exhibit a behavioral bias towards pessimism in their beliefs, in a lottery or more generally in an investment opportunities framework. In this paper, we analyze the answers of a sample of 1,540 individuals to the following question "Imagine that a coin will be flipped 10 times. Each time, if heads, you win 10€. How many times do you think that you will win?" The average answer is surprisingly about 3.9 which is below the average 5, and we interpret this as a pessimistic bias. We find that women are more "pessimistic" than men, as are old people relative to young. We also analyze how our notion of pessimism is related to more general notions of pessimism previously introduced in psychology.

Keywords : pessimism; judged probability; lottery

## 1. Introduction

Abel (2002) and Jouini-Napp (2005) show that the presence of a pessimistic bias in individual beliefs (in the sense that the probability of good outcomes is underestimated and the probability of bad outcomes is overestimated) leads to a higher risk premium and a lower risk-free rate in financial markets equilibrium models. This effect is particularly interesting in light of the risk-premium and the risk-free rate puzzles<sup>1</sup>. More generally, it is an important issue to determine whether individuals exhibit a behavioral bias towards pessimism in their beliefs, in an investment opportunities framework.

The aim of this paper is to shed light on the possible presence of such a bias. More precisely, we consider a very simple investment-like situation, on which individuals have no influence and that has a direct impact on their well-being, and we analyze if individuals tend to underestimate their probability of gain.

Previous work related to this issue include empirical studies of professionals' economic forecasts as well as psychological surveys and the main conclusion is towards optimism<sup>2</sup>. However, it has been repeatedly argued in the literature that professionals' forecasts may be biased by environmental factors<sup>3</sup>. In psychology, the notion of pessimism that has been considered so far is based on a negative conception of personal life (personal pessimism) and/or life in general (general pessimism). These notions are not well adapted to our purpose. Indeed, personal pessimism measures how individuals perceive their future and they clearly have an influence on this future. General pessimism measures how individuals perceive the future in general through items<sup>4</sup> that do not have a clear direct impact on their well-being.

In this paper, we analyze the answers of a sample of 1,540 individuals to the following question "Imagine that a coin will be flipped 10 times. Each time, if heads, you win

10€. How many times do you think that you will win?". We shall consider answers that are below the objective average of 5 as resulting from a form of pessimism. We shall refer to this form of pessimism as "pure-hazard introspective pessimism" (PHIP). "Introspective pessimism" refers to the fact that our approach is introspective and different from a choice-theoretic approach in the sense that we elicit individual beliefs through verbal expression and not through pairwise choices. Implicit in such an approach is the assumption that these beliefs result from a cognitive process. "Pure-hazard pessimism" refers to the fact that we are interested in individual beliefs in the face of "pure hazard", represented by lotteries, and not in the face of events whose outcomes the individuals can influence.

The mean score we obtain is about 3.9. It is quite striking that in our simple lottery, individuals announce that heads will occur (and that they will win) less than four times out of ten. In other words, individuals have a higher (resp. lower) judged probability for bad (resp. good) events. We interpret this result as a pessimistic bias. It is interesting to notice that if there is no gain associated to the coin tossing, then the average answer<sup>5</sup> is 4.9 and 90% of them answer exactly 5 as expected, which would mean that the exhibited pessimistic bias can not be explained by a wrong elementary probability inference. It is also interesting to notice that when the question is on 100 flips (instead of 10) the average score<sup>6</sup> is about ten times the one obtained on 10 flips. This seems to confirm the fact that answers reflect judged probabilities rather than risk aversion or other risk related notions.

Our results are different from the results obtained in psychology, with the usual notions of personal and general pessimism. However, we show that the pure-hazard introspective pessimism is positively correlated with the usual notions of pessimism in psychology, and more particularly with the notion of personal pessimism.

Moreover, we observe that in our survey women are more pessimistic than men as are young people relative to old.

The paper is organized as follows. We start in Section 2 by presenting the survey instrument. Section 3 is devoted to the notion of “pure-hazard introspective pessimism”. Section 4 deals with the results and possible interpretations. Section 5 concludes.

## **2. Survey instrument (data collection)**

The survey was conducted face-to-face in the field by professional interviewers experienced for in-person surveys. These include both undergraduate and graduate students, as well as non-students under the management of senior field work supervisors and senior staff members. Interviewers are trained in general and project-specific interviewing techniques, such as maintaining objectivity, reading questions as written, and securing respondent cooperation. Interviewers were continuously monitored during data collection for quality assurance.

The sample consists of adults, between 22 and 55 randomly chosen and yielded 1,540 responses<sup>7</sup>. We have chosen a large enough sample size in order to run cross sectional analysis.

The questionnaire consists of essentially three parts<sup>8</sup>.

In the first part, the participant is asked about his/her willingness to participate in a game of chance. Then, the participant is supposed to be offered the opportunity of entering a heads or tails game in ten draws. More precisely, a coin is being tossed ten times; each time heads occurs, the participant is supposed to get 10€. The participant is then asked for his/her own estimation, according to his/her experience and his/her luck, of the number of times heads will occur, i.e. how many times (out of ten) he/she

thinks he/she is going to win (and get 10€).

The second part deals with optimism/pessimism questions as in Wenglert and Rosen (2000). The aim of this part is to analyze the correlation between our PHIP with a standard measure of pessimism in psychology. It includes 16 items concerning personal events (*I will have a happy life, I will keep my best friends,...*) and 15 items concerning general events (*there will be a third world war, the unemployment rate shall fall, life expectancy shall increase, etc.*). For each item, individuals are asked about the importance granted to the considered event (between -10 and +10), as well as its "judged" probability of occurrence (between 0 and 100). For negatively formulated questions, the participants had sometimes trouble interpreting the question about the importance granted to the event, due to the negative scaling. The interviewer then split the question into two successive ones: 1) is this event positive or negative for you (do you wish that it happens) ? and 2) how important is it for you (give an answer between 0 and 10) ?

The third part deals with personal questions, such as gender, age, marital status, employment status, education and income.

### **3. Pessimism**

Recall that our survey presents answers to the following simple question "what is your own estimation, according to your experience and your luck, of the number of times heads will occur, i.e. how many times (out of ten) do you think you are going to win (and get 10€)?".

Our PHIP measure results from the number of times  $x_i \in \{0, \dots, 10\}$  that the individual  $i$  thinks he is going to win (and get 10€). Indeed, a value of  $x_i$  below the objective value of 5 should be considered as a form of pessimism. More precisely, our

PHIP measure for individual  $i$  is given by the distance of  $x_i$  to 5 ( $PHIP_i = \frac{x_i-5}{5}$ ).

We do not consider this measure based on only one question as a way to determine the individual level of pessimism in a general setting. However, we want to observe whether there is a clear departure from the objective value of 5, which would reflect a behavioral pessimistic bias.

The simple question and the resulting measure that we have adopted have the following advantages.

First, lotteries are usually considered as a simple and good way to model financial investment opportunities. In particular, individuals have no influence on the outcomes and these outcomes have a direct impact on the individuals well-being.

Second, a survey based on hypothetical scenarios permits to avoid environmental effects like the insider bias effect of analysts. Indeed, with hypothetical questions, environmental factors and incentives (e.g. unique to analysts) are absent and human psychological bias is more clearly evident.

Third, it is natural to relate the notion of pessimism to the underweighting of “good” states of the world and overweighting of “bad” states of the world. This implies that in order to elicit the presence of pessimism, one should consider situations in which states of the world are identified as unambiguously good (resp. unambiguously bad).

This simple lottery also has other advantages. The framework is simple enough in order to maximize transparency and cognitive ease for the subjects. Therefore, divergence among agents cannot result from a divergent understanding of the framework. All agents should have the same understanding of the situation and their answers ought to differ only through different psychological evaluations of the probabilities. Besides, we refer to real life experiences (heads or tails) and we do not define the lotteries by the explicit distribution of the payoffs, in order to let room for free interpretation.

Note that the respondents do not have monetary incentives when answering the questions, as is often the case in experiments. This can be seen as a drawback of our method of data collection; because respondents are not staking actual funds on the investment, there is no way to reliably assess whether their actual behaviour would mimic their answers. This applies equally well of course to all previous studies using survey questions involving thought experiments. Fortunately, however, there is evidence (see for instance Beattie and Loomes (1997) and Camerer and Hogarth (1999)) that for simple (choice) problems respondents do not need real incentives to reveal their preferences. Camerer and Hogarth (1999) present a theory describing when payments can be expected to make a large difference and when not. The main conclusion is that payments increase the effort that is made by the respondent. This can be highly relevant for complex or tedious tasks, but our respondents are only presented with a short and very simple questionnaire on lotteries. It does not seem that our respondents are bored or disinterested, so the need for increasing their effort by monetary incentives is only small. Finally, there is in our framework a specific problem linked to financial incentives. Indeed, since the focus of our study is the elicitation of individual beliefs, the reward should be related to the accuracy of the predictions. Now, either the participants are confronted with “real lotteries”, which means that they truly receive the outcomes, but in this case, payments for correct forecasts could generate diversification behaviour: for instance, in our heads or tails setting, people expecting the best (heads will occur) will forecast the worst (tails) in order to win money in both cases (the good outcome if heads occurs and the reward for the correct forecast if tails occurs) even if they believe that heads will occur. Another possibility would be to confront the participants with hypothetical scenarios and to only reward the question on their beliefs, but in such a situation, it is likely that participants would tend to focus on the rewarded task, which



is the accuracy of the prediction and would tend to neglect the lottery itself so that the “good” outcome would not be felt as good anymore by the participants.

As mentioned in e.g. Hartog, Carbonnel and Jonker (2002), there is a special problem linked to non-response and response with zero "judged" probability of winning. Indeed, zero "judged" probability of winning can truly reflect strong pessimism but it can also signal that the individual refuses, on ideological or religious grounds, to participate in the imaginary lottery. To avoid this problem, we have started our survey by asking the individuals whether they are willing to participate in a game of chance.

#### **4. The results and possible interpretations**

We are interested in the notion of PHIP itself (its distribution among individuals, its mean, standard deviation,...), in its links with other demographic variables, such as gender, income, age, etc. as well as in its links with other notions of pessimism already introduced in the psychological literature (personal, general).

##### **4.1. Pure-Hazard Introspective Pessimism (PHIP)**

Figure 1 illustrates the distribution of our measure of optimism among individuals and provides a few descriptive statistics.

We can first observe that there is a great heterogeneity in the level of pessimism among agents.

This result is consistent with previous results on subjective expectations (even in situations where the individuals have access to the same information, see e.g. Gillette, Stevens, Watts and Williams (1999)).

For the considered sample of 1,540 individuals, the mean value for the measure of

optimism is equal to -0.215. Equivalently, the mean value for the number of times (out of ten) the individual announces he is going to win is equal to 3.925 or the mean subjective probability of gain is equal to 0.3925. Moreover, 75% of the individuals give an answer below 5. This result is quite striking and in favour of the existence of a behavioral bias towards pessimism in individual beliefs. The same results have been obtained on a sample of undergraduate and graduate students in management and mathematics (236 individuals). Besides, notice that when individuals are asked<sup>9</sup> about the number of times (out of ten) they think "heads" will occur without associated gains, the average answer is 5 as expected and 90% of the answers are exactly 5. This would mean that our results are not related to numerical skills or to knowledge of elementary probability.

Our result on the average level of "pessimism" is significantly different from empirical studies on analysts' earnings forecasts. However, as we have seen above, there are many convincing possible explanations to account for an optimism bias in earnings forecasts, specific to analysts (Schipper, 1991, Mc Nichols and O'Brien, 1997, Darrough and Russell, 2002). Our result is nevertheless consistent with Giordani and Söderlind (2005), who do not deal with earnings but with variables for which the previous bias does not hold.

Our result is also significantly different from empirical psychological studies, which conclude to an optimistic bias. This can be explained by the fact that they consider a much more general setting while we focus on an investment-like situation.

In forecast experiments, Affleck-Graves, Davis and Mendenhall (1990) (see also Maines and Hand (1996), Calegari and Fargher (1997) and Gillette et al. (1999)) show that the forecasts are more pessimistic in market sessions (where the agents hold an asset and receive the corresponding dividends) than in the non-market sessions, which can be interpreted as reflecting some form of pessimism in our sense, i.e. in situations

where the outcomes have a direct impact on the individual well-being. Moreover, in Stevens and Williams (2003), it is shown that individuals systematically underreact to positive and negative information and that the underreaction is greater for positive information than negative information, which can also be interpreted as some form of pessimism. This is also confirmed by Taylor (1991), who finds that “negative information is weighted more heavily than positive information”. Notice that such a behaviour could possibly account for the presence of some pure-hazard introspective pessimism in individual beliefs. In other words, pessimistic individuals in our survey would be those who put more weight on all the times they have lost at heads or tails than on the times they have won.

#### **4.2. Cross-sectional analysis of PHIP**

The average level of pessimism is equal to -0.237 (3.815) for women and -0.192 (4.04) for men, hence women in our sample and for our notion of pessimism, are more pessimistic than men (see Figure 2).

By sorting the individuals into age classes, and by computing the average value for our measure of pessimism for each class, we obtain a decreasing relationship between optimism and age (Table 1).

As far as income is concerned, our initial sample is slightly modified (from 1,540 to 1,328 individuals) since some individuals refused to answer (74) and this data is missing for some others (138). We divide our sample of 1,328 individuals into 7 income classes. It seems on the means by class that there is an increasing relationship between pessimism and income (Table 2).

### 4.3. PHIP, personal pessimism and general pessimism

For our considered sample of 1,540 individuals, the respondents exhibit personal optimism and are almost neutral with respect to general events (Figure 3). Wengler and Rosen (2000), that deals with a sample of 183 individuals, also obtain personal optimism, with a level of 0.596, which is almost similar to ours. They also obtain, as we do, a level of general optimism (0.336) which is lower than the level of personal optimism (0.596). The difference with our results is that they obtain general optimism whereas we obtain general neutrality.

We have analyzed the link between the three different notions of pessimism, our notion of pessimism (PHIP) and the two standard notions of pessimism in psychology (personal pessimism and general pessimism). Table 3 shows that there is some increasing relationship between PHIP and personal pessimism as well as between personal and general pessimism.

Moreover, three questions in the questionnaire on personal pessimism have attracted our attention : “you have no chance to win at a lottery game” (Q1), “you have no chance to be selected for a television game” (Q2) and “you will win one day at the promo sport<sup>10</sup>” (Q3), since intuitively, they should have a link with our notion of PHIP.

Table 4 shows that there is a decreasing relationship between (Q1) and PHIP as well as between (Q2) and PHIP, and an increasing relationship between (Q3) and PHIP, which seems natural. However these relations are not very strong.

## 5. Conclusion

In this paper, we have shown that there is a pessimistic behavioral bias in individual beliefs in a simple lottery context and we have denoted it by pure-hazard introspective

pessimism (PHIP). The very simple lottery we adopted in the survey has permitted to show the presence of pessimism without having to refer to a specific decision-theoretical model. The concept of PHIP is different from the concepts of personal and general pessimism previously introduced in the psychology literature even if there is a significant link between all these concepts. We have obtained with our notion of pessimism that men are less pessimistic than women and that the level of pessimism increases with age and decreases with income.

It is a delicate question to identify the origin of the elicited pessimism. The observed pessimism might result from an individual learning process, where individuals overestimate bad experiences (see Taylor, 1991). Another possible partial explanation might come from the fact that people are used, with casinos and national lotteries, to getting less than the theoretical average gain in pure hazard games, which leads them to be suspicious and systematically underestimate their probability of success. Finally, people seem to be regret averse in their choices (Joseph, Larrick, Steele and Nisbett, 1996, Ritov, 1996). Regret avoidance may reflect a self deception mechanism designed to protect self esteem about decision making ability, i.e. a calculated avoidance of unpleasant future feelings. The elicited pessimism could be interpreted as defensive pessimism, an anticipatory strategy that involves setting defensively low expectations prior to entering a situation so as to defend against loss of self esteem in the event of failure.

**Authors :** *Selima Ben Mansour, DRM-Université Paris-Dauphine, Place du Maréchal de Lattre de Tassigny, 75 775 Paris Cedex 16, France. Elyès Jouini, Ceremade-Université Paris-Dauphine, IFD & Institut universitaire de France, Place du Maréchal de Lattre de Tassigny, 75 775 Paris Cedex 16, France, phone : +33 1 44 05 42 26, fax: + 33 1 44 05 48 49, jouini@ceremade.dauphine.fr. Clotilde Napp, CNRS-DRM, Université Paris-Dauphine & CREST, Place du Maréchal de Lattre de Tassigny, 75 775 Paris Cedex 16,*

*France, phone : +33 1 44 05 46 42, fax: + 33 1 44 05 48 49, clotilde.napp@dauphine.fr*

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## Footnotes

<sup>1</sup> As shown by Mehra-Prescott (1985) and Weil (1989), standard models of financial markets equilibrium predict risk-premia (resp. risk-free rates) that are too low (resp. too high) to fit observed data.

<sup>2</sup> see e.g. Fried and Givoly (1982), O'Brien (1988), Francis and Philbrick (1993), Kang et al. (1994) and Dreman and Berry (1995). However, Giordani and Söderlind (2005) obtain the opposite result.

<sup>3</sup> see e.g. Schipper (1991), Mc Nichols and O'Brien (1997), Abarbanell and Lehavy (2001), Darrough and Russell (2002).

<sup>4</sup> For instance, in Wenglert and Rosen (2000), the items are among others "There will be a third world war", "The unemployment rate shall fall", "Life expectancy shall increase",...

<sup>5</sup> on a subsample of 30 individuals

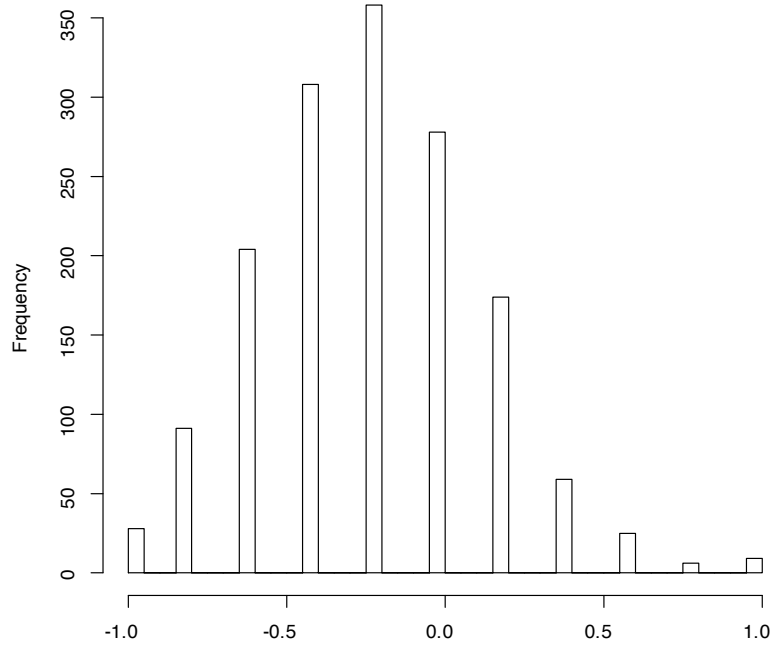
<sup>6</sup> on a subsample of 90 individuals

<sup>7</sup> We obtained similar results on smaller samples (236 individuals) of undergraduate and graduate students in management and mathematics.

<sup>8</sup> The whole questionnaire is available upon request.

<sup>9</sup> The sample for this observation is different from the initial one and much smaller.

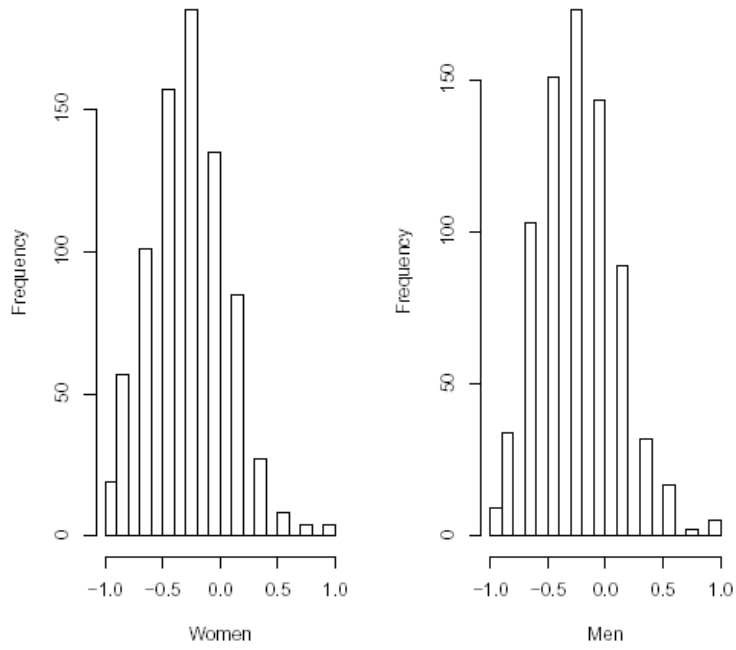
<sup>10</sup> The promospot is a game of chance dealing with sport results.



Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Std Dev.
-1,000	-0,400	-0,200	-0,215	0,000	1,000	0,352

**Figure 1: Distribution of PHIP**

This figure represents the distribution of “pessimism” across our sample. A value of -1 (resp. 1) corresponds to people who think that they will never (resp. always) win at the heads or tails game. The value of -0.1, which is endowed with the largest frequency of individuals, corresponds to people who think that they will win (or heads will occur) 4 times out of ten.



**Figure 2: Distribution of PHIP by gender**

This figure represents the distribution of pessimism across women (resp. men). Women appear as more pessimistic than men. This is confirmed by a Wilcoxon test ( $W = 2.8 \times 10^5$ ;  $p\text{-value} = 1\% < 5\%$ ).

Age Band	(0, 25]	(25, 30]	(30, 35]	(35, 40]	(40, 45]	(45, 50]
Mean	-0,1497	-0,1919	-0,2280	-0,245	-0,227	-0,248
Median	-0,200	-0,200	-0,200	-0,200	-0,200	-0,200
Min.	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Max.	1,000	1,000	1,000	1,000	0,800	1,000
Std Dev.	0,395	0,362	0,359	0,328	0,324	0,331
N° of Obs.	191	372	292	289	230	166

**Table 1: PHIP and age**

This table synthetizes the distribution of “pessimism” by age range. Spearman’s and Kendall’s tests confirm a increasing relation between age and pessimism, even though the  $Rh\hat{o}$  and the  $Tau$  are small ( $S = 6.7 \times 10^8$ ,  $Rh\hat{o} = -0.08$ ,  $p - value = 0.01^1$  and  $Z = -3.6$ ,  $Tau = -0.06$ ,  $p - value = 10^{-4}$ ).

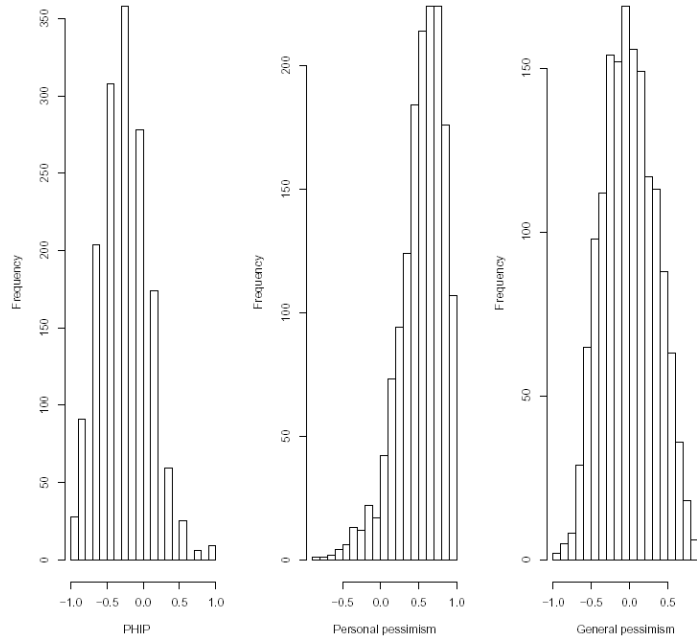
Income	$\leq 200$	(200,400]	(400,600]	(600,800]	(800,1000]	(1000,1500]	$> 1500$
Mean	-0,295	-0,320	-0,233	-0,187	-0,231	-0,200	-0,207
Median	-0,200	-0,200	-0,200	-0,200	-0,200	-0,200	-0,200
Min.	-0,800	-1,000	-1,000	-1,000	-1,000	-1,000	-1,000
Max.	0,400	0,400	0,800	1,000	0,600	0,800	1,000
Std Dev.	0,315	0,305	0,337	0,363	0,308	0,374	0,401
N° of Obs.	19	160	317	402	229	74	53

**Table 2: PHIP and income**

This table reports the average level of pessimism by income class. The Kruskal Wallis test indicates that these variables are linked ( $KW = 14$ ,  $df = 6$ ,  $p - value = 3\%$ ) and that pessimism decreases with income.

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<sup>1</sup>The alternative hypotheses are such that  $Tau$  and  $Rh\hat{o}$  are negative.



	Min.	Max.	Mean	Std. Dev.
PHIP	-1,000	1,000	-0,215	0,352
Personal Pessimism	-0,819	0,988	0,537	0,293
General Pessimism	-0,968	0,865	-0,004	0,342

**Figure 3 : PHIP, personal pessimism and general pessimism.**

This figure represents the distribution of the different measures of pessimism across our sample. As it can be easily seen, individuals in our sample exhibit a pessimistic bias when facing pure-hazard, an optimistic bias when facing questions related to their future and are neutral with respect to general questions.

	Kendall's Tau	Spearman's Rhô	Pearson Correlation
PHIP / Pers. Pessimism	0,14*	0,19*	0,14*
PHIP / Gen. Pessimism	-0,03	-0,04	0,03
Pers. Pess. / Gen. Pess.	0,11*	0,17*	0,21*

**Table 3: Results of Kendall's, Spearman's and Pearson's tests. \*: significantly different from 0**

This table presents a few statistics about the link between the three different measures of individuals' pessimism (when facing pure-hazard, when facing questions related to their own future and when facing general questions)

	Kendall	Spearman	Pearson Correlation
PHIP/Q1	-0,23*	-0,30*	-0,30
PHIP/Q2	-0,21*	-0,27*	-0,27
PHIP/Q3	0,15*	0,19*	0,20

**Table 4: Link between PHIP, (Q1), (Q2), (Q3).**

This table presents a few statistics about the link between individuals' pessimism when facing pure hazard and their answers to questions that are present in more general psychological surveys and that are also somehow related to pure-hazard situations: "you have no chance to win at a lottery game" (Q1), "you have no chance to be selected for a television game" (Q2) and "you will win one day at the promo sport" (Q3).