Is there a pessimistic bias in individual beliefs ? Evidence from survey data.

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Abstract

The aim of this paper is to determine whether individuals exhibit in their beliefs a behavioral bias towards pessimism, in a lottery or more generally in an investment opportunities framework. For this purpose, we design a field survey aiming at deriving a measure of pessimism from answers to hypothetical scenarios. We observe in the context of our experiment that individuals are on average pessimistic. We analyze how pessimism is distributed among individuals, in particular in link with gender, age and income. We also analyze how our notion of pessimism is related to more general notions of pessimism already introduced in psychology.

1. Introduction

Commonly defined, optimism reflects an expectation that good things will happen, whereas pessimism reflects an expectation that bad things will happen.

In this paper, our aim is to determine whether individuals exhibit in their beliefs a behavioral bias towards pessimism, in a lottery or more generally in an investment opportunities framework. More precisely, we shall design a survey,

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involving verbal expressions of beliefs concerning lotteries, that permits to provide an individual measure of pessimism in such a context. We shall refer to this measure 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. We shall analyze how pure-hazard introspective pessimism is distributed among individuals, in particular in link with age, gender, income. We shall also analyze how PHIP is related to other concepts of pessimism already introduced in psychology, more general concepts based upon pessimism as a negative conception of life or future.

Decision theory literature has analyzed, mostly in the framework of Prospect Theory (or its derived versions Rank Dependant Expected Utility or Cumulative Prospect Theory), subjective distortions of the objective probability. Experimental studies in this framework have tried to determine the shape of the probability transformation function. Most of these studies rely on choices and revealed preferences. Typically, subjects are given a large number of choice pairs and instructed to state their preferences in each pair. This leads to an indirect estimation of individual beliefs. In such studies, individual choices involve probability distortions as well as risk aversion and the two effects have to be disentangled. Moreover, numerous possible human biases like overconfidence, loss aversion, regret, doubt, etc. might influence the decision procedure. Our aim is to assess directly probability judgements, in a way that is not based on decision choices and that does not depend upon a specific decision making model.

There is a well-known debate between the intuititive approach, for which beliefs exist prior to the choice behavior and the choice theoretic approach for which beliefs exist only in so far as they are expressed in choice behavior. Without getting too much into the details of this debate, we choose an introspective approach which is based on the verbal expression of the beliefs[1] (Fox and Tversky, 1998, Karni, 1996) because it appears as more adapted to our study. Indeed, the choice-

[1] This does not mean that the verbally expressed individual beliefs are independent of any decision choice. As noted by Karni (1996), the two notions of individual beliefs, in the choice-theoretic approach and in the intuitive approach, are equivalent as soon as we consider that the utility function is state independent.

theoretic approach which is based on pairwise choices requires the embedding of beliefs in a broader model of human behavior, and we want to avoid the risk of confounding beliefs with other aspects of the decision making process. Moreover, note that in the choice-theoretic approach, the utility function as well as the beliefs, or more precisely the subjective probabilities, are theoretical constructs inferred from the decision maker's choice behavior. They do not necessarily exist in the mind of the decision maker, whose intuition is assumed to apply only to choices among alternative courses of action, and therefore do not correspond to a concept of individual "beliefs" and pessimism, which is the purpose of our study. We think that the verbal expression of beliefs is valuable, if applied to simple circumstances in which it is reasonable to expect truthful answers, which is the case for the questions of our survey. Notice that a great number of empirical studies, aiming at eliciting some dose of pessimism/optimism in the forecasts of individuals in investment-like situations, also rely on the verbal expression of expectations[2].

In psychology, the notion of pessimism that has been considered so far is very general and based on the concept of pessimism as a negative conception of life. Recent literature has provided two different measures of individual pessimism, one being related to personal pessimism (in relation to events which have a direct impact on the well being of the individual) and the other to general pessimism (in relation to events which have a direct impact on the well being of the society). Intuitively, our notion of PHIP should be close to the notion of personal pessimism. However, in order to measure personal pessimism, the questions asked in psychological surveys aim at evaluating the way the individuals perceive their future. Such a perception of one's future takes into account how individuals might influence future events and involves feelings like self esteem or overconfidence. Our aim is to focus on individual probability assessment on events that have a direct impact on individual well being, like in the personal pessimism, but that are exogenously given like in lotteries or investment opportunities. Standard psychology studies (e.g., Kahneman and Lovallo, 1993, Taylor and Brown, 1988) conclude to a significative level of optimism. Kahneman and Lovallo (1993) interpreted that overly optimistic forecasts result from the adoption of an inside view of the problem, which anchors predictions on plans of success rather than on past results, the so-called *insider bias*. With an insider view of the problem, risk is perceived as a challenge to be overcome by the exercice of skill. Taylor and Brown (1988) listed three main forms of a pervasive optimistic bias: (i) unrealistically positive

[2] See the end of this section for references.

self evaluations, (ii) unrealistic optimism about future events and plans and (iii) illusion of control. As summarized by the authors, most of us untertain the unlikely belief that "the future will be great, especially for me". One of the aims of the present study is to analyze if the optimistic bias pertains if we get rid of the positive self evaluation and illusion of control biases and consider investment-like situations on which the individual has no influence.

As we have mentioned it above, there exists in the empirical literature a certain number of studies looking for evidence of optimism/pessimism in investment situations. These studies focus on forecasts of "professionals"; the participants are analysts, economists from industry, government, banking, etc. and they provide forecasts on earnings, dividends or on GDP, consumption, etc.. These studies have led to different results depending on the contexts. Fried and Givoly (1982), O'Brien (1988), Francis and Philbrick (1993), Kang et al. (1994) and Dreman and Berry (1995) provide evidence that analysts' forecasts on earnings are overly optimistic and the converse result is obtained about professional forecasts on GDP in Giordani and Söderlind (2005). However, as underlined by Schipper (1991), Mc Nichols and O'Brien (1997), Abarbanell and Lehavy (2001), Darrough and Russell (2002), professionals' forecasts may be biased by environmental factors. Since our aim is to evaluate optimism/pessimism caused by human biases that might be typical of all economic agents, we have chosen to adopt a survey based on hypothetical scenarios.

Our data, based on a sample of 1,532 individuals, exhibit a significative level of PHIP, which is very 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 has an influence on the usual notions of pessimism in psychology, and more particularly on the notion of personal pessimism.

Moreover, the presence of pessimism in investment-like situations is particularly interesting in light of recent papers on the risk premium puzzle (Abel, 2002, Jouini-Napp, 2004, 2005a). In particular, we quantify the impact of the observed degree of pessimism on the level of the equilibrium risk premium.

As far as the link between pure-hazard introspective pessimism and other demographic variables is concerned, we observe that in our survey women are more pessimistic than men. Besides, there is a strong link between PHIP and individual characteristics such as income, and age.

The paper is organized as follows. We start in Section 2 by presenting the notion of "pure-hazard introspective pessimism" as well as the approach that we propose in order to elicit a possible pessimistic bias in individual beliefs. We relate

them to the different notions of pessimism and the different approaches previously adopted in the literature. Section 3 is devoted to the description of the survey and Section 4 deals with the results, possible interpretations and applications.

2. Pessimism

In theoretical models, the notion of pessimism is related to the way an individual transforms an objective distribution into a subjective one. This notion has revealed to be highly important, in particular in relation with the equity premium puzzle (see e.g. Abel, 2002).

2.1. The notion of pessimism and the corresponding methodology in the literature

Let us recall that there are essentially two ways to generalize the standard model of individual preferences, in order to take into account possible subjective beliefs. The first one (Subjective Expected Utility) consists in introducing a subjective probability under which the agent evaluates possible outcomes (Savage, 1954). More precisely, instead of considering like in the standard model that the decision maker's satisfaction resulting from a given lottery with random outcomes $x = (x_1, ..., x_n)$ is given by $E^P[u(x)] = \sum_{i=1}^{n} p_i u(x_i)$ where u represents the individual's utility function and $P = (p_1, ..., p_n)$ represents the objective probability of the different states of the world, the decision maker's satisfaction is supposed to be given by $E^\pi[u(x)] = \sum_{i=1}^{n} \pi_i u(x_i)$ where the subjective probability $\pi = (\pi_1, ...\pi_n)$ might differ from P and represents the agent's subjective belief about the probability of occurrence of the states of the world. The second way to depart from the standard neutral belief setting is more general and considers nonlinear expected utility models associated to possible distortions of the objective probability (Prospect Theory, Rank Dependent Expected Utility, Cumulative Prospect Theory). For example, in the Rank Dependent Expected Utility (RDEU) model (Quiggin, 1981, Yaari, 1987), instead of considering like in the standard model that the agent's satisfaction resulting from $x = (x_1, ..., x_n)$ is given by $E^P[u(x)] = \sum_{i=1}^{n} p_i u(x_i)$, the agent's satisfaction is supposed to be given by $\sum_{i=1}^{n} \omega_i(x) u(x_i)$ where the weighting function $\omega_i(x)$ is a distortion of the objective probability that depends upon the distribution function (hence on the rank) of the possible outcomes x.

There are many ways to transform a given objective distribution into a subjective one and to define related concepts of pessimism. In the SEU setting, Abel (2002) proposes to relate pessimism to First order Stochastic Dominance[3] and Jouini-Napp (2005b) propose to relate it to the Monotone Likelihood Ratio dominance[4] of Landsberger and Meilijson (1990), or to the central riskiness property of Gollier (1995, 1997). In RDEU models, different notions of pessimism have been introduced, which correspond, for a given x, either to a First Stochastic Dominance shift (Chateauneuf et al., 2005), or to a Monotone Likelihood Ratio shift (Wakker, 2001).

Common to all these notions is the fact that an individual is said to be pessimistic if his subjective distribution is "less favourable" than the objective one, in the sense that it puts more (resp. less) weight on the bad (resp. good) states of the world. A typical example of a pessimistic individual is the one for which the subjective distribution of a given payoff is given by $\mathcal{N}(m, \sigma^2)$, whereas the objective distribution is given by $\mathcal{N}(M, \sigma^2)$ with $m < M$.

In empirical studies, the notion of pessimism also usually refers to the subjective distribution of a given variable (like earnings, dividends, US consumption and real output growth) compared to the objective distribution. Most frequently, for simplicity reasons, only the means of the subjective distribution and of the objective distribution are taken into account. For example, an individual will be said to be pessimistic if his/her forecasts of the average US consumption or output growth lies significantly below the true value. Notice that all notions of pessimism adopted in the previously mentioned theoretical models have in common that a pessimistic transformation lowers the mean of the distribution under consideration. Empirical studies have led to different results depending on the contexts. Fried and Givoly (1982), O'Brien (1988), Francis and Philbrick (1993), Kang et al. (1994) and Dreman and Berry (1995) provide evidence that analysts' forecasts on earnings are overly optimistic. Various explanations have been advanced for similar optimism findings (Schipper, 1991 ; Mc Nichols and O'Brien, 1997 ; Abarbanell and Lehavy, 2000). For example, it has been advocated that

[3] We recall that Y is said to dominate X in the sense of the first stochastic dominance ($Y \succcurlyeq_{FSD} X$) if for all t, $P(Y \leq t) \leq P(X \leq t)$. See Rotschild and Stiglitz (1970).

[4] We recall that Y is said to dominate X in the sense of the monotone likelihood ratio ($Y \succcurlyeq_{MLR} X$) if there exist numbers $-\infty \leq x_1 \leq x_2 \leq \infty$ and a nondecreasing function $h : [x_1, x_2] \to [0, \infty]$ such that $P(Y < x_1) = 0$, $P(X > x_2) = 0$ and $dF_Y(x) = h(x)\, dF_X(x)$ on $[x_1, x_2]$. The MLR order is widely used in the statistical literature and has been introduced for measuring the desirability of risky assets in a portfolio setting by Landsberger and Meilijson (1990).

many analysts are employed by brokerage firms, so forecast optimism is consistent with their incentives to promote the purchase of stock or maintain access to top executives at the firms they follow. More recently, researchers have associated the positive bias in analysts' forecasts with Kahneman and Lovallo's (1993) insider bias (e.g., Darrough and Russell, 2000). It is argued that, because of their close contact with company management, analysts take on characteristics of insiders and tend to overweight good news and underweight bad news. The converse result is obtained in Giordani and Söderlind (2005). The authors do not deal with earnings forecasts data, but with forecasts on GDP and consumption, for which the previous documented biases do not apply. Starting from the model of Abel (2002), the authors study data on professional forecasters (Livingston Survey and Survey of Professional Forecasters (SPF)) looking for evidence of pessimism in the subjective distributions of US consumption and real output growth. A unique feature of the SPF is that forecasters provide a histogram of their subjective probability distribution. The results show evidence of pessimism. At the four-quarter horizon, output growth was on average 0.64% higher than forecasted (the average growth was 2.31%). The main drawback of this approach is that there is no guarantee that the beliefs of professional forecasters on the level of GDP (as opposed to, say, those of the general investors on an asset they own) are the most relevant.

In psychology, the notion of pessimism is usually based on a much more general notion of pessimism than in the theoretical and empirical models. The first set of measures used to assess for optimism and pessimism is based on the definition of optimism and pessimism as reflecting positive and negative outcome expectancies. One of the first studies on pessimism, by Youmans (1961), is based on the following single assertion. "*In spite of what some people say, the life of the average man or woman is getting worse, not better*". Individuals are asked about whether they agree or not. One of the most popular measures to assess optimism and pessimism is Scheier and Carver's (1985) Life Orientation Test (LOT), as well as its derived versions, like the ELOT, an extended version of the LOT, introduced by Chang et al. (1997) or the revised Life Orientation Test (LOT-R) of Scheier et al. (1994). Typical questions include "*In uncertain times, I usually expect the best*" or "*If something can go wrong for me, it will*". Respondents are asked to rate the extent of their agreement with these items across a 5-point Likert-type scale ranging from 0 (strongly disagree) to 5 (strongly agree). In the same spirit, Dember et al. (1989), who have defined optimism and pessimism in a much broader way developed the Optimism-Pessimism Instrument. In contrast to expectancy-based measures, attributional measures, like Peterson et al.'s (1982)

Attributional Style Questionnaire (ASQ) or its derived version Peterson and Villanova (1988)'s Expanded Attributional Style Questionnaire (EASQ) provide a more indirect assessment of optimism and pessimism; for each event (e.g., "*you have been looking for a job unsuccessfully for some time*"), respondents are asked to write down one major cause for why that event occurred. Individuals who perceive that good things happen to them because of internal, stable and global factors are considered to have an optimistic explanatory style.

Wenglert and Rosen (2000) measured optimism through answers to questions about personal life (20 questions) as well as the world in general (20 questions). In each group of questions, half of the questions were associated to "good" events and the other half to "bad" events. Each question is associated to an event that might occur in the future and the participants are asked about the probability of occurrence (measured by a percentage) and about the importance granted to the considered event (measured by a number between -10 and +10). Typical questions are "*do you think that you will have a happy life ?" or "do you think there will be a third world war in the next thirty years ?".* The correlation between probability of occurrence and importance measures the level of optimism. Focusing on each group of questions (personal life, world in general), one obtains a measure of personal optimism as well as a measure of general optimism. The authors obtain an average level of personal optimism of 0.596 and an average level of general optimism of 0.336. They also obtain that women are more pessimistic than men.

This approach has the following advantages. It considers pessimism as an individual characteristics and the introduction of the questions on the importance granted to the event permits to measure it in a context that is directly related to the individual. Besides, it is interesting to be able to distinguish between personal and general pessimism. However, to our point of view, an important drawback of these psychological approaches is that they are not rigorously linked to the concept of pessimism in financial or economic theory, which, as seen above, is related to the transformation of an objective distribution. Moreover, it seems that other feelings than optimism/pessimism interfere when one is to answer a question like "*do you think you will have a happy life ?*". Indeed, among others, self esteem, pride, etc. might bias the answer.

Two sets of experimental studies are apparently more directly related to our research. A first set has investigated the forecasting ability of human subjects in an effort to identify possible sources of forecasts bias: Affleck-Graves et al. (1990), Maines and Hand (1996), Calegari and Fargher (1997) and Gillette et al. (1999). In these experimental studies, in varying contexts, subjects are given a certain

number of data on the EPS or dividends of a given asset and are asked to forecast the next EPS or the next dividends. The framework is compatible with our notion of pessimism as a transformation of a given distribution. However, the approach and the aims of these different papers are quite different from ours. Indeed, the main aim is either to measure individuals' ability to forecast or to observe how individuals react to the release of information. Hence the adopted approach is not suitable in order to measure what we refer to as pessimism. For instance, in Affleck-Graves et al. (1990), the participants were given a certain number of consecutive quarters of actual EPS data and were asked to provide a forecast for the next quarter. The authors find that the forecasts exhibit significant positive bias and conclude that there is an optimism bias. But from our point of view and let aside the problem that the random variable to be forecasted is too complex, these data do not correspond to something owned by the participants, high values for the next EPS are neither "good" nor "bad" for the respondent, and henceforth the prediction errors can not be considered as a measure of the degree of optimism or pessimism. They only reflect the way individuals extrapolate future terms of a partially observed series of numbers.

The aim of the second set of experimental studies is mainly to calibrate models of Prospect Theory in order to determine the shape of the probability weighting function. Parametric (Tversky-Kahneman, 1992, Camerer-Ho, 1994, Wu-Gonzalez, 1996, Gonzalez-Wu, 1999) as well as non parametric approaches (Prelec, 1998, Bleichrodt-Pinto, 2000, Abdellaoui, 2000) have been adopted and they all agree on an inverse S-shaped probability weighting function, which means that it overweights unlikely (extreme) outcomes and underweights outcomes with a medium or large probability relative to the objective probability. To our knowledge, no clear-cut conclusion has been drawn regarding pessimism.

Our objective is now to construct a survey that permits to measure the individual level of optimism/pessimism in an economics and finance framework (unlike the studies in psychology). The lessons learned from previous literature lead us to impose that the survey satisfies the following requirements.

It should be based on hypothetical scenarios in order to avoid environmental effects like the insider bias effect of analysts.

The sample should be large enough in order to run cross sectional analysis (which is not the case in the decision theory based experimental studies).

It should be consistent with our definition of pessimism as a transformation of an objective distribution into a subjective one. The setting should be simple enough to be consistent with all different models of subjective beliefs and different

notions of pessimism introduced in theoretical models, so that the obtained measure is independent of the choice of a specific decision theory model. Moreover, it should lead to a *direct* measure of the level of optimism/pessimism and should not involve other individual characteristics like risk aversion, or other feelings like overconfidence, loss aversion, regret, doubt, etc.

Our measure should lead us to consider as optimistic people that overweight "good" states of the world and underweight "bad" states of the world. This means that we have to set up lotteries in which some states are identified as unambiguously good (resp. some others as unambiguously bad) and clearly correspond to good (resp. bad) outcomes for the individual. This is not necessarily the case when the questions deal with a future value of GDP growth or with a future value of a true or artificial asset if this asset is not held (in positive quantity) by the individual.

2.2. Our approach

We shall design a survey based on hypothetical questions. Indeed, as we have underlined it, we want to be able to distinguish between optimism/pessimism caused by environmental factors (for instance unique to analysts) with optimism/pessimism caused by human decision biases that may be typical of all economic agents. With hypothetical questions, environmental factors and incentives (e.g. unique to analysts) are absent and human psychological bias is more clearly evident.

The hypothetical questions deal with heads or tails games. The participant is first supposed to be offered the opportunity of entering a heads or tails game in one draw. More precisely, a coin is being tossed once; if heads occurs, the participant is supposed to get 10 Tunisian dinars ($\approx$ 6.50 Euros), and if tails occurs, the participant is supposed to get nothing. The first question deals with the maximum amount the participant is willing to pay to enter the game.

Then the participant is confronted with the opportunity to play ten times this game. He/she is again asked about the maximum amount he/she is willing to pay. An additional question consists in asking 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 the ten Tunisian dinars).

Answers to the first two questions permit to determine the risk aversion level of participants. Answers to the third question will permit to have a direct measure

of the degree of pessimism/optimism of the individual in a financial gains context. The event "heads occurs" corresponds to a gain for the individual, it is therefore legitimate to consider it as a good event for the individual and the subjective probability associated to this event as a measure of the individual optimism. Such a measure of Pure-Hazard Introspective Pessimism can be directly estimated by the number of times $x_i \in \{0, ..., 10\}$ that the individual i thinks he is going to win (the subjective probability that the individual associates to the event "heads occurs" is then given by $\pi_i = \frac{x_i}{10}$). Indeed, a pessimistic individual shall be characterized by a value of x_i below the objective value of 5 and the distance to 5 measures the intensity of his PHIP ($o_i = \frac{x_i - 5}{5}$).

A few remarks are to be made. Notice first that like in the theoretical models, our notion of pessimism is related to the way an individual transforms an objective distribution into a subjective one. Moreover, in the simple context of a unique binary lottery, all decision theory models can be reduced to the choice of a given subjective probability and all concepts of pessimism are equivalent. This means that we need not adopt a specific model nor a specific concept of pessimism in order to elicit the presence of pessimism in individual beliefs.

We chose questions on lotteries since our aim is to determine if pessimism affects investors beliefs and how in a financial or economic framework and lotteries are usually considered as a simple way to model financial investment opportunities. Notice that we adopted, on purpose, a lottery whose outcomes have an equal probability of 0.5, to avoid the influence of the overweighting of low probabilities and underweighting of high probabilities (as highlighted by the experimental studies on PT, RDEU, CPT) in order to focus on the concept of pessimism itself.

The introduction of the ten times procedure is intended to provide the individuals with a simple framework, helping them to reveal their subjective probability associated to the event "heads occurs". 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. However, 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.

We shall also adopt an approach similar to Wenglert and Rosen (2000) in order to determine a measure of personal and general pessimism for the individuals in our sample. We shall then be able to analyze the link between our notion

of "pure-hazard introspective pessimism" and the usual notions of pessimism in psychological literature, e.g. personal as well as general pessimism. This will also permit to compare our results with previous ones obtained in the literature.

3. Survey instrument (data collection)

The survey was conducted face-to-face in the field by professional interviewers. The sample consisted of Tunisian adults, between 22 and 55 and yielded 1,540 responses.

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. Furthermore, Battalio et al. (1990) find that, quantitatively, subjects responding to real payoffs tend to be slightly more risk averse than subjects responding to hypothetical payoffs, but that qualitative conclusions based on the two settings tend to be the same. 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. The answers would then involve pessimism as well as risk aversion, and,

as we have underlined it several times, this is what we want to avoid. 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 and, like in the experimental studies (Affleck-Graves et al. (1990) and others), the approach would not be suitable to elicit pessimism. Note finally that it would be interesting to confront the individuals with real lotteries (without rewarding the main question on the beliefs), but, as previously underlined, it is very likely that the qualitative conlusions would remain the same.

As mentioned in e.g. Hartog et al. (2002), there is a special problem linked to non-response and response with zero probability of winning. Indeed, zero 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.

The questionnaire consists of essentially five parts[5].

The first part deals with the one draw game. After the first two questions that deal with the willingness to participate in a game of chance and why (religious grounds, etc.), in the third question, the individuals are asked to reveal the maximum amount that they are willing to pay in order to participate.

The second part deals with the game in ten draws. The individual is asked about his estimation of the number of times he is going to win as well as the maximum amount he is willing to pay to participate in the game.

The third part deals with questions as in Barsky et al. (1997) permitting to elicit the level of individual relative risk aversion. The data shall not be analyzed in the present paper.

The fourth part deals with optimism/pessimism questions as in Wenglert and Rosen (2000). 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 probability of occurrence (between 0 and 100). For negatively formulated questions, the participants had sometimes trouble interpreting the question about the importance granted to

[5] The whole questionnaire is available upon request.

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

4. The results, possible interpretations and applications

We are interested in the notion of PHIP itself (the distribution among individuals, the 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). We shall also analyze the impact of individual pessimism on the equilibrium risk premium.

4.1. Pure-Hazard Introspective Pessimism (PHIP)

Figure 1 illustrates the distribution of our measure of optimism among individuals.

Figure 1: Distribution of PHIP

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

This result is consistent with Gillette et al. (1999) and other previous experimental studies, according to which there is some heterogeneity in subjective expectations, even though the individuals have access to the same public information (in our setting, the distribution of the random payments); this heterogeneity comes from a different subjective processing of information. In Gillette et al. (1999), this different processing of information in a dynamic setting is linked to heuristics like the anchoring effect or the gambler's fallacy. In empirical studies on professional forecasts, it is linked, as we have underlined it, to the insider bias. In our context, the questionnaire has been designed in order to avoid all these effects and the pessimism seems then to be a primitive individual characteristics. It

would be interesting to analyze the origin of such a behavioral pessimism through psychological studies.

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

Table 1: Descriptive statistics of PHIP

For the considered sample of 1,540 individuals, the mean value for the measure of optimism is equal to -0.215 (Table 1). Equivalently, the mean value for the number of times the individual thinks he is going to win is equal to 3.925 or the mean subjective probability is equal to 0.3925. It is significant and quite striking to observe that when asked about how many times he/she is going to win at a heads or tails game in ten draws, an average individual does not answer 5 times as he/she should if thinking under the objective probability, but answers slightly less than 4 times. This means that, with our notion of pure-hazard introspective pessimism, the individuals in our sample are on average pessimistic. This result is in favour of the existence of a behavioral bias towards pessimism in individual beliefs.

The 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, Abarbanell and Lehavy, 2001, 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.

There is no evidence of pessimism in Affleck-Graves et al. (1990), Maines and Hand (1996), Calegari and Fargher (1997) and Gillette et al. (1999) but, as we have underlined it, this is not surprising since the experiments are not designed to measure optimism/pessimism in our sense. However, it is interesting to notice that in these experiments, the forecasts are more pessimistic in the market sessions where the agents hold the 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. 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

Figure 2: Distribution of PHIP by gender

Pessimism and gender. 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. This is confirmed by a Wilcoxon test ($W = 277181$; $p\text{-}value = 0.01272 < 5\%$).

Pessimism and age. By sorting the individuals into age classes, and by computing the average value for our measure of pessimism for each class, we obtain the following results, which show a decreasing relationship between optimism and age (Table 2). Spearman's and Kendall's tests confirm a decreasing relation, even though the Rhô and the Tau are small ($S = 666313384$, $Rh\hat{o}$=-0.08477426, $p - value = 0.01211$[6] and $Z = -3.6402, Tau = -0.06191076$, $p - value = 0.0001362$).

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 2: PHIP and age

[6] The alternative hypotheses are such that Tau and Rhô are negative.

Pessimism and income. 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 leading to the following results.

Income	≤ 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 3: PHIP and income

The Kruskall Wallis test indicates that these variables are linked ($KW = 14.0656, df = 6,\ p - value = 0.02891$). It seems on the means by class that there is an increasing relationship between pessimism and income.

It is interesting to notice that our measure of pessimism has the properties usually granted to risk aversion, i.e., it is greater for women than for men, it increases with age and decreases with income.

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 (Table 4). Wenglert 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.

Figure 3 : PHIP, personal pessimism and general pessimism.

	Min.	Max.	Mean	Std. Dev.
IOP	-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

Table 4: Descriptive statistics of PHIP, Personal Pessimism and General Pessimism

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

	Kendall'sTau	Spearman's Rhô	Pearson Correlation
PHIP / Pers. Pessimism	$0,138^*$	$0,190^*$	$0,143^*$
PHIP / Gen. Pessimism	$-0,029$	$-0,040$	$0,025$
Pers. Pess. / Gen. Pess.	$0,113^*$	$0,169^*$	$0,210^*$

Table 5: Results of Kendall's, Spearman's and Pearson's tests. *: significatively different from 0.

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[7]" (Q3), since intuitively, they should have a link with our notion of PHIP.

	Kendall	Spearman	Pearson Correlation
PHIP/Q1	$-0,231^*$	$-0,299^*$	$-0,295$
PHIP/Q2	$-0,211^*$	$-0,272^*$	$-0,267$
PHIP/Q3	$0,148^*$	$0,193^*$	$0,195$

Table 6: Link between PHIP, (Q1), (Q2), (Q3).

[7]The promosport is a game of chance dealing with sport results.

Table 6 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.

4.4. Impact on the Risk Premium

In a continuous time CCAPM model with a subjective belief, it is easy to obtain an adapted CCAPM formula that clearly reflects the impact of the representative agent's pessimism. Indeed, it is easy to obtain (see, e.g., Jouini-Napp, 2004) that the difference between the level of the Market Price of Risk in the subjective belief setting and in the standard setting is precisely given by the level of pessimism of the representative agent. The presence of pessimism increases then the market price of risk and might contribute to giving explanations to the risk premium puzzle.

More precisely, the model is the following. We assume that aggregate consumption/wealth e^* satisfies the stochastic differential equation

$$de_t^* = \alpha_t e_t^* dt + \beta_t e_t^* dW_t, \qquad \beta > 0$$

under the objective probability P, where W is a standard Brownian motion under P, and α and β represent respectively the drift and the volatility of aggregate wealth under P. We assume that the SDE satisfied by e^* under the subjective probability Q is given by

$$de_t^* = \alpha_t^Q e_t^* dt + \beta_t e_t^* dW_t^Q, \qquad \beta > 0$$

where W^Q is a standard Brownian motion under the subjective probability Q, and α^Q represents the drift of aggregate wealth under Q[8]. In a natural way, the subjective belief is pessimistic if it lowers the subjectively expected instantaneous rate of return of aggregate consumption/wealth. Since the subjectively expected instantaneous rate of return of aggregate consumption/wealth is given by α_t^Q, the subjective belief is pessimistic if and only if $\alpha_t^Q \leq \alpha_t$ or equivalently, letting $\delta_t \equiv \frac{\alpha_t^Q - \alpha_t}{\beta_t}$ denote the deviation in mean in units of standard deviation, if and only if $\delta_t \leq 0$.

In our survey, we obtained that the average subjective probability of the "good state" is $\overline{\pi} \equiv \frac{1}{N}\sum_{i=1}^{N} \pi^i \approx 0.3925$. It is easy to see that for the considered lottery

[8]Notice that, in such a model, if the subjective probability is equivalent to the initial probability, the volatility of e^* is necessarily the same under both probabilities.

the quantity δ is given by $\delta = \frac{10\overline{\pi}-5}{5} \approx -0.215$. For a GDP growth volatility of around 1.5%, our level of pessimism is equivalent to an underestimation of the GDP growth level of approximately 0.32% ($\delta \times 1.5 = 0.3225$). Giodarni and Söderlind (2005), for the 1982-2002 sample, obtain that professionals participating in the Survey of Professional Forecasters underestimate the GDP growth by 0.64% on average (which is greater than our 0.32%). Nevertheless,when they consider the period 1972-2002, the underestimation of the GDP is of 0.2% on average (which is lower than our 0.32%). Moreover, this implies that on the period 1972-1982, the forecasters have *overestimated* the GDP growth by 0.68% It seems therefore difficult to draw conclusions on the level of pessimism from such empirical studies, since the results are apparently highly dependent upon the considered period and the environmental factors.

Our results seem to show that there is a persistent *behavioral* pessimistic bias, which should not depend upon the environment and we shall now calibrate its impact on the equilibrium risk premium.

We have in Jouini-Napp (2004):

Proposition 1. *The equilibrium market price of risk (MPR) with a subjective belief is given by*

$$MPR\,[subjective] = MPR\,[standard] - \delta \tag{4.1}$$

The interpretation of this result is the following. The representative agent's pessimism leads him/her to underestimate the average rate of return of equity leaving unchanged his/her estimation of the risk free rate. Thus, the objective expectation of the MPR is greater than the representative agent's subjective expectation hence is greater than the standard MPR. Note that in this specific setting, the choice of a subjective probability is completely characterized by the choice of δ, which measures (in units of standard deviation) the change in mean induced by the subjective probability.

We have obtained in the survey $\delta \approx -0.215$, which implies that for an asset whose volatility is given by 15%, the (theoretical) equilibrium risk premium[9] is increased by approximately 3.2% in the subjective beliefs setting compared to the standard setting. Implicit in our calibration is the idea that individual beliefs are characterized by the parameter δ, independently of the specific frameworks. In other words, we assume that the individual cognitive bias, when facing a pure-hazard situation, is measured by the deviation in mean, in units of standard deviation.

[9] The risk premium is given by MPR$\times$volatility

5. Conclusion

In this paper, we have shown that there is a pessimistic behavioral bias in individual beliefs in a 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.

When embedded in a capital markets equilibrium framework, pessimism has a direct impact on the equilibrium risk premium, as shown by Abel (2002) and Jouini-Napp (2004, 2005a). The survey we conducted permits to calibrate this impact.

It is a delicate question to identify the origin of the elicited pessimism. The observed pessimism might result from an individual learning process, where indiduals 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 systematically underestimate their probability of success. Finally, people seem to be regret averse in their choices (Joseph et al., 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.

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