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Ambiguity Aversion and Illusion of Control: Experimental Evidence in an Emerging Market

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This paper investigates behavioral effects known as illusion of control and ambiguity aversion using an experiment with business and economics students in Brazil. Empirical results suggest that people present both ambiguity aversion and illusion of control. Nonetheless, most agents are not willing to pay a premium to reduce or eliminate ambiguity aversion and to gain "control." These results share some similarities with results for developed markets, but it seems cultural differences may play a role in these results.

Keywords: Behavioral Finance, Illusion of Control, Ambiguity Aversion, Experimental Economics

INTRODUCTION

According to traditional financial theory, individuals are considered rational in order to identify and use relevant information and be able to make optimal decisions. Rationality means, according to Bernatzi and Thaler [2002], two things: first, when individuals receive new information, they update their beliefs accordingly; second, considering their beliefs, individuals make decisions that are considered acceptable, in other words, consistent with Savage's Expected Utility Theory [1953].

The behavioral finance theory proposes that some financial phenomena can be better understood once we adopt models in which the agents are not completely rational. More precisely, this theory analyses what happens when we relax one or both premises of the classical financial theory.

Thaler [1994] affirms that in the financial market there are only two profiles for investors: the completely rational and the almost rational. The latter try to make good investment decisions, but make predictable mistakes that come from flaws in the rational process.[1]

In this paper, we test for two behavioral effects known in the literature as illusion of control and ambiguity aversion. In total, 196 people participated, the target public being students of economics and business of the Catholic University of Brasília.

The experiments performed offered the possibility to test the effects of relevant information and how the agents behave in risk situations that offer multiple choices. Through systematic and controlled changes of the studied variables in the experiments we found the choice biases. Financial incentives were offered to the participants to create a realistic investment scenario. We follow Charness and Gneezy [2003] and obtain similar results regarding illusion of control and ambiguity aversion.

The rest of the article is divided in the following manner: the next section presents a review of the literature. The third section presents the experiments that were performed and discusses the results. The fourth section concludes the paper.

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LITERATURE REVIEW

The classical financial literature is based on the Expected Utility Theory (Savage [1953]). Contrary to this theory, the psychological cognitive theory explains the decision as an interactive process in which non-trivial factors such as perceptions, convictions and mental models of the decision taker

have an influence. Intrinsic reasons such as emotions, state of mind, tendencies and psychological attitudes when it comes to relating one event with another, peculiar to each decision taker, can influence a decision as much as external incentives. More so, the memory of prior decisions and their consequences, represent a critical cognitive function that influences present decisions. Due to this complex vision, human behavior is conditioned to a determined situation, in other words, it depends on the context and on the observed conditions.

Tversky [1972] observed that individuals normally use different strategies of analysis when confronted with many alternatives and when the time to make the decision is limited. In these situations, they do not mentally analyze all the attributes and all the available options. The author verified that in decisions involving choices among various alternatives, individuals use an elimination process by aspect. First, they select an aspect or attribute among the various options that are available and create a minimum criteria for it. All options that do not satisfy the criteria are eliminated. Afterwards, individuals select another aspect, which is applied to the remaining options. This process, according to Tversky, is repeated until one option remains.

Tversky and Kahneman [1974], when performing an experiment to study the elimination by criteria, observed that many individuals used mental shortcuts that generally limited or distorted their capacity to make rational decisions. Many of the daily decisions are based on beliefs related to the probabilities of uncertain events. Sometimes, these beliefs are expressed through numerical formulas, such as subjective probabilities. They questioned what determined such beliefs and how individuals calculated the probability of a certain event. Finally, the authors demonstrated that people believe in a limited number of mental shortcuts that reduce the complex tasks of calculating events and predicting values. The biggest problem with mental shortcuts is that they eventually lead to grave systemic errors.[2]

Innumerous behavioral effects were documented in the decision making of an investment. Some important effects are nearsighted risk aversion, overconfidence, illusion of control and ambiguity aversion among others. This paper will focus on the last two effects.

Illusion of Control

Taylor and Brown [1988] define illusion of control as an unreal perception of an event. They analyzed different forms of illusion, classifying them as unreal self-evaluation, exaggerated perceptions of control and unreal optimism. They complement their work by affirming that illusion is a false mental image or conception that can come from flawed interpretation of something real or even something imagined by the individual.

A traditional concept of mental health states that the human being possesses conscience, accepting the positive and negative aspects associated with their characteristics. In contradiction of this affirmation, empirical evidence indicates that the majority of individuals have a positive self-evaluation (Greenwald [1980]). When asked to indicate the positive and negative aspects of their personalities, participants showed a strong belief that the positive aspects strongly outweighed the negative. In addition, according to the majority of the individuals, the positive information related to their personalities is processed in an efficient manner and/or more easily remembered, while the negative information is not as efficiently processed and not easily remembered (Kuiper and MacDonald [1982]).

Lewinsohn et al. [1980] performed an experiment with high school students in which they had to elaborate a ranking including each student from the group and themselves with adjectives that represented their personalities (e.g., friendly, caring, kind, dedicated). The results showed that self-evaluations were almost always higher than the evaluations of their colleagues; in other words, individuals consider themselves to be better than the rest of the group.

A second category of illusion appears when the majority of individuals believe to possess more control than they actually have, if they ever possess any, over random events.[3]

In a series of experiments using different game formats, Langer and Roth [1975a, 1975b] found that individuals generally make their decisions based on the belief that they possess control over a situation that involves a choice, but in fact results associated to these type of situations are determined by probabilities independent of any involvement of the individuals. Goffman [1967] through an experiment demonstrates that the participants behave as if the results of proposed situations were determined by the involved abilities and, therefore, they could have a certain amount of control.

Illusion of control is a term in reference to the belief that it is possible to influence random events. Examples of this would be gamblers who offer a premium for tickets with numbers of their preference, or the higher tendency to bet on "heads or tails" when the coin has not been tossed based on the belief that they can have influence over the result of an event that has not yet occurred (Thaler [1992]).

The expression "illusion of control" was employed by Langer and Roth [1975a, 1975b] to demonstrate, after performing a series of experiments, that people overrate their influence on events of probability when they are given options of choice. Langer and Roth [1975a, 1975b] define illusion of control as an expectation of probability of personal success that is higher than the real probability of the event. The author shows that choice, familiarity with the tasks, competition and active involvement lead individuals to increase their affirmations and confidence. For example, the agents that choose their own numbers on a lottery ticket attributed higher values to these tickets than ones with numbers that had already been defined. After this initial study, other researchers found that agents normally sense more control over a determined situation than they actually possess, making casual connections where none really exist.

Presson and Benassi [1996] performed an experimental analysis containing 53 experiments of illusion of control and made a distinction between illusion of control and illusion of prediction. They found better results, in other words, a higher identification of the phenomena in experiments that measured the perception of the participants concerning their ability to predict events than in experiments that measured the ability to control events. As a matter of fact, the authors pointed out (p. 496) that "few experiments really measured illusion of control in the sense that the choices offered to the participants influenced and affected the results." However, it is believed that certain people have a preference for control over events. For example, the agents believed that they would have more control if they threw the dice in a certain game than they would if someone else threw the dice.

Ambiguity Aversion

According to Savage [1953], the mathematical concept of probability is crucial for the definition of consistency conditions of any action facing uncertainty. The author identifies three classes of interpretations of mathematical probability concepts: (i) the objectivist, which interprets probability as observed repetitions of an event; (ii) the personalist, which interprets probability as a measure of the trust level of an individual in the truth of a particular proposition, allowing variations of that trust level among reasonable individuals confronted with the same factual evidence; and (iii) the necessary or logical, which defines probability as a measure of the extension in which a set of propositions confirms the truth about another, by simple logical necessity, without regard to opinions.

In the following passage, Savage criticizes the necessary version:

> "It is attractive to suppose that, if two individuals in the same situation, having the same tastes and disposing of the same information, act reasonably, they will act in the same manner. This agreement, which is the basis of the necessary vision (as opposed to the personalist) of probability, is certainly worth research. Personally, I believe that this does not correspond, not even remotely, to reality [. . .] I insist upon the fact that, until proven contrary, we should be prepared to judge the inadequate reasoning in order to reach the complete agreement.[. . .] It is possible, and I personally think that it is so, that there is an element in the decision, which transcends taste, over which, as in the case of taste, there can be no argument or dispute." (Savage, 1953, p.7)

The decision problem to which Savage makes reference, and for which the solution supposes that rational individuals are capable of proceeding to probabilistic calculations, is the one of choice under uncertainty toward external events. It is justified to ask if it makes sense to estimate necessary probabilities when agents and environment interact, as they do in social interaction. In the latter, the probability estimates reflect the expectations or beliefs of the agents toward the behavior of the others who also build expectations toward the actions of the first agents. In other words, the uncertainty caused by probabilistic calculations is referred to endogenous events. It is fair to ask if there is, in this context, some mechanism from which beliefs are created and reviewed in order to become rational beliefs and, therefore, converge.

Knight [1921] distinguishes uncertainty risk, the risk being quantifiable in terms of probability. Knight assumes that in situations of uncertainty, the use of probabilities is inappropriate. Uncertainty situations are classified as situations in which the decision maker is not aware of the statistical frequencies of the events that are relevant to his decisions, or when it is impossible to make preliminary calculations for the events.

Even in situations of uncertainty, people tend to make decisions as if they knew the probabilities of the events involved, or make decisions based on personal beliefs.

Shackle [1955] proposed an example for the analysis of uncertainty considering an extreme case of the Knight theory, in which statistical information of frequency with a large and repeating class of events is strictly irrelevant for the decision making if the returns depend on a single round. Shackle not only rejects numerical probabilities as a representation of uncertainty, but he also maintained the affirmation that in situations in which all the probabilities of response can occur, considering that they do not violate some imposed restriction causing surprise, it is impossible to estimate the final result.

Ellsberg [1961] performed several experiments with the purpose of contesting the axioms of Savage [1953], showing that people have preference for investing or betting in situations that present a known distribution, that is, situations in which it is possible to predict the results through probability. In one of the performed experiments, individuals were asked to choose from the colors black and red and then asked to withdraw a ball from a closed box. Ellsberg proposed two possibilities of choice for betting. The first possibility was to bet on box I, which presented an unknown distribution with 100 black and red balls. The second possibility was to bet on box II, which presented a known distribution with 50 black balls and 50 red balls. The result of the experiment showed that the participants had a preference for betting on the known distribution, that is, withdrawing the ball from box II. This result contradicts some of the axioms from Savage. For example, suppose that betting on the color red, the individual would prefer to withdraw the ball from box II, bet red_{II}. Applying the basic Ramsey-Savage rule, we conclude that option red_{II} has a higher probability than option red_{I}. Considering that it is not possible to define which option, red_{II} or red_{I}, is the most likely, we conclude that the choice was not made through probability. Therefore, since in this case it is impossible to make any probability inference in the choice of option I, some of the Savage axioms have been violated. The results of his experiment suggest that individuals do not appreciate situations in which they do not know

the distributions of probability of a certain game. Such ambiguity situations generate discomfort, indicating ambiguity aversion. Ambiguity aversion means that people prefer to assume risks based on known probabilities, instead of unknown probabilities. In other words, their personal information, regarding the subject to be decided, has decisive importance.[4]

Fox and Tversky (1995) proposed the concept of comparative ignorance hypothesis, according to which ambiguity aversion is produced in ambiguous events versus less ambiguous events or in individuals with great intellectual baggage. This hypothesis has support in the results of experimental studies, which showed the existence of ambiguity aversion in situations where the participants evaluated simultaneously a situation with a vague context and another with a clear and objective context. In contradiction, in the experiments that presented the same situations mentioned above, but isolated, ambiguity aversion was not captured.

Heath and Tversky [1991] conduced experiments to clarify the question: is the preference for decisions restricted to situations of choice involving events with or without the knowledge of probability of success, or is the preference determined by the existence of personal beliefs based on the knowledge of the world? The experiments compared the willingness of the individuals to bet on events with unknown probabilities, with the willingness to bet on events with known probability. In contradiction with the concept of ambiguity aversion, the authors observed that the individuals preferred to bet using their beliefs instead of known probabilities. This result occurred because the theme evaluated in the experiments was the specialty of the participants; therefore, they felt competent and confident. When the theme of the experiments was not their specialty, people betted on the option with the known probability.

The purpose of this work consists of testing the hypotheses of ambiguity aversion and illusion of control in a group of Brazilian students through experiments that simulate real decision-making situations under uncertainty. The experiments suggested in Charness and Gneezy [2003] were used to test these two hypotheses and the results compared with the ones obtained in the United States. Given the many cultural differences between Brazil and the United States, a relevant question is whether it is possible to obtain similar results. The next section presents in detail the experiments that were realized and the results that were obtained.

EXPERIMENTS AND EMPIRICAL RESULTS

We follow Charness and Gneezy [2003] in our illusion of control and ambiguity aversion experiments. In the next subsections we discuss each experiment and results obtained.

Illusion of Control

The experiments of illusion of control were performed in classes of the Catholic University of Brasília. A total of 106 students participated in the sessions, each student participating only once in each experiment.

The instructor asked the students to maintain a total lack of communication between them in order to obtain non-biased results. At the beginning of each experiment, each individual was handed a sheet of paper containing the instructions and a space to fill out his or her decisions/choices.[5] The students were confronted with a scenario where they were forced to take risky decisions. They had to decide how much of their initial assets they would invest and how much they would keep for themselves. Students were given 100 units of endowment (10 reais). The risky investment presented a 50% chance of success, with a return of 2.5 over the investment. Participants had to choose three numbers out of six possible ones (numbers 1 to 6 on a die) and only one throw would determine the winning number. They were also informed that 10% of the participants would be chosen by chance to receive payment in cash, according to the results of the investment.

The instructions of the four experiments related to the theme illusion of control will be described briefly:

Experiment 1: The participants were to choose three numbers out of six possible numbers (numbers on a die), the percentage to be invested in the risky investment and finally, who would throw the die, themselves or the instructor, without any cost for their choices.

Experiment 2: The participants were to choose three winning numbers out of six possible numbers (numbers on a die) and the percentage to be invested in the risky investment. In this experiment, the participants were to throw the die.

Experiment 3: The participants were to choose three winning numbers out of six possible numbers (numbers on a die) and the percentage to be invested in the risky investment. In this experiment, the instructor was to throw the die.

Experiment 4: The participants were to choose three winning numbers out of six possible numbers (numbers on a die), the percentage to be invested in the risky investment and finally, who would throw the die, themselves or the instructor. However, they were to pay 5% of their initial assets if they chose to throw the die themselves.

In the first experiment, the students decided who was to throw the die, themselves or the instructor. They also chose which proportion of their initial assets would be invested in the risky investment. In experiment 4 the choices were exactly the same, however they had to pay 5% of their initial assets if they chose to throw the die themselves. In Figure 1 we present the percentage of participants that chose to throw the die on both cases.

When the choice to throw the die, in other words, to exercise the preference for control is free of charge, 14 out of 21 individuals (66.67%), chose to throw the die. If the individuals were indifferent, it was expected that 50% would

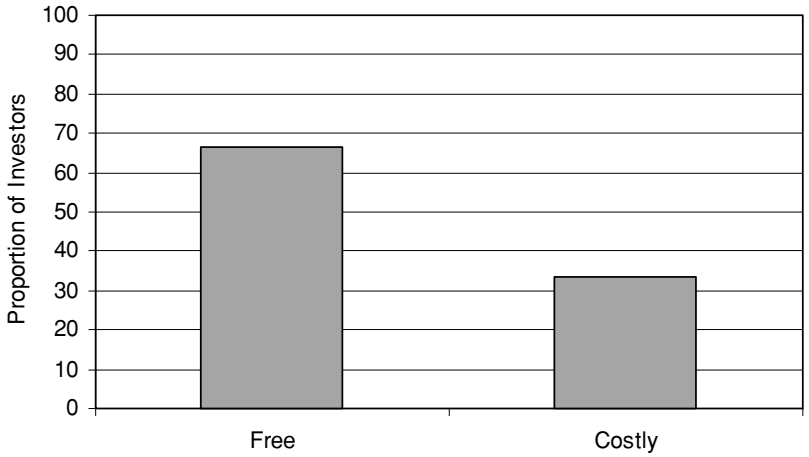

FIGURE 1 Preference for Control Experiments 1 and 4 correspond to the experiments without cost and with cost, respectively.

choose to exercise the preference for control. The binomial test of proportion of students that chose to throw the die is different from the random prediction ($Z = 1.53$, $p = 0.06$, one-tailed test). On the other hand, when 5% of the initial assets are charged for the agent to throw the dice, the proportion of participants that chose to throw the die fell drastically to 4 out of 34, which corresponds to 11.76% ($Z = -4.46$, $p < 0.01$, one-tailed test). This way, the results suggest that although agents may have illusion of control, they are not willing to pay a price to exercise that control. This change in proportions is statistically significant ($Z = 4.21$, $p < 0.01$)[6].

Figure 2 shows the invested proportion in the risky investment in the four experiments performed on illusion of control. A considerable variation in the average proportion invested in the risky investment between the four experiments was noted. In experiment 1 (choice free of charge) the average proportion was equal to 76.43%. In experiment 2 (investor throws die) the proportion was equal to 68.38%, while in experiment 3 (instructor throws die) the proportion fell to 57.86%. Finally in the last experiment (choice with charge) the proportion invested in the risky investment was equal to 87.95%.

Following the expectation that the phenomenon of illusion of control generates more confidence in the investors, it was expected that the average proportion invested in the risky investment would be higher when the participants exercised the control. The difference in proportions invested in experiments 1 and 4 is not statistically significant using the Wilcoxon-Mann-Whitney rank-sum test ($W = 1.424807$, $p = 0.1542$). Therefore, it cannot be stated that the agents invest different proportions in both experiments.

Comparing experiment 2 (investor throws die) with experiment 3 (instructor throws die) the null hypothesis that states that the invested proportions are statistically equal ($W = 1.444367$, $p = 0.1486$) cannot be rejected. However, proportions invested in experiments 3 and 4 are statistically different ($W = 3.73$, $p < 0.01$).

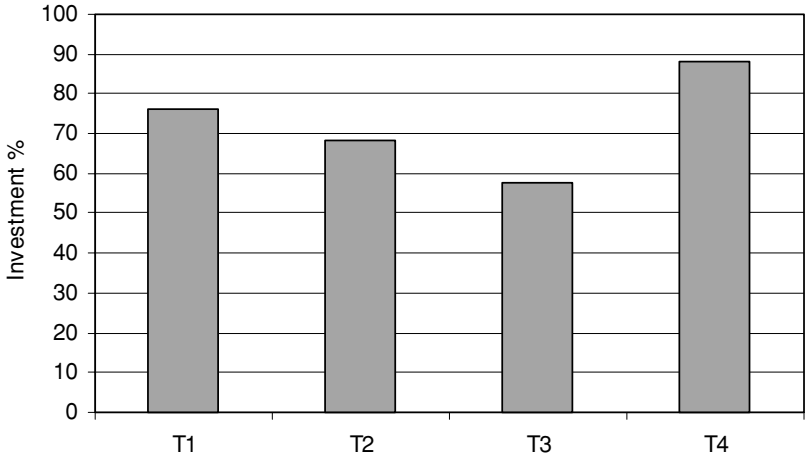

FIGURE 2 Average Proportions of Investment in Risk Investments 1,2,3 and 4 are presented.

Ambiguity Aversion

The ambiguity aversion experiments were performed in classes of the Catholic University of Brasília. A total of 90 students participated in the sessions, each student participated only once in each experiment.

The instructor asked the students to maintain a total lack of communication between them in order to obtain non-biased results. At the beginning of each experiment, each individual was handed a sheet of paper containing the instructions and a space to fill out his or her decisions/choices. The students were confronted with a scenario where they were forced to take risky decisions. They had to decide how much of their initial assets they would invest and how much they would keep for themselves. Students were given 100 units of endowment (10 reais). The risky investment presented a 50% chance of success, with a return of 2.5 over the investment. They were also informed that 10% of the participants would be chosen by chance to receive payment in cash, according to the results of the investment.

The instructions of the four experiments related to the theme of ambiguity aversion will be described briefly.

Experiment 5: Two boxes containing 20 balls each were presented to the participants. Box A presented a known distribution (10 red balls and 10 black balls) while box B presented an unknown distribution. The students were to choose a winning color (black or red), the percentage to be invested in a risky investment and the box from which the ball was to be withdrawn, without any cost for their choices.

Experiment 6: A box containing 20 balls (10 red balls and 10 black balls) was presented to the participants. The students were to choose a winning color (black or red), choose the percentage to be invested in the risky investment and withdraw a ball.

Experiment 7: A box containing 20 balls (unknown distribution) was presented to the participants. The students were to choose a winning color (black or red), choose the percentage to be invested in the risky investment and withdraw a ball.

Experiment 8: Two boxes containing 20 balls each, box A presenting a known distribution (10 red balls and 10 black balls) while box B presented an unknown distribution. The students were to choose a winning color (black or red), the percentage to be invested in the risky investment and the box from which the ball was to be withdrawn. However, they were to pay 5% of their initial assets if they chose to withdraw the ball from the box that presented known distribution.

In experiment 5, 17 out of 28 students chose box A, a proportion equal to 60.71%. The binomial test of proportions suggests that this proportion is not statistically different from the random prediction ($Z = 1.13$, $p = 0.13$). In experiment 8, we verified that 9 out of 33 students chose box A and paid a price of 5% of their initial assets to choose from a box with a known distribution of probability. In this case, the binomial test rejects the random prediction ($Z = 2.61$, $p < 0.01$). This way, approximately one-third of the students would be willing to pay to play with a known distribution. Figure 3 presents the proportions of the agents that chose box A in each experiment.

The binomial test suggests that the difference in proportions invested in experiments 5 and 8 are statistically significant ($Z=2.63$, $p < 0.01$). Therefore, the hypothesis that states that the proportion of students that chooses box A is equal in both experiments is rejected at the 1% significance level. This way, if agents are averse to ambiguity, judging by experiment 5, they are not willing to pay a price to reduce the ambiguity in their risky decisions.

Figure 4 presents the proportions of assets invested in the experiments 5, 6, 7 and 8 (80.71%, 77.00%, 53.55% and 66.34%, respectively). The comparison between experiments 5 and 8 suggests that the average proportions differ significantly ($W = 2.74$, $p < 0.01$). There is no difference between

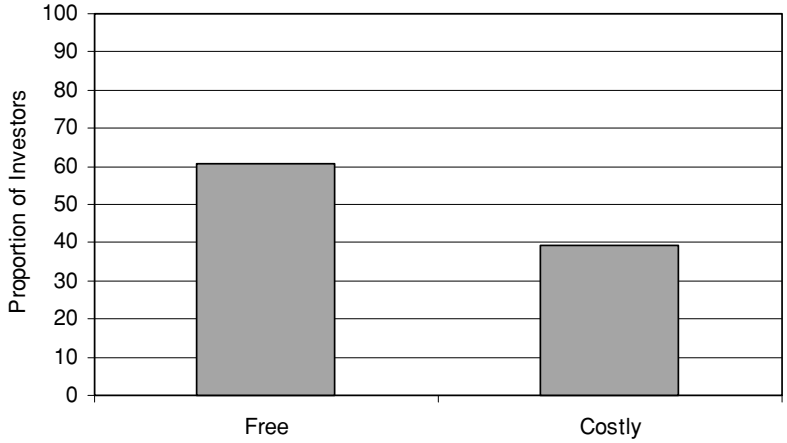

FIGURE 3 Proportion of Agents that Choose Box "A" in Experiments 5 and 8.

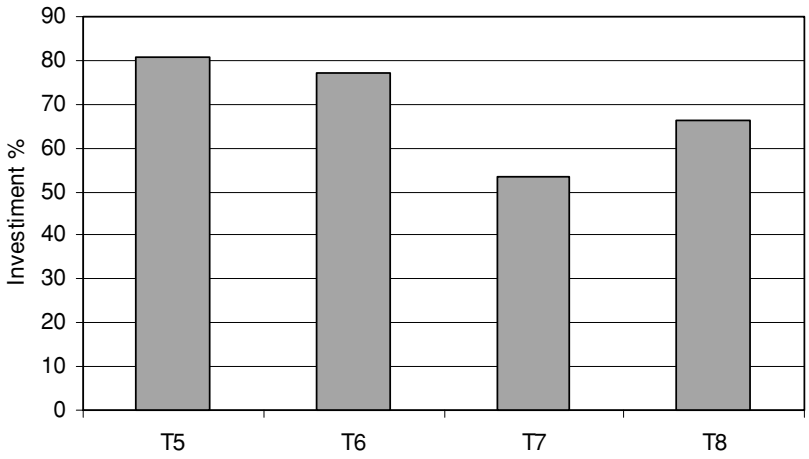

FIGURE 4 Average Invested Proportions in Experiments 5,6,7 and 8.

experiments 5 and 6 (W = 0.46). However, the difference between experiments 6 (known distribution-box A) and 7 (unknown distribution-box B) is significant (w = 2.60, P $<$ 0.01). This reduction follows the prediction of the theory: the invested proportions are significantly higher in the known distribution (ambiguity aversion).

FINAL CONSIDERATIONS

The experiments provided the possibility to test how agents behave when confronted with financial risk decisions. The biases of choice were identified through systematic and controlled changes of the studied variables.

The results showed that agents have the illusion of control, but they are not willing to pay a price to exercise that control. In addition, the invested proportions in situations where agents had control were compared to the ones in situations where they did not have control. In contradiction to the expectation that agents would invest more in situations where they had control, the invested proportions were statistically equal in both situations.

Students presented ambiguity aversion, but few were willing to pay a price to reduce or eliminate the ambiguity. However, the participants proved to be in line with the expectation that they would invest more when the probability of success was known.

Two behavioral differences were found in comparison to the study performed by Charness and Gneezy [2003]: The students of the University of Chicago were willing to pay for less ambiguity; however, they invested equal proportions in situations with or without ambiguity. On the other hand, Brazilian students were not willing to pay for less ambiguity but were disposed to invest more in the experiment that presented known probability, that is, less ambiguity. However, results for illusion of control were very similar. Charging for controlling the experiment eliminates this behavioral bias.

This paper brings a contribution to financial literature showing that the results obtained by other behavioral finance studies may not be easily obtained in other countries such as Brazil. This suggests that cultural differences, social status differences among others, should be taken into consideration before making general conclusions based on experiments. Future research should try to investigate the origins of such differences.

NOTES

1. According to Thaler and Mullainathan [2001], behavioral finance study how economic, sociologic and psychological concepts combine to explain events in the real economy, where the actions of the individuals are not fully rational. In the traditional financial theory, economic agents possess the capacity to operate with unlimited reason, which enables them to make decisions that are compatible with the Expected Utility Theory, forming unbiased expectations on future events.
2. See Sternberg et al. [2000].
3. See Heider [1958].
4. See Tversky and Kahneman [1974].
5. Instruction sheets are available upon request.
6. We employ the test of difference in proportions (see Glasnapp and Poggio [1985]).

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