The effect of small-scale changes in wealth on risk attitudes: an experimental study

Sergio Almeida
Department of Economics, Faculty of Economics Management and Accountancy, University of Sao Paulo, Sao Paulo, Brazil

Received 19 September 2022
Revised 22 February 2023
Accepted 7 July 2023

Abstract

Purpose – This study aims to examine the effects of prior small-scale changes to wealth on subsequent risky choices.

Design/methodology/approach – The paper opted for a laboratory experiment in which subjects perform two sequences of risky tasks. In between these two sets, the author transfers money for real for a randomly selected half of the subjects. Data on choices before and after the transfer of money are used to estimate risk attitudes and analyze whether the transfer of money affected attitudes to risk.

Findings – The author finds that the money gain does not change subjects' risk preferences – neither in a within- nor in a between-subject design. This suggests that individuals' risky choices are consistent with their constant absolute (CARA) risk aversion preferences, a result that supports a key assumption in recent literature on the calibration critique of decision theories and the view that individuals engage in narrow framing.

Research limitations/implications – Because of the relatively small transfer of money, the research results may lack generalizability.

Practical implications – The paper includes implications for the reference-dependent and other theories that explain how prior outcomes affect risk-taking behavior in sequential problems.

Social implications – The results are relevant to the research community studying risk-taking behavior as the results shed new light on a well-known result put forward by a seminal paper by Thaler.

Originality/value – This paper fills in an identified gap in the literature which is the need to test the house-money effect in a more realistic setting (over repeated risk-elicitation tasks, with money given outside the lotteries and in a within-subject design).

Keywords Risk-taking, Small-scale wealth effect, House money effect, Earned money

Paper type Research paper

1. Introduction

This paper aimed to study the effect of a small-scale change on the wealth of subsequent risky choices. This was done using a laboratory experiment where the subjects faced two identical sets of risk-elicitation tasks and a small wealth increment, to be received with certainty at the end of the experiment, was announced between the sets. The risk attitudes of the subjects in the treatment condition were compared with those of the subjects in the control group, where no increment was given, and no change in risk attitudes was found to be induced by the gain.

The author gratefully acknowledges financial support from CAPES (Brazilian Federal Agency under the Ministry of Education for support and evaluation of graduate education). The author would like to thank EconomiA's Associate Editor Benjamin Tabak for the feedback on this paper. Finally, the author is very grateful to two anonymous reviewers for their careful reviews and constructive suggestions. All remaining errors are the author's own.

EconomiA
Vol. 24 No. 2, 2023
pp. 219-229
Emerald Publishing Limited
e-ISSN: 2358-2820
p-ISSN: 1517-7580
DOI 10.1108/ECON-09-2022-0132

The assumptions about how changes in wealth affect attitudes toward risk underpin the empirical and theoretical results in a broad range of topics in economics. Ogaki and Zhang (2001), for instance, point out how strikingly different the empirical tests of the risk sharing hypothesis underlying household consumption models can be when the estimation methods are based on preferences that allow relative risk aversion to decrease as a household becomes richer. The models dealing with phenomena as diverse as life-cycle savings (Weil, 1993), portfolio choice (Hadar & Seo, 1990), and asset pricing (Gollier, 2001) make predictions that are extremely sensitive to the way risk attitudes are affected by changes in wealth.

Despite the importance of understanding how changes in wealth affect attitudes toward risk, the empirical and experimental evidence on this issue is still mixed, and results are sometimes controversial. Rosenzweig and Binswanger (1993), Guiso, Jappelli, and Terlizzese (1996), Guiso and Paiella (2008) and Ogaki and Zhang (2001), for instance, supporting evidence for the decreasing relative risk aversion hypothesis, while Szpiro (1986), using data on insurance, and Chiappori and Paiella (2011), using data on household-level asset holdings, found empirical support for constant relative risk aversion. However, Barsky (1997) and Donkers, Melenberg, and Van Soest (2001), instead found evidence that risk aversion increases with wealth, while Binswanger (1980) found that changes in wealth exert no significant effect on risk aversion. A possible reason for this discrepancy in results could be that most of these studies are based on cross-sectional data involving hypothetical questions on risk-taking behavior and self-reported measures of wealth. Such type of data is potentially bedeviled by bias (see, e.g. Neill, Cummings, Ganderton, Harrison, and McGuckin (1994) and Harrison and Rutstrom (2008)) and the analysis may suffer from identification problems if risk preferences are heterogeneous and wealth measures are not exogenous to individuals' attitudes to risk.

An alternative approach would be a laboratory experiment where wealth can be exogenously manipulated. Though a laboratory experiment cannot produce an extensive map of individuals' wealth states onto their risk attitudes–except at a prohibitive cost–it can produce evidence that complements econometric studies by providing careful controls of risks taken and changes of wealth experienced. While several experimental investigations have offered evidence about attitudes toward scaled-up risks given subjects' initial wealth level (e.g. Harrison, 1986; Holt & Laury, 2002; Bosch-Domenech & Silvestre, 1999, 2006), the contributions that test the effects of changes in wealth on attitudes toward a *given* risk are scarce.

This study contributes to the literature by experimentally eliciting the sensitivity of risk attitudes to small-scale changes in wealth. This was done using a multiple price list method at two different times, say t_0 and t_1. While one sub-group of subjects (treatment group) was awarded money between t_0 and t_1, another sub-group (control group) was not awarded any money, and their choices were used to detect the changing patterns of risk attitudes elicited at t_1 relative to t_0 that are caused by noise, inconsistent preferences, and so on–that is, the changes that cannot be attributed to the changes in outcomes induced by the experimenter. Hence, this paper contributes to this literature by providing a cleaner test of wealth effects on attitudes toward risks.

It was found that the money given to subjects does not affect their attitudes to risk. This is robust to both a within- and a between-subject design. This result contrasts with previous studies that reported a "house-money" effect: a change of risk preferences induced by money given prior to risky choices (see, (Thaler & Johnson, 1990; Battalio, Kagel, & Jiranyakul, 1990; Ackert, Charupat, Church, & Deaves, 2006)). This study argues that the inability of the money given to subjects to induce changes in their attitudes to risk reflects subjects' tendency to not merge their prior gains with the potential consequences of risky choices ("narrow bracketing"). More importantly, as the money given to subjects in the experiment was administered between risky tasks, these experimental results suggest that the effects a monetary gain may have on individuals' risk preferences may be more sensitive to prior experience with the risk-elicitation task than previously thought.

Our paper is related to the existing studies that test key theoretical predictions for how changes in wealth affect risk-taking behavior in portfolio allocation and production decisions. Just (2001), for instance, uses a calibration technique to derive lower boundaries for changes in the curvature of a utility function necessary to rationalize a decrease in absolute risk aversion induced by a scheme of subsidy payments not linked to production. The subsidies, by increasing producers' wealth, reduce their risk aversion and increase production, as Hennessy (1998) suggested. Using annual observation of US agriculture from 1960 to 1999, he finds that the changes in production resulting from subsidy payments would require the producer to be risk-loving to such payments, which is not consistent with a DARA utility function.

The rest of this paper is organized as follows. In the next section, the experimental design is described, and in Section 3, the results are presented and discussed. Section 4 concludes the paper.

2. Experimental design

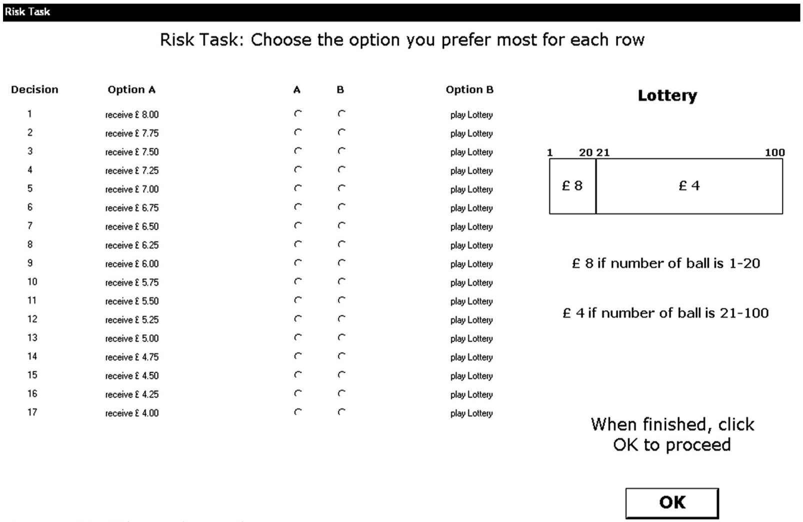
The participants were recruited from an email pool of undergraduate students at the University of Nottingham, UK For a total of 138 participants, 10 sessions, with approximately 14 participants each, were held. Upon arrival, they were welcomed and randomly seated at visually separated computer terminals. The experiment consisted of three parts, and the participants were handed out instructions at the beginning of each part. They were given five minutes to read through the instructions, and then the experimenter read them aloud [1].

2.1 Part one: risk-elicitation

In the first part, the participants were asked to complete a set of risk tasks, without mentioning how many of them there were. These risk tasks were used to elicit their attitudes to risk via a Multiple Price List (MPL) procedure, a widely used method for eliciting risk attitudes from experimental subjects. For each task, a subject faced a number of pairwise choice problems in a table, one per row. Each decision row on the table constituted a choice problem, which was to choose between option A, a sure sum of money, or option B, a binary lottery with only positive outcomes. The participants were then asked to indicate their preference for each option for each row. As one proceeds down the table, the sure amount of money decreased, becoming less and less attractive when compared to the lottery's expected value. Moreover, since the difference between the sure sum and the expected value of the risky option decreased and turned negative from some point on, even an extremely risk-averse individual was expected to switch over to the lottery at some row when going down the table. Figure 1 illustrates what a risk task looked like for a given lottery. Each subject faced a sequence of six such risk tasks in part one. For convenience, Table 1 below presents the set of lotteries used in each of these risk tasks in the order they were presented. All risk tasks involved binary lotteries with strictly positive outcomes. The participants were informed prior to responding to the risk tasks that one of them would be randomly selected, and their winnings determined by the option they chose.

Provided a subject started by choosing A and switched once, the task responses could be reduced to a closed switching interval which the certainty-equivalent of the lottery option falls into. For instance, if a subject crossed over to the risky option

One concern with this elicitation method was that some subjects may switch back and forth between options as they proceed down the menu of choices. This problem was addressed by designing a software for the experiment that did not permit a subject to have multiple switch points; this was done in a similar fashion to the extension proposed by Andersen, Harrison, Lau, and Rutstrom (2006). When one chose option A, say a sure amount



Risk Task

Risk Task: Choose the option you prefer most for each row

Decision	Option A	A	B	Option B
1	receive £ 8.00	○	○	play Lottery
2	receive £ 7.75	○	○	play Lottery
3	receive £ 7.50	○	○	play Lottery
4	receive £ 7.25	○	○	play Lottery
5	receive £ 7.00	○	○	play Lottery
6	receive £ 6.75	○	○	play Lottery
7	receive £ 6.50	○	○	play Lottery
8	receive £ 6.25	○	○	play Lottery
9	receive £ 6.00	○	○	play Lottery
10	receive £ 5.75	○	○	play Lottery
11	receive £ 5.50	○	○	play Lottery
12	receive £ 5.25	○	○	play Lottery
13	receive £ 5.00	○	○	play Lottery
14	receive £ 4.75	○	○	play Lottery
15	receive £ 4.50	○	○	play Lottery
16	receive £ 4.25	○	○	play Lottery
17	receive £ 4.00	○	○	play Lottery

Lottery

£ 8 if number of ball is 1-20

£ 4 if number of ball is 21-100

When finished, click OK to proceed

Figure 1.
Screenshot of risk task

Source(s): Figure by author

Lottery	Payoff 1	Pr(Payoff 1)	Payoff 2	Pr(Payoff 2)	EV	Rows
L1	8	0.2	4	0.8	4.8	17
L2	9	0.2	3	0.8	4.2	25
L3	6	0.4	3	0.6	4.2	13
L4	9	0.3	4	0.7	5.5	21
L5	16	0.2	10	0.8	11.2	25
L6	6	0.4	3	0.6	4.2	13

Note(s): Each entry presents the lottery option used in in each risk task. Payoff 1 and 2 represent the outcome of the lotteries and “Pr(Payoff 1)” and “Pr(Payoff 2)” represent the probability of each outcome, respectively. “EV” represents the expected value of the gamble and “Rows” represents the number of rows in the multiple price list table (for an example, see Figure 1). were presented. All risk tasks involved binary lotteries with strictly positive outcomes when the sure option offered, say, x in choosing the lottery thereafter, then we knew that the sum of money that is regarded as good as the lottery was between x and the sum offered in the next row, $x + \epsilon$. The switching interval midpoint was used as the operational concept of the observed certainty-equivalent. The problem of eliciting an interval response rather than a point estimate was alleviated by choosing a quite small ϵ (0.25), which made the midpoint of the switching interval a more refined estimate of the subjects’ money-equivalent point of the lottery option in each risk task. This variation between the sure amounts of money from decision row to decision row was kept constant across all risk tasks

Source(s): Table by author

Table 1.
Set of lotteries used in each risk-elicitation task

m of money, over option B, the lottery, the computer assumed that option A was also preferred over the lottery whenever it offered a sum larger than m, filling-in the choice buttons accordingly. Likewise, when the lottery option was chosen over m, the computer also assumed that the lottery was preferred to any sure amount of money smaller than m. Before proceeding to a new risk task, the subjects could change their choices and adjust their switching point as many times as they wished. The subjects experienced a risk task trial round before the ones for real to get used to this feature of the software.

This feature of the software had several advantages. First, it helped to alleviate boredom; the subjects who understood it realized that they did not necessarily need to pick an option at every decision row. Second, it offered complete flexibility while embodying a feature that those who understood and took the task seriously would probably want to obey. Third, it allowed the subjects to economize on the "clicking effort", thus simplifying the decision problem and helping them to focus attention on the provision of a switch point as accurately as possible. Fourth, and last, it allowed a more refined elicitation of a certainty-equivalent from the *entire* sample by eliminating the appearance of "anomalous" responses (i.e. responses that violate monotonicity).

2.2 Part two: cognitive test for money transfer

In the second part, the subjects were asked to complete a 12-min cognitive test. They were told that their answers had no effect on their earnings in the experiment.

The cognitive test had two major purposes. First, to allow the small-scale wealth increment to be framed as a reward for completing the test. The idea was to use this test as an "endogenous" treatment administration route: depending on the treatment condition, the subjects were randomly assigned to (more on this later); they learned that a money reward for submitting a complete set of answers to the test was guaranteed at the end of the experiment. This way, they were induced to think that the reward was "earned" rather than received as a "gift" from the experimenter. The second purpose was to crowd out the subjects' working memory; since they would face the same lotteries in a later stage task of the experiment, by going through a cognitive test-type of task, their working memory would be likely loaded with new information, making it less likely for them to spot the equivalence between the first and second round of the risk tasks, which might cause them to guess that the experiment tests for consistency and respond accordingly (see, e.g. Bertrand & Mullainathan, 2001).

2.3 Part three: risk-elicitation

In the third part, the subjects were asked to complete more risk tasks. Though they were not told this, they actually faced the same sequence of the six risk tasks they had faced before.

2.4 Treatments and payoffs

The experiment had two treatment conditions where the money reward, say Δw, that the subjects were given for completing the cognitive test was manipulated. Δw takes one of two values: £ 0 or £ 7.00, denoted by *zero* and *nonzero* increment treatment conditions. The experimentally induced increment was modest, but it was larger than the expected value of almost all the lotteries used in the risk tasks. The subjects assigned to the treatment condition where $\Delta w = 0$ were used as the control group. Their responses across stages were used to control for the differences in risk attitudes elicited at part one and part two that were genuinely induced by $\Delta w = 7$ from those differences induced by inherently imprecise preferences (Butler & Loomes, 2007), stochastic choices (Loomes & Sugden, 1995; Loomes, 2005), or even changes in individual circumstances.

Payment was made at the end of the experiment. The average earnings for subjects in the "non-zero" increment condition were £ 14.61, with payoffs ranging from £ 10 to £ 23. Among those in the "zero" increment conditions, the average earnings were £ 6.70, with payoffs ranging from £ 3 to £ 16.

3. Experimental results

This section aimed at determining whether risk-taking behavior changes after a transfer of money. This tested whether participants tend to make choices that are consistent, under expected utility theory, with constant absolute risk aversion, or, under prospect theory, with an editing rule with no memory and in which prior outcomes do not alter the coding of the subsequent lotteries (Thaler & Johnson, 1990) [2]. This was done by comparing the risk-taking behavior in each of the first six tasks, before treatment was introduced, to the risk-taking behavior in the last six risk tasks. The risk premium of each lottery task was used as the objective risk aversion measure. Both a between- and a within-subject analysis were performed. In the former (between), whether the changes in risk premia of subjects in the *nonzero increment* condition are significantly different from the changes in risk premia of subjects in the *zero increment* condition was tested. In the latter (within), whether after-treatment risk attitudes are significantly different from pre-treatment ones was tested.

A descriptive analysis was conducted first. Then, whether and how the transfer of money affected risk-taking behavior was examined.

3.1 Descriptive findings

Table 2 gives the overall summary results of the risk preferences. A useful common measure of risk preference for a given lottery L is the risk premium (R(L)), the difference between the expected value of the lottery L (E(L)) and a subject's certainty-equivalent for that lottery (C(L)). This measure was our primary basis for analysis. Subjects exhibited risk-averse (risk-seeking) behavior in a risk task if $R(L) = E(L) - C(L) > 0$ ($R(L) < 0$). They were risk-neutral if $R(L) = 0$. By considering the expected value of each lottery, this measure was, to some extent, "normalized" across the lotteries with different stakes, making subjects' elicited risk preferences readily comparable across the risk tasks.

Table 2 also shows the fractions of subjects in each distributional "class" of risk preference over the entire set of risk tasks. A subject was placed at class $[n,m]$ if she were risk averse in n risk tasks and risk neutral/loving in m ($n + m = 12$). The first line shows that almost half of our participants were systematically not risk averse throughout the risk tasks. Table 2 shows, for instance, that 77.36% of all individuals in our experiment made either risk-neutral or risk-loving choices in at least 3/4 of all risk tasks. Less than 5% were systematically risk averse in more than half of the risk tasks. Following Smith and Walker (1993), one interpretation for these results is that, for many subjects, only very few of the monetary rewards offered in each risk task were sufficient to dominate the non-monetary influences, such as the excitement from playing the lottery.

Distribution class of risk preferences	Frequency	%	Accumulated
[0,12]	47	44.34	44.34
[1,11]	14	13.21	57.55
[2,10]	13	12.26	69.81
[3,9]	8	7.55	77.36
[4,8]	11	10.38	87.74
[5,7]	6	5.66	93.40
[6,6]	2	1.89	95.28
[7,5]	1	0.94	96.25
[8,4]	–	–	96.25
[9,3]	2	1.89	98.11
[10,2]	1	0.94	99.06
[11,1]	–	–	99.06
[12,0]	1	0.94	100.00

Source(s): Table by author

Table 2.
Distributional classes of risk preferences in all risk tasks

3.2 Wealth effects

3.2.1 Non-parametric tests. Table 3 reports the results of the Mann-Whitney and Wilcoxon Signed-rank tests. The tests were performed for each risk task, as it is of interest to see whether potential wealth effects on attitudes to risk are robust to risk tasks involving different lottery prizes and probabilities. According to the results, there are no systematic differences between those who gained £ 7,00 in between risk-elicitation stages and those who did not gain such extra money (between-subject analysis). Moreover, it was found that the hypothesis that there exists no systematic differences between measures of risk aversion elicited before and after the increment (within-subject analysis) cannot be rejected.

3.2.2 Regression analysis. The experimental design used in this study acquired repeated risk preference measures from the same subjects across different risk tasks and treatment conditions. The systematic differences between individual subjects' risk preferences would induce correlated errors in an ordinary linear regression model testing money transfer effects. This required the consideration of individual subjects' effects in the statistical analysis. To do so, individuals' risk premia on subjects' characteristics and parameters of the experiment were regressed. With the panel data structure of our dataset, one can now look at the same issue by not only exploiting the heterogeneity within a given subject's sequence of risk aversion measures, but also controlling for the fundamental characteristics of the experiment and some observed demographics [3]. To this end, the following panel data regression specification was included:

$$yit = b1Ti + b2Di + b3Eit + b4Rit + b5Oi + b6Ii + b7Si + b8Gi + b9Pi + b10Ai + uit \tag{1}$$

where y_{it}, the risk premium derived from subjects' choices in each risk task, is the dependent variable; the set of regressors mostly include dummies for characteristics of the experiment as well as for subject-specific characteristics:

(1) T_i is a dummy variable for whether i was assigned to the nonzero increment treatment;

(2) D_i is a dummy variable for whether i is assigned to the delay treatment;

(3) E_{it}^3 is the expected value of the lottery option in the risk task faced in period t; 4. R_{it} is the number of decision rows in the risk task i faces in period t;

(4) O_i is a dummy for the order in which the risks involving lotteries $L2$ and $L5$ were faced;

Risk task	Within-subject	Between-subjects
L1 (8,0.2,4	z = 1.34 (p = 0.18)	z = 0.585 (p = 0.55)
L2 (9,0.2.,4	z = 0.94 (p = 0.35)	z = 1.542 (p = 0.123)
L3 (6,0.4.,4	z = –0.97 (p = 0.33)	z = –1.93 (p = 0.23)
L4 (9,0.3.,4	z = –1.00 (p = 0.32)	z = –0827 (p = 0.41)
L5 (16,0.2,10	z = –0.72 (p = 0.47)	z = 0.045 (p = 0.96)

Note(s): $*p < 0.1$, $**p < 0.05$, $***p < 0.01$. Wilcoxon signed rank sum test: the null is that before- and after-treatment measures of risk aversion (risk premia) from subjects assigned to the non-zero increment condition are not significantly different. The Mann-Whitney two-sample test statistic: null is that changes in attitudes to risk (variation in risk premia in a given risk task) across stages among treated ($\Delta w = 7$) and untreated ($\Delta w = 0$) subjects are not different. * Standard error and p-value in parentheses
Source(s): Table by author

Table 3.
Non-parametric tests

(5) I_i^6 is a dummy equal to one if i said that her average monthly income is less than 1,000; This information was used to control for wealth effects due to income differences outside the lab.

(6) S_i is the the overall score in the cognitive test;

(7) G_i, and P_i^9 are two dummies: they are equal to one if i is female and a post-graduate student, respectively.

(8) A_i is the i's self-reported age. u_{it} is a composite error term including a random intercept that captures the subject-specific effect and a overall disturbance term assumed to be i.i.d over i and t.

A generalized least square random effects estimator was used to fit (1). Table 4 reports the estimation results for this specification. The fact that the coefficient in front of T_i is not statistically significant suggests that risk attitudes, as measured by the lottery risk premium, are not influenced by the transfer of money received.

Estimates showed that an increase in the number of rows in a risk task tended, on average, to reduce subjects' risk premia. The coefficient in front of R_i is negative and statistically significant. Recall that risk tasks with more decisions rows have larger stakes, so the coefficient of the number of rows' variable captures the effect of stake size on risk attitudes. This is consistent with the sign of the coefficient of the expected value variable, which also reflects the size of the lottery stakes. The remainder of the variables, including most demographic controls, are not statistically significant. Thus, our regression analysis confirms the non-parametric tests. Altogether, they support the following finding.

Finding: The attitudes toward given risks, elicited through a series of lottery choices, are not affected by the prior money given to subjects.

Dependent variable: Individual risk premium	
Increment	0.071
	(0.113)
Lottery's expected value	−0.053
	(0.012)
Delay	0.075
	(0.117)
Number of rows in risk task	−0.046*
	(0.013)
L1-L5 order	−0.052
	(0.126)
Cognitive ability	−0.011
	(0.032)
Female	−0.068 (0.122)
Age	−0.011
	(0.045)
Posgrad	−0.08
	(0.0135)
Low income	0.019
	(0.012)
Observations	1.188
R^2	0.56

Note(s): $^*p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$. Reported standard errors (in parenthesis) account for potential clustering on the session-group level. Increment is equal to one if the subject is assigned to the treatment in which she receives 7 (GBP) before the second round of risk-elicitation tasks (part three) and zero otherwise

Source(s): Table by author

Table 4.
Determinants of subjects' risk premium. The GLS estimates of a random effects model

This is consistent with the idea that individuals adopt a narrow frame by simply not merging prior gains with the potential consequences of taking a given risk (Barberis, Huang, & Thaler, 2006). Thus, the money given to subjects does not induce changes in their attitudes to risk. It is also worth noting that this result contrasts with the "house money" effect reported by previous studies: a change of risk preferences induced by money given prior to risky choices. But, as the money given to subjects in our experiment was administered in between risky tasks and our risky choices were in the strict domain of gains, such a result suggests that the effects a monetary gain may have on individuals' risk preferences may be more sensitive to previous experience and the type of gambles than previously thought. Thus, it is argued that our result is informative and raises new research questions about the strength of this effect.

4. Conclusions

This paper reports the results of an experiment designed to examine the effects of a small-scale change in wealth on subsequent risky choices. The assumptions made about how changes in wealth affect attitudes toward risk underpin empirical and theoretical results in a broad range of topics in economics. Thus, research which furthers our understanding of how changes in wealth affect attitudes towards given risks is of interest.

In the experiment, it was observed that attitudes towards a given set of risks, elicited right after the subjects earned a certain amount of money, were not systematically different from the attitudes elicited right before these gains. Theoretically, and from an expected utility theory standpoint, this result is consistent with constant absolute risk aversion, offering some support to a key assumption in a recent study over the calibration critique of decision theories, namely that attitudes toward a risk do not change over a given range of wealth levels (Rabin, 2000; Cox & Sadiraj, 2006; Safra & Segal, 2008; Wakker, 2010). Also, since it was observed that individuals tend to evaluate new gambles they are offered in isolation from other wealth-relevant events, our results can be seen as well as evidence confirming Barberis *et al.*'s (2006) analysis of how narrow framing plays an important role in decision-making under risk. Several utility specifications have difficulty explaining risk aversion over small, actuarially fair gambles that are also evaluated in isolation from what their outcomes imply for total wealth risk. Our result offers empirical support for a preference specification developed by Barberis and Huang (2009) that can account for both first-order risk aversion and narrow framing. Our result, therefore, offers empirical support for a theoretical framework that helps understand some financial markets puzzles, such as wealth portfolios with low equity allocation and stockholders holding a smaller number of stocks than recommended for diversification. Further, given the differences in treatment administration and risk elicitation between our design and the design used in previous similar studies that reported a "house money effect," our results also suggest that this effect may be more sensitive to previous experience with the risk-elicitation task and the type of risky choices involved (mixed gambles) than previously thought. Thus, this paper should be seen as complementary to the large experimental literature on risk-taking behavior, suggesting further research, in particular, on how prior outcomes influence subsequent risky choices.

Notes

1. The experimental instructions can be found in the Supplementary material online.
2. For a theoretical discussion of how utility functions compare to cumulative prospect theory, see, e.g. Wakker & Tversky (1993, section 9).
3. The sample used in the regression analysis, when the model used to estimate risk behavior includes controls for treatment conditions and income class, is slightly different (102 subjects) since some subjects with missing income data were excluded. The qualitative results on the treatment effects were robust to dropping the income variable and included all sample units in the regression.

References

Ackert, L., Charupat, N., Church, B., & Deaves, R. (2006). An experimental examination of the house money effect in a multi-period setting. *Experimental Economics*, *9*(1), 5–16. doi: 10.1007/s10683-006-1467-1.

Andersen, S., Harrison, G., Lau, M., & Rutstrom, E. (2006). Elicitation using multiple price list formats. *Experimental Economics*, *9*(4), 383–405. doi: 10.1007/s10683-006-7055-6.

Barberis, N., & Huang, M. (2009). Preferences with frames: A new utility specification that allows for the framing of risks. *Journal of Economic Dynamics and Control*, *33*(8), 1555–1576. doi: 10.1016/j.jedc.2009.01.009.

Barberis, N., Huang, M., & Thaler, R. H. (2006). Individual preferences, monetary gambles, and stock market participation: A case for narrow framing. *American Economic Review*, *96*(4), 1069–1090. doi: 10.1257/aer.96.4.1069.

Barsky, R. B. E. A. (1997). Preference parameters and behavioral heterogeneity: An experimental approach in the health and retirement study. *The Quarterly Journal of Economics*, *112*(2), 537–79. doi: 10.1162/003355397555280.

Battalio, R. C., Kagel, J. H., & Jiranyakul, K. (1990). Testing between alternative models of choice under uncertainty: Some initial results. *Journal of Risk and Uncertainty*, *3*(1), 25–50. doi: 10.1007/BF00213259.

Bertrand, M., & Mullainathan, S. (2001). Do people mean what they say? Implications for subjective survey data. *American Economic Review*, *91*(2), 67–72. doi: 10.1257/aer.91.2.67.

Binswanger, H. P. (1980). Attitudes toward risk: Experimental measurement in rural India. *American Journal of Agricultural Economics*, *62*(3), 395–407. doi: 10.2307/1240194.

Bosch-Domenech, A., & Silvestre, J. (1999). Does risk aversion or attraction depend on income? An experiment. *Economics Letters*, *65*(3), 265–273. doi: 10.1016/S0165-1765(99)00154-8.

Bosch-Domenech, A. & Silvestre, J. (2006). Do the wealthy risk more money? An experimental comparison. In Schultz, C. & Vind, K. (Eds.), *Institutions, equilibria and efficiency: essays in honor of Birgit Grodal* (pp. 95–106). Berlin: Springer. doi: 10.1007/3-540-28161-4_6.

Butler, D. J., & Loomes, G. C. (2007). Imprecision as an account of the preference reversal phenomenon. *American Economic Review*, *97*(1), 277–297. doi: 10.1257/aer.97.1.277.

Chiappori, P. -A., & Paiella, M. (2011). Relative risk aversion is constant: Evidence from panel data. *Journal of the European Economic Association*, *9*(6), 1021–1052. doi: 10.1111/j.1542-4774.2011.01046.x.

Cox, J. C., & Sadiraj, V. (2006). Small- and large-stakes risk aversion: Implications of concavity calibration for decision theory. *Games and Economic Behavior*, *56*(1), 45–60. doi: 10.1016/j.geb.2005.08.001.

Donkers, B., Melenberg, B., & Van Soest, A. (2001). Estimating risk attitudes using lotteries: A large sample approach. *Journal of Risk and Uncertainty*, *22*(2), 165–95. doi: 10.1023/A:1011109625844.

Gollier, C. (2001). Wealth inequality and asset pricing. *Review of Economic Studies*, *68*(1), 181–203. doi: 10.1111/1467-937X.00165.

Guiso, L., & Paiella, M. (2008). Risk aversion, wealth, and background risk. *Journal of the European Economic Association*, *6*(1), 1109–1150. doi: 10.1162/JEEA.2008.6.6.1109.

Guiso, L., Jappelli, T., & Terlizzese, D. (1996). Income risk, borrowing constraints, and portfolio choice. *American Economic Review*, *86*(1), 158–72.

Hadar, J., & Seo, T. K. (1990). The effects of shifts in a return distribution on optimal portfolios. *International Economic Review*, *31*(3), 721–36. doi: 10.2307/2527171.

Harrison, G. (1986). An experimental test for risk aversion. *Economics Letters*, *21*(1), 7–11. doi: 10.1016/0165-1765(86)90111-4.

Harrison, G. W. & Rutstrom, E. E. (2008), Experimental evidence on the existence of hypothetical bias in value elicitation methods, *Handbook of Experimental Economics Results*, Elsevier, Chapter 81, (Vol. 1, pp. 752–767). doi: 10.1016/S1574-0722(07)00081-9.

Hennessy, D. A. (1998). The production effects of agricultural income support policies under uncertainty. *American Journal of Agricultural Economics*, *80*(1), 46–57. doi: 10.2307/3180267.

Holt, C. A., & Laury, S. K. (2002). Risk aversion and incentive effects. *American Economic Review*, *92*(5), 1644–1655. doi: 10.1257/000282802762024700.

Just, D. (2001). Calibrating the wealth effects of decoupled payments: Does decreasing absolute risk aversion matter?. *Journal of Econometrics*, *162*(1), 25–34. doi: 10.1016/j.jeconom.2009.10.006.

Loomes, G. (2005). Modelling the stochastic component of behaviour in experiments: Some issues for the interpretation of data. *Experimental Economics*, *8*(4), 301–323. doi: 10.1007/s10683-005-5372-9.

Loomes, G., & Sugden, R. (1995). Incorporating a stochastic element into decision theories. *European Economic Review*, *39*(3), 641–648. doi: 10.1016/0014-2921(94)00071-7.

Neill, H. R., Cummings, R. G., Ganderton, P. T., Harrison, G. W., & McGuckin, T. (1994). Hypothetical surveys and real economic commitments. *Land Economics*, *70*(2), 145–154. doi: 10.2307/3146318.

Ogaki, M., & Zhang, Q. (2001). Decreasing relative risk aversion and tests of risk sharing. *Econometrica*, *69*(2), 515–26. doi: 10.1111/1468-0262.00201.

Rabin, M. (2000). Risk aversion and expected-utility theory: A calibration theorem. *Econometrica*, *68*(5), 1281–1292. doi: 10.1111/1468-0262.00158.

Rosenzweig, M. R., & Binswanger, H. P. (1993). Wealth, weather risk and the composition and profitability of agricultural investments. *Economic Journal*, *103*(416), 56–78. doi: 10.2307/2234337.

Safra, Z., & Segal, U. (2008). Calibration results for non-expected utility theories. *Econometrica*, *76*(5), 1143–1166. doi: 10.3982/ECTA6175.

Smith, V. L., & Walker, J. M. (1993). Monetary rewards and decision cost in experimental economics. *Economic Inquiry*, *31*(2), 245–261. doi: 10.1111/j.1465-7295.1993.tb00881.x.

Szpiro, G. G. (1986). Measuring risk aversion: An alternative approach. *The Review of Economics and Statistics*, *68*(1), 156–59. doi: 10.2307/1924939.

Thaler, R. H. & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management Science*, *36*(6), 643–60. doi: 10.1287/mnsc.36.6.643.

Wakker, P. P. (2010). Where prospect theory deviates from rank-dependent utility and expected utility: Reference dependence versus asset integration. In Wakker, P. (Ed.), *Prospect theory: For risk and ambiguity*. Cambridge: Cambridge University Press. doi: 10.1017/CBO9780511779329.

Wakker, P., & Tversky, A. (1993). An axiomatization of cumulative prospect theory. *Journal of Risk and Uncertainty*, *7*(2), 147–175. Available from: http://www.jstor.org/stable/41760700

Weil, P. (1993). Precautionary savings and the permanent income hypothesis. *Review of Economic Studies*, *60*(2), 367–83. doi: 10.2307/2298062.

Supplementary material

The supplementary material for this article can be found online.

Corresponding author

Sergio Almeida can be contacted at: sergio.almeida@usp.br