

Leading Behavioral Characteristics and Investors' Decisions: An Experimental Approach



Anna Blajer-Gołębiewska, Leszek Czerwonka and Arkadiusz Kozłowski

Abstract Individual investor behavior is subject to many factors including risk attitude, behavioral heuristics, cognitive biases, herding, etc. The aim of this study was to investigate the impacts of selected behavioral factors of an investor as a leader in making individual investment decisions. To achieve this aim, we conducted an economic experiment which allowed us to observe individual behavior of subjects on an artificial stock exchange. In this study, we investigated two groups of factors, applying: (1) psychological scales assessing two independent thinking styles: rational and experiential which may affect investors' decisions and (2) measures of subjective self-assessment of investors' characteristics, namely their expected emotional response to losses and risk attitude. We claim that subjects behave according to how they perceive themselves and how they would like to be perceived. Therefore, they are subject to confirmation bias. Analyzing data from an economic experiment, we found that propensity to invest in the case of male subjects was influenced by the following six factors: experience in investing, need for cognition, faith in intuition, risk attitude, age and the time of decision making. Higher need for cognition refrains some investors from investing when they regard the amount of possessed information as insufficient. Faith in intuition increases the propensity to invest in the case of seemingly positive financial results of the analyzed firm. However, both results concerning rational and affective thinking styles hold true only for male subjects. In the case of female subjects, no significant impact of the need for cognition and of faith in intuition was reported. Propensity to invest in the case of female subjects was influenced only by two factors: expected emotional response to losses and trust

This work was supported by the National Science Centre under Grant no. 2016/23/D/HS4/02913.

A. Blajer-Gołębiewska (✉) · L. Czerwonka
Faculty of Economics, University of Gdansk, Sopot, Poland
e-mail: a.blajer@ug.edu.pl

L. Czerwonka
e-mail: leszek.czerwonka@ug.edu.pl

A. Kozłowski
Faculty of Management, University of Gdansk, Sopot, Poland
e-mail: arkadiusz.kozlowski@ug.edu.pl

in strangers. Curiously, these are the remaining two factors that did not affect male subjects' investment decisions.

1 Introduction

In the research literature, there are studies on factors influencing individual investment decisions, such as risk attitude, behavioral heuristics, and herding. Previous studies indicate that factors that may affect the size of investment in shares and the willingness to invest some or all of its assets include: risk aversion, gender, age, or cognitive biases. In this study, we investigated two groups of factors, applying: (1) psychological scales assessing two independent thinking styles: rational and experiential which may affect investors decisions and (2) measures of subjective self-assessment of investors characteristics, namely their expected emotional response to losses and risk attitude.

As far as thinking styles are concerned, the rational analytical one is represented by need for cognition. We hypothesize that higher need for cognition refrains some investors from investing when they regard the amount of possessed information as insufficient. The experiential one is intimately associated with affectation, emotion, and faith in intuition. We hypothesize that higher faith in intuition increases a propensity to invest in the case of seemingly positive financial results of the analyzed firm. Referring to the measures of objective assessment of investors' characteristics, we consider factors that have already been measured in some previous studies. However, we think that the measure of subjective self-assessment of these factors made by investors themselves may change the results. For instance, when subjects assess themselves as risk lovers, they may in fact behave riskier to confirm their self-judgment (confirmation bias). Similarly, subjects reporting less emotional response to losses will display less emotional behavior.

Consequently, the aim of this study was to investigate impacts of selected behavioral factors on individual investment decisions. We conducted an economic experiment which allowed us to observe individual behavior of subjects on an artificial stock exchange. The remainder of this paper is organized as follows. In the first section, we review the literature on factors affecting investment decisions. In the second one, the research design and methodology are presented. In the next section, we discuss data analysis and present results. In the final section, we provide discussion and conclusions.

2 Selected Behavioral Factors Affecting Investors Decisions

Two of the key factors affecting the propensity to invest are risk and ambiguity. There is a huge number of measures of risk attitude (e.g., Safe Asset vs. Risky Task) (Kramer and Weber 2012) and behavioral measures of risk (e.g., Sequential Investment Task;

Frey et al. 2015; Mentel and Brożyna 2015; Mentel et al. 2017). However, very often a researcher has to decide between the measurement accuracy of a chosen method and its simplicity. Simplicity is highly desirable especially in complicated experiments, when there is no time for time-consuming tests. It makes researchers sure that the task will be understandable to respondents. One of the simple risk elicitation methods is a risk question from the German Socio-Economic Panel Study (SOEP) (Dohmen et al. 2005, 2011). Respondents are asked to answer the following question: ‘How do you see yourself: are you generally a person who is fully prepared to take risk or do you try to avoid taking risk?’ by indicating a number on an 11-point scale: from 0 (‘unwilling to take risks’) to 10 (‘fully prepared to take risk’). This seemingly simple method leads to reliable results. Dohmen et al. (2005) found this measure to be ‘a good predictor of actual risk-taking behavior’. In the cases of specific behaviors, the context-specific risk measures were best predictors. However, according to the study, the general risk question (from SOEP) was also found to have a substantial predictive power, overperforming an incentivized lottery measure. The general risk question has already been used in studies related to investment decisions, for instance by Fossen (2011). The results of his study suggest a positive relationship between willingness to take risk and entrepreneurial investment (measured by the ownership of private business equity).

The results of many studies in the field of psychology and experimental economics confirmed that people are ambiguity averse. They prefer the lottery with known probabilities instead of a similar lottery with unknown probabilities (Ellsberg 1961). This means that investors must take into account both risk and ambiguity when making investment decisions. Research on the relationship between ambiguity and the propensity to invest was conducted by, among others, Antoniou et al. (2015) and Dimmock et al. (2016). In empirical research, it is difficult to find the right proxy for describing ambiguity. However, some research (especially in the area of medical decision making) shows that ambiguity, uncertainty, intolerance, and need for cognition are correlated (Buhr and Dugas 2006; Ianello et al. 2017). One of the most popular psychological tests to measure need for cognition is the Rational Experiential Inventory (REI) (Pacini and Epstein 1999). The REI test helps to evaluate how people process information (Norris et al. 1998) measuring two thinking styles: rational (analytical, cognitive, conscious) and experiential (affective, emotional, intuitive, precocious). Consequently, REI consists of two subscales: Need for Cognition and Faith in Intuition. Each of these subscales consists of five elements—statements. Subjects are asked to determine to what extent they agree with each of these.

The other factor that influences investors decisions is the expected emotional response to losses. According to the prospect theory, ‘losses loom larger than gains’ (Kahneman and Tversky 1979). When asked to judge their feelings about possible outcomes, people often state that losses have greater effect on their feelings than gains. This is how loss aversion arises. As a result, expected emotional responses to losses and gains may also be correlated to a risk attitude. Furthermore, previous studies revealed that older adults cope better with losses, e.g., in a study by Bruine de Bruin et al. (2018) older adults reported relatively lesser negative emotions after

losses. Lucarelli et al. (2015) were analyzing accumulation of emotional experience. They found that emotional response to gains and to losses is trend dependent.

Almost each real-life investment is associated with some level of risk. However, people still decide to invest. The possible explanation for this fact is the phenomenon of trust. When people trust, they take risk into consideration, but they are able to accept it because they hold positive expectations about the outcome. As a result, trust is claimed to allow people to invest or to invest more. There is no commonly accepted explanation of trust. It can be analyzed in terms of ‘economic preferences, social norms, personality traits, group processes or expectations’ (Evans and Krueger 2009).

The relationship between age and investing was also examined in previous studies. The conclusions from empirical studies are as follows: people become more risk averse as they get older. Bonsang and Dohmen (2015) stated that the age-related change in risk attitude can mostly be ascribed to cognitive aging. Christelis et al. (2010) found that the propensity to invest in stocks is strongly associated with cognitive abilities. This relationship occurs for both direct stock market participation and indirect participation through mutual funds and retirement accounts.

Previous studies show the impact of gender on stock market investments. Women are found more risk averse (Barsky et al. 1997; Croson and Gneezy 2009) and then less likely to participate in the stock market or possess a high share of stocks as their investment (Barber and Odean 2001; Dwyer et al. 2002; Halko et al. 2012). In a study on behavior of mutual fund investors, it turned out that women take risk to a lesser extent than men. However, the difference is largely not due to gender but due to knowledge disparities (Dwyer et al. 2002). In a study of the relation between gender and share investment in Finland, information on risk attitudes from 81 investment advisers and managers, 77 finance students and 177 private banking customers was collected (Halko et al. 2012). The researchers did not notice the difference with respect to stock market participation, while men had a larger share of shares in their investment portfolio than women. The observed differences resulted from woman’s greater risk aversion. What is important, they found that a self-reported financial risk attitude is a better measure than traditional measures, based on allocation to hypothetical investments or certainty equivalent (Halko et al. 2012; Kalinowski 2017).

In this study, we focus on selected psychological characteristics of investors: expected emotional response to losses, need for cognition, faith in intuition, risk attitude and trust in strangers. We also considered age, gender, previous experience in investing in stock markets and the time of decision making.

3 Experimental Design and Methodology

For the purpose of the research outlined in this paper, we designed an experiment. At the very beginning of the study, the subjects were informed that they would take part in a game resembling stock market environment and their aim was to earn the highest possible amount of artificial money. In order to achieve reliable results of the

study, we had to increase the subjects' cognitive effort and to motivate them to make decisions which they really consider to be optimal. Consequently, we introduced financial incentives: the subjects, who scored more than the average, were supposed to receive 50.00 PLN (about 11.50 EUR).

After assessing their expected emotional response to losses, the subjects entered the artificial stock exchange. At the beginning, they could observe changes in prices of a firm listed in the stock exchange. The subjects were told that they would observe 'a firm selected by the computer program', but they were not conscious that for each of them it was the same firm. The observations covered 10 periods. Prices were fluctuating, but the trend was positive, and at the end of the last period of observation, the price was 11% higher than at the beginning of the first period of observation. The subjects were also given the same additional information on this company, including its size, market sector and its financial indicators (in relation to the average values of indicators in the sectors). The aim of such a manipulation was to create exactly the same, positive perception of the firm perceived by each investor. This enables researchers to compare investment decisions of the subjects. Then, the subjects were given artificial money of 10,000 monetary units, and they could decide about the amount they would like to invest in the shares of the company. At the final phase of the 'game', the subjects were asked to fill in REI-10 scale (with Need for Cognition and Faith in Intuition subscales) (Pacini and Epstein 1999), to assess their risk attitude using SOEP risk question (as described in Sect. 2) and to assess their trust in strangers on the basis of the statement 'Nowadays, one cannot be too careful in dealing with others' (5-point Likert scale). Then, they answered questions about their age, gender and experience in investing in stock markets. The final score of each subject and information about winning was revealed in the last screen of the experiment.

4 Findings

The final sample included 319 subjects (female = 204; male = 115), mainly students of the last year of Master studies in finance and lecturers in finance. About 7% of subjects had some previous experience in investing on stock exchanges (mean = 1.5 years, s.d. = 0.5). Due to the nature of the experiment, the distribution of the invested amount is limited to the range [0, 10,000]. Most of the observations (82%) are full thousands and zeros. About 13% of observations fall on extreme values (0 and 10,000). The distribution is not regular; it is multimodal; in particular, it is far from the normal distribution. Conducting preliminary statistical analysis, we found a relationship between gender and the amount invested (Fig. 1). In the association plot indicating deviations from independence in contingency table, if the observed frequency of a cell is greater than the expected one, the box rises above the baseline and is shaded dark gray; otherwise, the box falls below the baseline and is shaded light gray. The height of the rectangles is proportional to the contribution of a cell to Pearson's chi-squared statistics, and the width is proportional to the expected count corresponding to a cell. The plot confirms that there is a relationship between gender

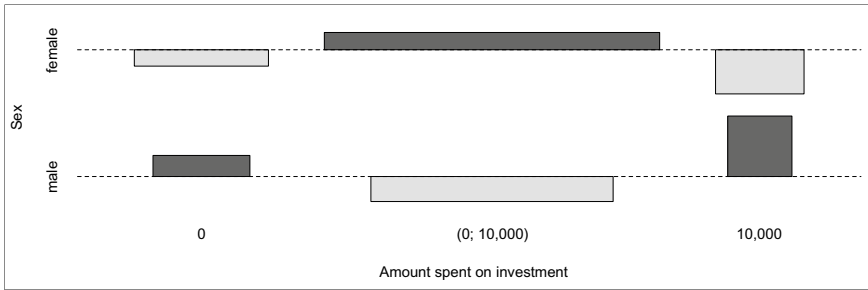


Fig. 1 Association plot indicating deviations from independence in contingency table. *Source* Own results

and the amount invested (p -value for chi-squared test for independence equals 0.029). Women were much less likely to make extreme choices (zero or the total amount). A particularly large disproportion exists in the case of choosing the entire amount for the investment—men much more often opted for such options than women.

The modeled variable Y is a part of the available funds spent on investments, $Y \in [0, 1]$, i.e., Y can take fractional values, 0, and 1. For this reason, the fractional regression model will be appropriate (Papke and Wooldridge 1996; Ramalho et al. 2011). It was decided on a two-part model that includes a binary model for the discrete component, and a fractional regression model for the continuous component. The choice of the two-part model, i.e., separate models for limit value and for the fractional part, instead of the one-part model, i.e., the same approach to all observations, was dictated by two reasons. First, the non-trivial part of the observation falls on the boundary value 0 (no investment). Second, from the authors' prior knowledge, it follows that there are some factors which may affect whether someone makes the investment or not, but if the investment is made, different factors may explain the amount invested.

In the binary component, we modeled the propensity to invest, i.e., the probability of a decision to invest any amount of artificial money; hence, the explanatory variable takes value 0 if $Y = 0$, and 1 if $Y > 0$. All units from the research sample were used to estimate the binary model, which here is a logistic regression. The models are estimated by the maximum-likelihood method. Then, a fractional regression model was used to model the amount invested where only observations with values from the interval $(0, 1]$ were used. Logit was used as a link function. The model was estimated by Bernoulli-based quasi-maximum likelihood.

Regarding the results of the preliminary analysis, the models were estimated separately for women and men. Furthermore, final models, after exclusion of statistically insignificant variables ($p > 0.1$), were presented and analyzed. Two specifications tests were performed for each model. The first is the well-known RESET (Regression Equation Specification Error Test) created by Ramsey (1969) and intended originally for linear regression. However, it can be adapted to any generalized regression model. Here, the maximum power of the linear predictors was set at the level of 2. The sec-

Table 1 Binary component of a two-part model—logit specification ($Y = 0$ vs. $Y > 0$), male

	Estimate	Std. error	<i>t</i> value	Pr(> <i>t</i>)		Odds ratio for change	
						Unit	Range
<i>The Full Model</i>							
Intercept	3.534	5.484	0.644	0.519			
Age	-0.251	0.197	-1.274	0.203		0.778	0.366
Experience	-1.308	0.628	-2.082	0.037	**	0.270	0.270
EER to losses	0.337	0.215	1.564	0.118		1.401	3.850
Need for cognition	-0.059	0.083	-0.713	0.476		0.943	0.412
Faith in intuition	0.144	0.064	2.268	0.023	**	1.155	17.835
Risk attitude	0.280	0.106	2.634	0.008	***	1.323	16.432
Trust	0.323	0.361	0.895	0.371		1.382	2.637
Time	0.335	2.064	0.162	0.871		1.398	1.247
$R^2 = 0.202$ RESET(2) test = 0.497 GOFF test = 0.646							
<i>The Final Model</i>							
Intercept	-1.867	1.167	-1.600	0.110			
Experience	-1.594	0.590	-2.701	0.007	***	0.203	0.203
Faith in intuition	0.148	0.056	2.617	0.009	***	1.159	19.232
Risk attitude	0.230	0.095	2.431	0.015	**	1.259	9.993
$R^2 = 0.145$ RESET(2) test = 0.975 GOFF test = 0.706							

Source Own results

ond test is goodness of functional form test (GOFF), which can also be interpreted as goodness of link test (Ramalho et al. 2013). Both tests for each model indicate that we fail to reject the zero hypothesis that the linear combination of predictors with logit as the link function is the proper choice for the models. Regarding R^2 , the best fitted models are those for males, especially binary models explaining the propensity to invest any money versus total passivity.

According to the analysis of the binary component of the two-part model, we found that statistically significant predictors of investing (vs. not investing) in the case of male subjects were previous experience in investing at stock markets, risk attitude and faith in intuition (Table 1). More risk loving and more believing in their intuition male subjects tended to invest in stock. Interestingly, more experienced in investing male subjects were more likely to refrain from investing. The remaining variables (age, expected emotional response for losses, need for cognition, trust in strangers and the time of decision making process) were statistically non-significant.

Table 2 Fractional logit regression model, male

	Estimate	Std. error	t value	Pr(> t)		Odds ratio for change	
						Unit	Range
<i>The Full Model</i>							
Intercept	-3.053	2.188	-1.395	0.163			
Age	0.135	0.077	1.759	0.079	*	1.144	1.714
Experience	-0.134	0.379	-0.353	0.724		0.875	0.875
EER to losses	0.082	0.104	0.792	0.428		1.086	1.389
Need for cognition	-0.063	0.030	-2.093	0.036	**	0.939	0.386
Faith in intuition	0.024	0.032	0.748	0.454		1.024	1.610
Risk attitude	0.112	0.044	2.519	0.012	**	1.118	3.059
Trust	0.001	0.152	0.005	0.996		1.001	1.002
Time	-1.698	1.002	-1.696	0.090	*	0.183	0.326
$R^2 = 0.098$; RESET(2) test = 0.376; GOFF test = 0.352							
<i>Final Model</i>							
Intercept	-2.075	1.836	-1.130	0.258			
Age	0.125	0.074	1.693	0.090	*	1.133	1.649
Need for cognition	-0.063	0.029	-2.159	0.031	**	0.939	0.390
Risk attitude	0.102	0.043	2.363	0.018	**	1.107	2.770
Time	-1.857	0.928	-2.001	0.045	**	0.156	0.294
$R^2 = 0.083$; RESET(2) test = 0.623; GOFF test = 0.620							

Source Own results

In the group of male subjects, who decided to invest (fractional logit regression model), those who tended to invest more were older and more risk-loving subjects, as well as those with lower need for cognition (see Table 2). They were taking less time to make their decisions.

According to the analysis of the binary component of the two-part model, we found that in the case of female subjects, there was only one statistically significant predictor of investing (vs. not investing): expected emotional response (EER) to losses (Table 3). The more emotional response to losses was expected by a subject, the more probable it was that the subject would invest. In the group of female subjects, who decided to invest (fractional logit regression model), those who were more trusting in strangers tended to invest more (Table 4).

Furthermore, analyzing the whole sample we found some statistically significant pairwise correlations and differences in mean or proportion between explanatory

Table 3 Binary component of a two-part model—logit specification ($Y = 0$ vs. $Y > 0$), female

	Estimate	Std. error	<i>t</i> value	Pr(> <i>t</i>)		Odds ratio for change	
						Unit	Range
<i>Full Model</i>							
Intercept	1.600	3.761	0.426	0.670			
Age	-0.023	0.156	-0.147	0.883		0.977	0.912
Experience	15.727	1881.764	0.008	0.993		x	x
EER to losses	0.477	0.164	2.904	0.004	***	1.611	6.732
Need for cognition	-0.011	0.055	-0.194	0.846		0.989	0.833
Faith in intuition	-0.053	0.046	-1.154	0.248		0.949	0.349
Risk attitude	0.004	0.080	0.055	0.956		1.004	1.045
Trust	0.291	0.278	1.045	0.296		1.337	2.391
Time	0.981	1.391	0.705	0.481		2.667	1.911
$R^2 = 0.055$ RESET(2) test = 0.745 GOFF test = 0.443							
<i>Final Model</i>							
Intercept	0.883	0.389	2.270	0.023	**		
EER for losses	0.460	0.155	2.966	0.003	***	1.584	6.297
$R^2 = 0.031$ RESET(2) test = 0.936 GOFF test = 0.996							

Source Own results

variables. More risk-loving subjects trusted more in strangers ($r = 0.1322, p = 0.0181$) and expected less emotional response to losses ($r = -0.1626, p = 0.0036$). Male subjects, in comparison with female subjects, more often had experience in investing (test for a difference in proportion: $\chi^2 = 13.55, p = 0.0002$), were more risk-loving (test for a difference in mean: $t = 3.26, p = 0.0012$) and were taking less time to make their decisions (test for a difference in mean: $t = -3.06, p = 0.0023$). Curiously, the subjects with higher need for cognition were risk-takers ($r = 0.2271, p = 0.0000$) and they were taking more time to make their decisions ($r = -0.1742, p = 0.0018$).

5 Discussion and Conclusions

The main novel contributions of our study are applications of (1) psychological scales assessing two independent processing modes: rational and experiential which may

Table 4 Fractional logit regression model, female

	Estimate	Std. error	t value	Pr(> t)		Odds ratio for change	
						Unit	Range
<i>Full Model</i>							
Intercept	-1.323	1.223	-1.082	0.279			
Age	0.000	0.050	-0.008	0.994		1.000	0.998
Experience	0.127	0.322	0.396	0.692		1.136	1.136
EER to losses	0.064	0.060	1.065	0.287		1.066	1.292
Need for cognition	0.007	0.018	0.387	0.699		1.007	1.129
Faith in intuition	0.002	0.016	0.100	0.921		1.002	1.032
Risk attitude	-0.001	0.029	-0.035	0.972		0.999	0.990
Trust	0.184	0.090	2.032	0.042	**	1.202	1.736
Time	0.165	0.468	0.353	0.724		1.180	1.115
$R^2 = 0.020$; RESET(2) test = 0.778; GOFF test = 0.778							
<i>Final Model</i>							
Intercept	-0.950	0.197	-4.827	0.000	***		
Trust	0.190	0.092	2.068	0.039	**	1.210	1.770
$R^2 = 0.015$; RESET(2) test = 0.520; GOFF test = 0.518							

Source Own results

affect investors decisions and (2) measures of subjective assessment of investors characteristics.

The propensity to invest in the case of male subjects was influenced by the following six factors: experience in investing, need for cognition, faith in intuition, risk attitude, age and the time of decision making. Male subjects with a higher need for cognition refrain from investing. It is compatible with a hypothesis put forward in the introductory part of the paper, that higher need for cognition refrains some investors from investing when they regard the amount of possessed information as insufficient. The results concerning the impact of faith in intuition on the propensity to invest also support the hypothesis put forward. Faith in intuition increases a propensity to invest in the case of seemingly positive financial results of an analyzed firm. However, both results concerning rational and affective thinking styles hold true only for male subjects. In the case of female subjects, no significant impact of need for cognition was reported.

Our results support the results of studies of Barsky et al. (1997) and Croson and Gneezy (2009) showing that women are more risk-averse. Generally, women’s investing behavior is subject to different factors than in the case of men. However, we did not find a support for the claim that women are less likely to participate in

the stock market or possess a high share of stocks as their investment (Barber and Odean 2001; Dwyer et al. 2002). On the basis of our results, we would rather support the results of the study of Halko et al. (2012) claiming that the observed differences resulted not directly from gender, but from greater risk aversion in the case of women. The propensity to invest in the case of female subjects was influenced only by two factors: expected emotional response to losses and trust in strangers. Curiously, these are the remaining two factors that did not affect male subjects' investment decisions. According to Evans and Krueger (2009), trust is claimed to allow people to invest or to invest more. In our research, this applies only to female subjects. However, analyzing the whole sample we found that more risk-loving subjects trust more in strangers. Probably, they are able to accept higher risk because they hold more positive expectations. Furthermore, rational thinking style (need for cognition) was significantly positively correlated with risk attitude, and negatively with the time of decision making. As we could expect, emotional thinking style (faith in intuition) was positively correlated with expected emotional response to losses. While we are conscious of the weaknesses and limitations of the study, we believe it to be a useful starting point for further investigation into this problem.

References

- Antoniou C, Harris RDF, Zhang R (2015) Ambiguity aversion and stock market participation: an empirical analysis. *J Banking Finan* 58:57–70. <https://doi.org/10.1016/j.jbankfin.2015.04.009>
- Barber BM, Odean T (2001) Boys will be boys: gender, overconfidence, and common stock investment. *Q J Econ*, Oxford University Press 116(1):261–292. <https://doi.org/10.1162/003355301556400>
- Barsky RB, Juster FT, Kimball MS, Shapiro MD (1997) Preference parameters and behavioral heterogeneity: an experimental approach in the health and retirement study. *Q J Econ*. Oxford University Press 112(2):537–579. <https://doi.org/10.1162/003355397555280>
- Bonsang E, Dohmen T (2015) Risk attitude and cognitive aging. *J Econ Behav Organ* 112:112–126. <https://doi.org/10.1016/j.jebo.2015.01.004>
- Bruine de Bruin W, van Putten M, van Emden R, Strough JN (2018) Age differences in emotional responses to monetary losses and gains. *Psychol Aging* 33(3):413–418. <https://doi.org/10.1037/pag0000219>
- Buhr K, Dugas MJ (2006) Investigating the construct validity of intolerance of uncertainty and its unique relationship with worry. *Anxiety Disorders* 20(2):222–236. <https://doi.org/10.1016/j.janxdis.2004.12.004>
- Christelis D, Jappelli T, Padula M (2010) Cognitive abilities and portfolio choice. *Eur Econ Rev* 54(1):18–38. <https://doi.org/10.1016/j.eurocorev.2009.04.001>
- Crosron R, Gneezy U (2009) Gender differences in preferences. *J Econ Lit* 47(2):448–474. <https://doi.org/10.1257/jel.47.2.448>
- Dimmock SG, Kouwenberg R, Mitchell OS, Peijnenburg K (2016) Ambiguity aversion and household portfolio choice puzzles: empirical evidence. *J Finan Econ* 119(3):559–577. <https://doi.org/10.1016/j.jfineco.2016.01.003>
- Dohmen T, Falk A, Huffman D, Sunde U, Schupp J, Wagner GG (2005) Individual risk attitudes: new evidence from a large, representative. Experimentally-validated survey. *Deutsches Institut für Wirtschaftsforschung discussion papers* 511, Berlin, p 61

- Dohmen T, Falk A, Huffman D, Sunde U, Schupp J, Wagner GG (2011) Individual risk attitudes: measurement, determinants, and behavioral consequences. *J Eur Econ Assoc* 9(3):522–550. <https://doi.org/10.1016/j.jfineco.2016.01.003>
- Dwyer PD, Gilkeson JH, List JA (2002) Gender differences in revealed risk taking: evidence from mutual fund investors. *Econ Lett*, North-Holland 76(2):151–158. [https://doi.org/10.1016/S0165-1765\(02\)00045-9](https://doi.org/10.1016/S0165-1765(02)00045-9)
- Ellsberg D (1961) Risk, ambiguity, and the savage axioms. *Q J Econ* 75(4):643–669. <https://doi.org/10.2307/1884324>
- Evans AM, Krueger JI (2009) The psychology (and economics) of trust. *Soc Pers Psychol Compass* 3(6):10031017. <https://doi.org/10.1111/j.1751-9004.2009.00232.x>
- Fossen FM (2011) The private equity premium puzzle revised: new evidence on the role of heterogeneous risk attitudes. *Econometrica* 78(312):656–675. <https://doi.org/10.1111/j.1468-0335.2010.00864.x>
- Frey R, Rieskamp J, Hertwig R (2015) Sell in may and go away? learning and risk taking in nonmonotonic decision problems. *J Exp Psychol Learn Mem Cogn* 41(1):193–208. <https://doi.org/10.1037/a0038118>
- Halko M-L, Kaustia M, Alanko E (2012) The gender effect in risky asset holdings. *J Econ Behav Organ*, North-Holland 83(1):66–81. <https://doi.org/10.1016/j.jebo.2011.06.011>
- Iannello P, Mottini A, Tirelli S, Riva S, Antonietti A (2017) Ambiguity and uncertainty tolerance, need for cognition, and their association with stress. A study among Italian practicing physicians 2017. *Med Edu Online* 22(1):1270009. <https://doi.org/10.1080/10872981.2016.1270009>
- Kalinowski S (2017) Operating risk of polish public companies—sectoral differences. *Econ Sociol* 10(1):22–34. <https://doi.org/10.14254/2071-789X.2017/10-1/2>
- Kahneman D, Tversky A (1979) Prospect theory: an analysis of decision under risk. *Econometrica* 47(2):263–292. <https://doi.org/10.2307/1914185>
- Kramer LA, Weber JM (2012) This is your portfolio on winter: seasonal affective disorder and risk aversion in financial decision making. *Soc Psychol Pers Sci* 3(2):193–199. <https://doi.org/10.1177/1948550611415694>
- Lucarelli C, Uberti P, Brighetti G, Maggi M (2015) Risky choices and emotion-based learning. *J Econ Psychol* 49(C):59–73. <https://doi.org/10.1016/j.joep.2015.04.004>
- Mentel G, Brożyna J (2015) Compatibility of market risk measures. *J Int Stud* 8(2):52–62. <https://doi.org/10.14254/2071-8330.2015/8-2/5>
- Mentel G, Brożyna J, Szetela B (2017) Evaluation of the effectiveness of investment fund deposits in Poland in a time of crisis. *J Int Stud* 10(2):46–60. <https://doi.org/10.14254/2071-8330.2017/10-2/3>
- Norris P, Pacini R, Epstein S (1998) The rational-experiential inventory, short form. Unpublished Inventory. Univ Massachusetts at Amherst
- Pacini R, Epstein S (1999) The relation of rational and experiential information processing styles to personality, basic beliefs, and the ratio-bias phenomenon. *J Pers Soc Psychol* 76(6):972–987. <https://doi.org/10.1037/0022-3514.76.6.972>
- Papke LE, Wooldridge JM (1996) Econometric methods for fractional response variables with an application to 401(k) plan participation rates. *J Appl Econ* 11(6):619–632. [https://doi.org/10.1002/\(SICI\)1099-1255\(199611\)11:6%3c619:AID-JAE418%3e3.0.CO;2-1](https://doi.org/10.1002/(SICI)1099-1255(199611)11:6%3c619:AID-JAE418%3e3.0.CO;2-1)
- Ramalho EA, Ramalho JJS, Murteira JMR (2011) Alternative estimating and testing empirical strategies for fractional regression models. *J Econ Surv* 25(1):19–68. <https://doi.org/10.1111/j.1467-6419.2009.00602.x>
- Ramalho EA, Ramalho JJS, Murteira JMR (2013) A generalized goodness-of-functional form test for binary and fractional regression models. *Manchester Sch* 82(4):488–507. <https://doi.org/10.1111/manc.12032>
- Ramsey JB (1969) Tests for specification errors in classical linear least-squares regression analysis. *J Roy Stat Soc B* 31(2):350–371