Higher Order Risk Attitudes of Financial Experts*

Anna Bottasso† Sébastien Duchêne‡ Eric Guerci§ Nobuyuki Hanaki¶
Charles N. Noussair‖

October 31, 2021

Abstract

We measure risk aversion, prudence and temperance in a sample of 173 financial experts. These experts are traders, analysts, or work in support or commercial functions in the financial industry, which routinely deals with risk. We compare their decisions with those of a demographically representative sample and of university students that are reported in the study of Noussair et al. (2014). The experts were more risk-seeking and intemperate than individuals in the other two groups. They were also more imprudent than students, though equally prudent as the general population.

JEL codes: D83, G11, G41

Keywords: Risk aversion, Prudence, Temperance, Experiment

*We thank the organizers of the 30^{th} International Federation of Technical Analysts (IFTA) 2017 Conference in Milan for their kind support in realizing the experiments. We especially thank Davide Bulgarelli, the President of SIAT, the Italian branch of IFTA. We would like to thank conference participants at the 11^{th} Annual Meeting of the Academy of Behavioral Finance & Economics (Chicago, 2018), the Experimental Finance Conference (Heidelberg, 2018), and the 9^{th} French Association of Experimental Economists Annual Meeting (Nice, 2018), as well as seminar participants at Kedge Business School (Marseille, 2019) and at the Behavioral and Experimental Analyses on Macro-finance workshop (Amsterdam, 2018). This research was funded by ANR ORA-Plus project "BEAM" (Behavioral and Experimental Analyses in Macro-Finance, ANR-15-ORAR-0004), JSPS-Kakenhi (18K19954), as well as by the Agence Nationale de la Recherche under Investissements d'Avenir UCA^{JEDI} (ANR-15-IDEX-01). In particular, we thank the UCAinACTION project. The experiment reported in this paper has not received IRB approval. Because when the experiment was conducted in 2018, IRB approval was not required for conducting non-intrusive experiments like ours at Université Côte d'Azur. The data and codes used to analyze the data are available from the authors upon request.

†Department of Economics, University of Genova, Via Vivaldi 5, 16124 Genova, Italy. E-mail: mailto:bottasso@economia.unige.it

‡CEE-M, Univ. Montpellier, CNRS, INRA, Montpellier SupAgro, Montpellier, France. Email: sebastien.duchene@umontpellier.fr

§Université Côte d'Azur, CNRS, GREDEG. 250 rue Albert Einstein, 06560 Valbonne, France. E-mail: eric.guerci@gredeg.cnrs.fr

¶Corresponding author. Institute of Social and Economic Research, Osaka University, Osaka, Japan. E-mail: nobuyuki.hanaki@iser.osaka-u.ac.jp

‖University of Arizona, Tucson, Arizona, USA. E-mail: cnoussair@email.arizona.edu

1 Introduction

Risk attitudes have an important influence on economic decision making, affecting investment, savings, employment, educational, leisure, and other choices. To quantify the relationships between risk attitudes and economic outcomes, the risk attitudes of decision makers must be measured or estimated. Most studies attempting to directly measure these attitudes with incentivized tasks have focused on undergraduate students. This has the scientific advantage that students are a segment of the population that is readily available to most researchers. Employing student participants facilitates the gathering of data and the replication of prior studies.

However, undergraduate students are not demographically representative of the general population in terms of age, educational level, or income, and what can be inferred from them about the preference parameters of the general population or other specific groups of interest is limited. As a consequence, laboratory protocols to measure risk attitudes that were originally developed for students have been administered, sometimes in modified form, to other populations in artefactual field experiments (Harrison and List, 2004). These studies have almost all been focused on the measurement of *risk aversion*, the concavity of the utility function, and its' demographic and behavioral correlates. This research agenda has been very productive and risk aversion has been shown to vary systematically by age, gender, income, religion, and nationality (Donkers et al., 2001; Dohmen et al., 2017; Harrison et al., 2007; Noussair et al., 2012; Falk et al., 2018).

In our view, it is of particular interest to study the decisions of individuals who are expert in the domain being studied. Experts tend to make more numerous, higher-stake, and more important decisions than the population at large, and/or to influence others through advice or example. The few experimental studies comparing professional expert and student populations participating in economic decision tasks tend to fail to find substantive differences between the two groups (Frechette, 2015). When differences do appear, the experts tend to make decisions that are more at variance with classical economic theory than the students.

Economic research on risk attitudes has concentrated predominantly on financial risk taking. Financial decisions are especially amenable to the methodology of experimen-

tal economics, which employs cash payments to induce the intended incentives (Smith, 1982). For the specific domain of risk aversion, a number of studies have considered the behavior of financial professionals, a group whose profession is fundamentally concerned with managing, pricing, and selecting levels of financial risk. Gilad and Kliger (2008) find that the investment decisions of professionals are more susceptible to priming intended to influence risk taking than are those of undergraduate students.[1] Abdellaoui et al. (2013) observe that financial professionals are risk averse in the domain of gains and risk seeking in the losses, with similar preference parameter estimates to those for students. In contrast, Razen et al. (2020) find that financial professionals take more risk than those in other professions when decisions are taken in the loss domain, but there is no difference in the gain domain. Cohn et al. (2015) report that risk aversion is countercyclical, in that financial professionals primed with time series of declining market prices take less risk than those primed with a rising market. Kirchler et al. (2018) investigate the impact of ranking and risk-taking on a very large sample of professionals in the financial industry, as well as on students. They show that (i) an anonymous ranking of participants among their peers (without any financial rewards linked to the ranking), or (ii) a tournament (where remuneration depends in part on the ranking), increases the risk taking of professional traders who are underperformers, while students are only affected by the tournament structure.[2]

As mentioned above, like other branches of economics, research on the measurement of risk attitudes has focused on risk aversion. However, there is also recognition that a

[1] Thoma et al. (2015), using survey evidence rather than incentivized tasks, report that financial professionals take more risk than non-expert decision makers.

[2] There have been a number of recent experimental studies that have compared the decisions made by financial professionals with those of university students in areas other than risk taking. Haigh and List (2005) showed that professional traders of futures and options at the Chicago Board of Trade exhibited behaviors that were more consistent with myopic loss aversion (MLA) than did undergraduate students. In another experiment, professionals were slightly less inclined to fall prey to the Allais paradox than students (List and Haigh, 2005). In an option pricing experiment, Abbink and Rockenbach (2006) found that traders from a German bank performed worse than students. Glaeser et al. (2007) found that financial professionals exhibited more overconfidence in their forecasts and skills than students. Kaustia et al. (2008) showed that professionals were less prone to anchoring bias than students. While Cipriani and Guarino (2009) found that professionals exhibited herding behavior that was close to that of students, Alevy et al. (2007) reported that professional traders, in an information cascade game, were better able to analyze, discern and use information than students were. Cohn et al. (2014) showed that banking professionals tended to cheat more than students. Weitzel et al. (2020) found, in a bubble-prone experimental asset market setup, that professional traders generated price bubbles, albeit significantly smaller ones, than students. In a forecasting experiment, Schwaiger et al. (2020) observed that professional traders made more optimistic price forecasts than students, both when the stock whose price was to be predicted declined and then recovered, and when the asset generated a positive final return.

full characterization of an individual's attitude toward risk is more complex than pure aversion or attraction. Higher order risk attitudes, in particular prudence and temperance, have been drawing increasing attention (see Trautmann and van de Kuilen, 2018, for a review). Prudence is defined as the convexity of the first derivative of the utility function, which is equivalent to a positive third derivative ($u''' > 0$; Kimball, 1990). A prudent attitude implies high negative weight given to downside risks (Eeckhoudt et al. 1995), or a preference for positive skew in a payoff distribution (Ebert, 2013), a pattern strongly observed in investment decisions (Harvey and Siddique, 2000; de Roon and Karehnke, 2017). [3] A prudent attitude is also equivalent to a desire for precautionary saving (Leland, 1968; Kimball, 1992), since a convex marginal utility function implies that the expected marginal utility of wealth is increasing in background risk. A consequence of prudence that is especially useful for the design of measurement tasks is that a prudent (imprudent) individual, when forced to accept an unavoidable risk, prefers to do so in relatively high (low) wealth states (Eeckhoudt and Schlesinger, 2006).

Temperance is defined as the concavity of the second derivative, or equivalently as a negative fourth derivative ($u'''' < 0$; Kimball, 1993), of the utility function. Temperance also implies a dislike of kurtosis in payoff distributions (Ebert, 2013). Thus, temperance can influence the valuation of assets (Corrado and Su, 1996; Harvey and Siddique, 2000). Temperate (intemperate) individuals take on less (more) risk in the presence of greater unavoidable background risk. If faced with two unavoidable independent risks, a temperate person prefers to disaggregate them across two different states (Eeckhoudt and Schlesinger, 2006), while an intemperate individual prefers to concentrate them in the same state.

The incidence of prudence and temperance in student populations have been evaluated in a number of studies. Ebert and Wiesen (2011, 2014), Deck and Schlesinger (2010, 2014) and Noussair et al. (2014) all observe that a majority of student participants are prudent. Ebert and Wiesen (2014), Deck and Schlesinger (2014) and Noussair et al. (2014) also

[3] Holzmeister et al. (2020) observe that the perception of risk among financial professionals, in nine different countries, depends on the skew of the return distribution rather than its variance. Participants in their study were shown return distributions and asked to indicate how risky they thought the distributions were. Variance and kurtosis did not influence the risk perception of either professionals or lay people. Assets with negatively-skewed returns were viewed as less risky than those with symmetric returns, which in turn were perceived as less risky than those with positive skew. The level actually invested depended on both variance and skew.

report that a majority of individuals are temperate, while Deck and Schlesinger (2010) find that a majority are intemperate. Deck and Schlesinger (2014) report two common general patterns of risk attitude. The first type of individual, the *mixed risk averter*, prefers to combine unavoidable adverse events with favorable ones, or in the words of Deck and Schlesinger, they seek to "combine good with bad". Under the assumption of expected utility, mixed risk averters exhibit alternating signs in the derivatives of their utility function. They are risk averse ($u'' < 0$), prudent ($u''' > 0$), and temperate ($u'''' < 0$). The other profile, the *mixed risk seeker*, prefers to "combine good with good and bad with bad", that is, concentrating favorable (unfavorable) events together. Individuals with this profile are risk seeking ($u'' > 0$), prudent ($u''' > 0$), and intemperate ($u'''' > 0$). Thus, both types are prudent, while the two types differ in whether or not they are risk averse and temperate.

Noussair et al. (2014) are the only authors, to our knowledge, who measure prudence and temperance among a non-student population. Their sample consists of 3566 subjects: 3457 demographically representative Dutch residents, drawn from a participant pool called the *LISS panel*, maintained by Tilburg University in the Netherlands, and 109 students currently enrolled at the University. They measure higher-order risk attitudes, study their correlations with risk aversion, link them to demographic characteristics, and analyze their relationship with savings and portfolio choices. They observe that majorities of individuals are prudent and temperate. Prudence correlates positively with educational level, savings, and owning one's own home, and correlates negatively with credit card debt. Temperance correlates with a lower probability of holding risky investments and with a lower share of risky assets in one's investment portfolio. On average, women are more temperate than men. There have been, to our knowledge, no attempts to measure the levels of prudence and temperance among individuals who specialize in analyzing and working with risk.

The study that we report in this paper measures the higher order risk attitudes of a sample of participants that are financial experts. The sample consists of experienced professionals, who work as traders, financial analysts, or in support and commercial functions in the financial industry. Consequently, the sample is based on a wide variety of businesses in the banking, asset management and trading sectors. Our procedure is to

replicate the experiment of Noussair et al. (2014) with these financial experts and to compare their decisions with those of the students and the demographically representative individuals in the original study. We are aware that the temporal distance between the collection of the samples is a relevant issue as it is for replicability studies. We compare our newly collected sample of financial experts (2017) with a unique large sample of the general Dutch population (2010) and a further sample of university students. Our design is concerned by a potential exogenous shock occurring during the time window elapsing between the two experimental moments. This shock could shift the average level of risk or higher-order risk in the population (Schildberg-Hörisch, 2018) and provide a source of bias for a proper estimation. Both samples have been collected within a "safe" time window comprised after the subprime crisis of 2007 and also before the COVID-19 pandemic. The fact that behavior in the particular experimental task we implemented correlates so strongly with other life decisions means that the behavior we observe in our task is likely to be informative of other decisions that our participants make outside the experiment.

We find that the financial professionals participating in our experiments are significantly more risk-seeking and intemperate than both students and the demographically representative participants in Noussair et al. (2014). The professionals are significantly less prudent than students but their level of prudence does not differ from members of the general population. We do not find any relationships between job characteristics and risk attitudes.

2 Experimental design

To facilitate a comparison between our expert participants and the other subject pools, we utilize the same protocol as Noussair et al. (2014). In the experiment, participants face 17 binary choices between lotteries, presented sequentially. Table 1 summarizes the 17 choice tasks. Each of the 17 rows corresponds to one decision to be taken between the Left lottery and the Right lottery. The notation [a_b] indicates an equiprobable gamble in which either a or b is added to the previous total, each with probability .5. For example, in the choice entitled Riskav 1, shown in the first row in Table 1), the Right lottery has the values $a = 65$ and $b = 5$. This means that if the Right lottery is chosen, the outcome will

Table 1: List of choice tasks

Name of task	Left lottery	Right lottery
Riskav 1	20	[65_5]
Riskav 2	25	[65_5]
Riskav 3	30	[65_5]
Riskav 4	35	[65_5]
Riskav 5	40	[65_5]
Prud 1	[(90 + [20_-20])_60]	[90_(60 + [20_-20])]
Prud 2	[(90 + [10_-10])_60]	[90_(60 + [10_-10])]
Prud 3	[(90 + [40_-40])_60]	[90_(60 + [40_-40])]
Prud 4	[(135 + [30_-30])_90]	[135_(90 + [30_-30])]
Prud 5	[(65 + [20_-20])_35]	[65_(35 + [20_-20])]
Temp 1	[(90 + [30_-30])_(90 + [30_-30])]	[90_(90 + [30_-30] + [30_-30])]
Temp 2	[(90 + [30_-30])_(90 + [10_-10])]	[90_(90 + [30_-30] + [10_-10])]
Temp 3	[(90 + [30_-30])_(90 + [50_-50])]	[90_(90 + [30_-30] + [50_-50])]
Temp 4	[(30 + [10_-10])_(30 + [10_-10])]	[30_(30 + [10_-10] + [10_-10])]
Temp 5	[(70 + [30_-30])_(70 + [30_-30])]	[70_(70 + [30_-30] + [30_-30])]
RA_EU1	[40_30]	[50_24]
Prud_EU2	[(50 + [25_-25])_30]	[50_(30 + [15_-15])]

[a_b] indicates an equiprobable lottery in which either a or b is received; choice of the left lottery indicates risk aversion, prudence and temperance respectively.

be either 65 Experimental Currency Units (ECU) or 5 ECU with equal probability.

The elicitation procedure consists of four parts. The first part, which measures the degree of risk aversion, is composed of five choices between a sure payoff and a lottery with two possible payoffs, each occurring with equal probability. Parts two and three each include five binary choices between two different lotteries to measure prudence and temperance, respectively. Part four, consisting of the last two decisions (RA_EU1 and Prud_EU2), assesses the strength of relative risk aversion and relative prudence, respectively. RA_EU1 tests whether the coefficient of relative risk aversion, $RR(x) = -xu''(x)/u'(x)$, is greater than one under the assumption of the CRRA functional form, $u(x) = \frac{x^{1-r}}{1-r}$. In other words, it reveals whether an individual is more or less risk averse than logarithmic utility $u(x) = ln(x)$. Prud_EU2 measures whether the coefficient of relative prudence, $RP(x) = -xu'''(x)/u''(x)$, is greater than 2, under the assumptions of expected utility and CRRA. If the decision maker is sufficiently risk averse and prudent, she would select the Left lotteries in the last two rows of Table 1.[4]

[4]As in Noussair et al. (2014), the sequence of parts 2 and 3 was counterbalanced. Half of the subjects completed Part 3 before Part 2. For these two parts, the positioning of the lotteries on the left and the right were reversed for one half of participants. In the first part of the session measuring risk aversion, one half of

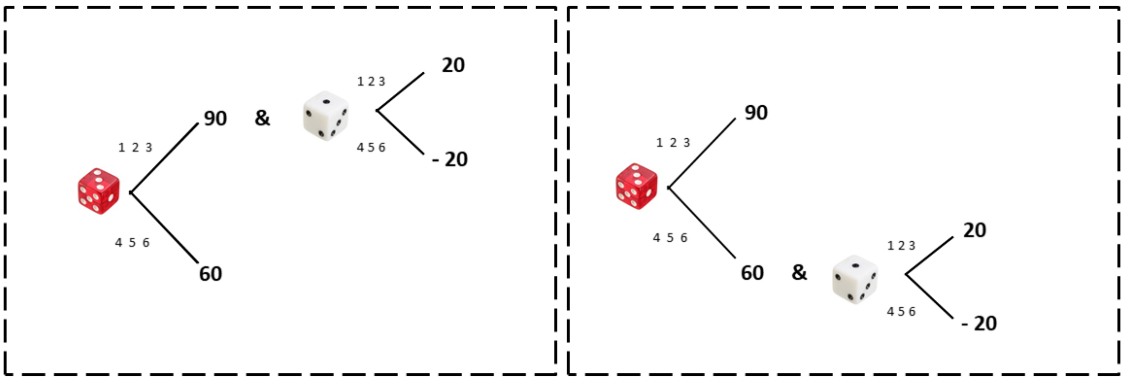


Figure 1: Prud 1 choice task, display shown to participants (subject chooses between compound lotteries on the left and on the right)

The tasks that assess prudence in Part 2, listed in Table 1 as Prud 1 - Prud 5, have the following functional form:

$$[(a + [c_{1\_} - c_1])\_b] \quad vs. \quad [a\_(b + [c_{1\_} - c_1])] \tag{1}$$

where a, b, and c_1 are strictly positive monetary outcomes. For example, consider the lottery shown in Figure 1, termed *Prud 1* in Table 1. The parameters are $a = 90$, $b = 60$, and $c_1 = 20$. a and b are the wealth levels in the good and bad states respectively. In both lotteries, there is an unavoidable risk, under which the individual gains or loses c_1 with equal probability. If the agent chooses the Left lottery, there is an initial random draw, visualized in the figure and on participants' computer screens as a die roll, which results in 90 or 60 ECU, each with probability .5. If the result is a 1, 2, or 3, resulting in 90 ECU, another virtual die is rolled, and 20 ECU is either added to or subtracted from the 90 ECU, each with probability .5. If the outcome of the initial die roll is 4, 5, or 6, the result is 60 ECU. The Right lottery differs in that the second die roll occurs if and only if the first roll results in 60 ECU. By making the choice on the left, the individual is choosing to take on the risk in the high-wealth state, and by choosing the option on the right, she is electing to put the risk in the low-wealth state. A choice of Left indicates prudence, one of Right shows imprudence.

In Table 1, we also describe the five temperance tasks constituting Part 3 of the exper-

the participants received the lotteries in increasing order of the fixed payment, and the other in decreasing order. The instructions for the experiment are provided in Appendix A.

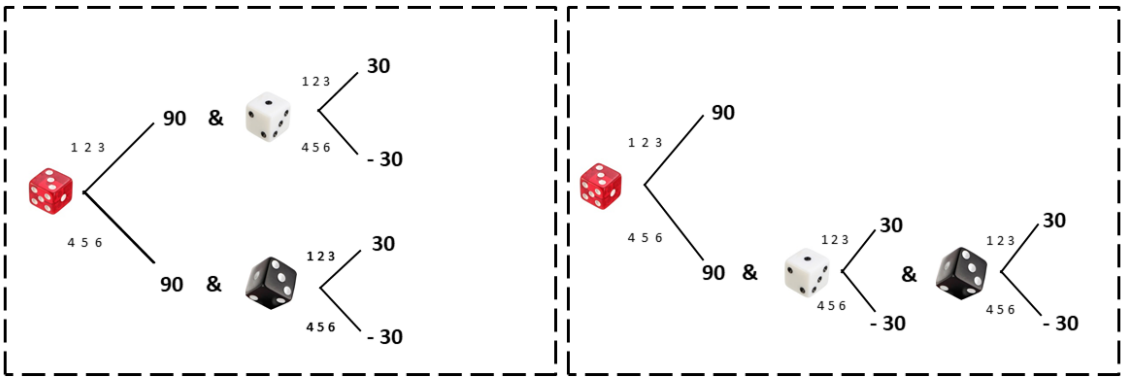


Figure 2: Temp 1 choice task (subject chooses between compound lotteries on the left and on the right)

iment. Adhering to the notation introduced earlier, the choice tasks are listed in Table 1 in the form:

$$[(a + [c_{2\_} - c_2])\_a + [c_{1\_} - c_1])] \quad vs. \quad [a\_(a + [c_{2\_} - c_2] + [c_{1\_} - c_1])] \tag{2}$$

As an example, consider the Temp 1 task, displayed in Figure 2. The values of the parameters are $a = 90$, $c_1 = c_2 = 30$. a is the (here certain) payoff of the first die roll, c_1 or $-c_1$, and c_2 or $-c_2$, are the possible payoffs of a second and third equiprobable draw, respectively. A temperate decision maker has a preference for disaggregating the two risks by choosing the lottery on the left, while an intemperate individual prefers to assign both risks to the same state, as in the alternative on the right. The prospect of receiving an additional c_2 or $-c_2$ can be interpreted as a background risk. A temperate (intemperate) decision maker prefers to assign an additional unavoidable risk to a state with less (greater) background risk.

The decisions to measure prudence and temperance have the structure of risk apportionment tasks. Consider, for example, the task Prud 1, shown in Figure 1. The decision maker chooses whether to place the risk represented by the white die roll in the high or low wealth state. In the task Temp 1, shown in Figure 2, the individual chooses whether to apportion the risk represented by the black die to a state with no risk, or to one in which there is already the risk embodied in the white die roll. The notion of using risk apportionment tasks to distinguish higher-order risk attitudes is due to Eeckhoudt and Schlesinger (2006). The ability to frame the measurement tasks in such simple terms,

moving a die roll to another location, makes it easier to implement such tasks with individuals who are not accustomed to experimental decision situations.

We replicated two treatments of Noussair et al. (2014), which they called "Real" and "Real lowvar". Here, for greater clarity, we term the two treatments "High Var" and "Low Var", respectively. The only difference between the two treatments is that the magnitude of the risk c_1 in Low Var is always equal to one-tenth of its value in the High Var treatment. The values for High Var are shown in Table 1.[5]

After making the 17 binary choices listed in Table 1, subjects had to answer a seven-question version of the Cognitive Reflection Test (Frederick, 2005; Finucane and Gullion, 2010; Toplak et al, 2014).[6] The test is presented in Appendix C. At the end of the experiment, subjects also completed a final questionnaire, which is given in Appendix D, about their professional status and job description. The questions concerned the particular job they have, the trading strategies they use, the types of assets they invest in, their employer, and several personal characteristics.

The experiment was followed by a second, unrelated experiment on portfolio choices with the same subjects participating. The second experiment, which occurred after ours, cannot influence our data, is to be reported in another paper.[7] The two experiments together lasted a total of one hour. After completing the two experiments, each subject had a 10% chance of being selected by the computer to be paid. For the participants that were chosen, the experiment that was renumerated was randomly drawn with equal probability.

If the experiment on higher order risk attitudes was drawn to count toward earnings, the computer randomly selected one of the 17 options the subject had chosen and rolled virtual dice to determine the monetary reward. The currency used was called ECU. The

[5]Noussair et al. (2014) included the Low Var treatment to evaluate a possibility raised by Eeckhoudt and Schlesinger (2006) that if one of the two risks that may be combined is small, individuals would become more intemperate. As reported in Section 4, we do not observe any difference between High Var and Low Var with regard to temperance. On the other hand, we do observe that the experts become less prudent in Low Var, where one of the risks is small.

[6]Studying professional traders, Thoma et al. (2015) observe that higher CRT scores are associated with more years of experience and greater salaries. In general, laboratory asset-market experiments show that better cognitive abilities are associated with higher earnings (Corgnet et al., 2015; Breaban and Noussair, 2015; Noussair et al., 2016, Akiyama et al., 2017). Kirchler et al. (2018) find, in a large-sample study including professionals, that the average amount invested in a risky asset is not correlated with CRT score.

[7]At the beginning of the experiment, participants knew that two successive experiments would be run. Introductory instructions, shown at the beginning of the experiment, are given in Appendix A.1.

exchange rate was 1 ECU equal to 4 Euros. If a subject was selected by the computer, the expected payoff was approximately 70 ECU, which equals 280 Euros, and could vary between 40 and 600 Euros, depending on the participant's choices and the lottery outcomes. In addition, each subject received a backpack worth 30 Euros at the end of this experiment, as a reward for her participation.

Our reward scheme is comparable to other experiments conducted with financial market professionals. Cohn et al. (2015) paid 20% of their 162 participants, who could earn between 0 and 546 dollars. Kirchler et al. (2018) paid 20% of their professionals with an average (maximum) payment of 52 Euros (600 euros) for a 45-minute experiment, while Haigh and List (2005) paid 40 dollars for a 25-minute task. In the study of Weitzel et al. (2020), the average payment was 76.5 Euros for a 70-minute experiment. Using the calculations of Kirchler et al. (2018), who estimated that their professional participants earned an hourly net wage of 26 Euros in their job, the average (maximum) per-hour remuneration in effect in our experiment was 270% (2,308%) of hourly wage, which represents a substantial monetary incentive.

3 Subject pool

The data were collected at the 30th International Federation of Technical Analysts (IFTA) Conference. The conference was held in Milan (Italy), at the Excelsior Hotel Gallia, from Friday, October 13th, to Sunday, October 15, 2017. For the occasion, and in collaboration with the leaders of the trading federation, an experimental laboratory was prepared in a room next to the conference hall. About half of the subjects were Italian (80 out of 173), and the other nationalities most represented were Malaysia (24), Switzerland (11), United Kingdom (10), United States (7), Australia (6) and Germany (5).

The experiment was conducted in compliance with the ethical rules of the LEEN (experimental economics laboratory of Nice) and implemented using O-Tree (Chen et al., 2016)[8]. 178 financial market professionals took part in the experiment. Five subjects did not finish the experiment because they did not complete the questionnaire. Removing them, our final sample is made up of 173 professionals of whom 27 are women (16% of

[8]http://otree.readthedocs.io/en/latest/

the sample). The average and standard deviation of their ages is 44.04 and 12.25 years, respectively. We also collected information about their academic background. 6% of the participants (11) declared that they held a PhD and the great majority (108, 63%) have a post-graduate degree. The sample distributions of gender, age and academic background are reported in Appendix B.

The average score on the seven-item CRT questionnaire was 2.83 with a standard deviation of 1.74. Considering only the first three questions, corresponding to the standard three-item version of the test, the average score was 0.9 with a standard deviation of 0.98.[9] The distribution of correct responses is reported in Appendix C along with the list of questions. The distributions of responses for most of the items in the questionnaire about job experience are given in Appendix D, with the text of the survey form.

Participants reported several different job specializations. 75 of them can be classified as working in the area of trading (prop trader, sales trader, sales, asset/portfolio manager), while 21 work as analysts (financial analyst, strategist/economist, risk analyst). The remaining 77 respondents did not provide a precise answerand usually worked in support or sales functions in finance and asset management. With regard to their operating strategies, the large majority of subjects (132) indicated that they mainly applied technical analysis and very often used other trading strategies in addition. In terms of the type of market they work with, 44 subjects operate exclusively in spot markets, 32 in derivatives markets, and 65 in both. The remaining 32 participants did not specify the markets in which they were active. The average and standard deviations of their years of experience in the financial sector are 14.01 and 8.61 years, respectively. The survey responses indicate that the participants have daily and extensive exposure to working with monetary risk, and thus can be considered as experts in finance.

4 Results

We measure, as in Noussair et al. (2014), individual risk aversion as the number of safe choices in decisions 1 to 5 in Table 1, Part 1 of the experiment. It can be seen from the payoff structure of these decisions that making from 2 to 5 choices is consistent with risk

[9]Other studies of financial professionals typically report higher average CRT scores. Kirchler et al. (2018) document an average CRT score of 1.81 in their sample and Thoma et al. (2015) observe an average of 1.62.

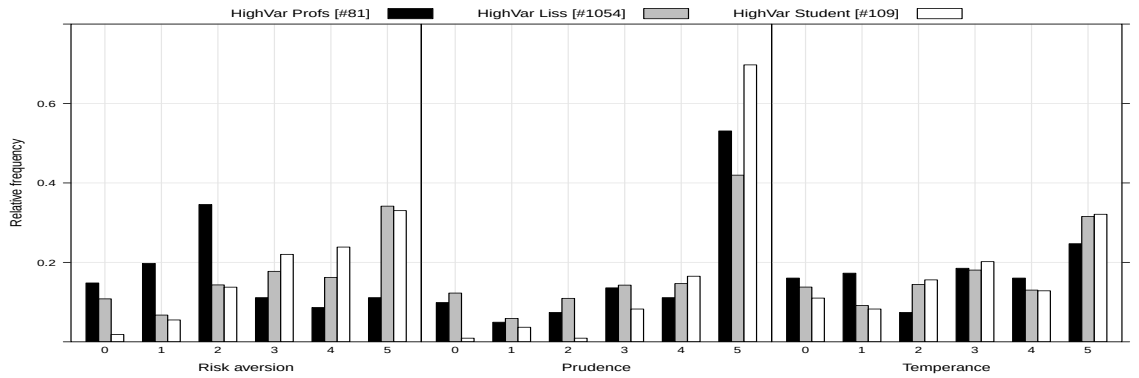


Figure 3: Percentages of individuals' making different numbers of safe choices in both the High Var and Low Var treatments, prudent and temperate choices in the High Var treatment only; LISS panel participants shown in gray, university students in white, and experts in black

aversion. Zero or 1 safe choices is consistent with risk seeking preferences, and either 1 or 2 safe choices would be made by a risk-neutral individual. Making zero safe choices is consistent only with risk seeking and 3 - 5 only with risk aversion. Following Noussair et al. (2014), we measure prudence (temperance) by the number of prudent (temperate) choices made in decisions 6 to 10 (11 to 15) in Table 1, Parts 2 and 3 of the experiment. We classify an individual as prudent if a majority of her five decisions were prudent in Part 2. Similarly, a participant is classified as temperate if a majority of her decisions in Part 3 were temperate.

Figure 3 contains histograms of the risk aversion (left panel) levels in the three samples from Part 1 of both the High Var and Low Var treatments, as measured by the number of safe choices made. The figure also reports the distribution of the number of prudent (middle panel), and temperate (right panel) choices made in the three samples, from Parts 2 and 3 of the High Var treatment, where there is data available from all three samples. The gray and white bars show the data for the LISS panel participants and the student sample of Noussair et al. (2014), respectively, and our sample of experts is displayed with black bars. In the figure, each individual constitutes one observation. Figure 4 contrasts the behavior of both experts and LISS participants between the High Var and Low Var treatments, in terms of prudence and temperance. The Low Var treatment was not administered to students.

Risk aversion: The data reported in the left panel of Figure 3 highlight the fact that the experts are significantly more risk loving than students ($p < 0.0001$, Pearson's Chi-

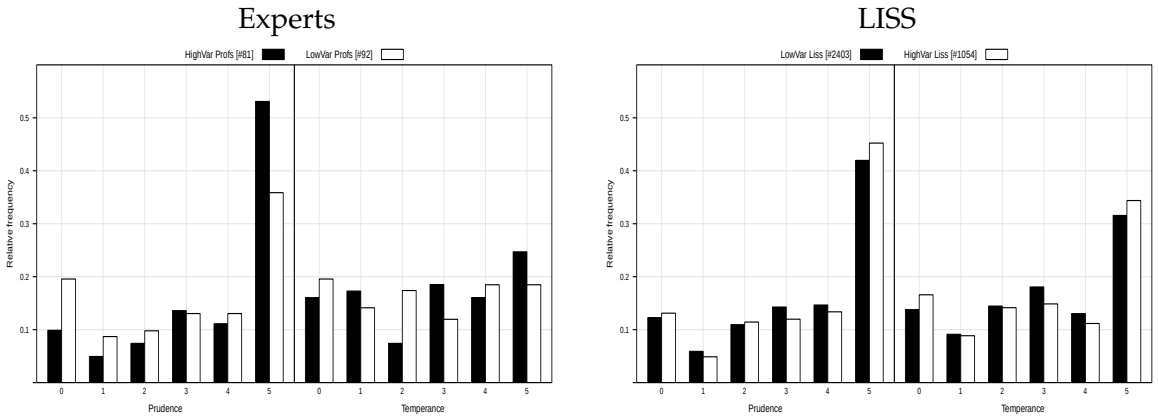


Figure 4: Histograms of individuals' number of prudent (left within a panel) and temperate (right within a panel) choices in the HighVar (white bars) and LowVar (dark bars) treatments; for experts (left) and LISS respondents (right).

squared test, $p < 0.0001$, MW two-sided test) and LISS panel respondents ($p < 0.0001$, Pearson's Chi-squared test, $p < 0.0001$, MW two-sided test), whereas LISS respondents are slightly, though significantly, less risk-averse than students ($p = 0.017$, Pearson's Chi-squared test, $p = 0.09$, MW two-sided test). The average number of safe choices is 2.439 for financial experts, 3.596 for students, and 3.378 for Liss panel participants. Almost 29% of the experts can be classified as risk-seekers, as they make $\{0, 1\}$ safe choices, while 18% and 8% of LISS participants and students, respectively, are risk-seeking by the same criterion. This percentage of risk seekers rises to approximately 60% for the experts if we also include those who make two safe choices, thereby creating a category for risk-seekers plus risk-neutral individuals. The percentages in this category are 32% and 21% for LISS participants and students, respectively.[10] The experts are significantly less risk averse than members of the other groups.

Prudence: The middle panel of Figure 3 and the left half of each panel of Figure 4 show that a large majority of decisions made by the experts reflects a prudent attitude. The average number of prudent choices is 3.704 for financial experts in the High Var treatment, 2.99 in Low Var, and 3.32 in the pooled data from the two treatments. For

[10]The results from the RA_EU1 task also show lower risk aversion among experts than LISS participants. 36% of experts choose the relatively safe option, in comparison with 49% of LISS Panel respondents and 37% of students. A Pearson's Chi-squared test and a Mann-Whitney rank sum test are both statistically significant when comparing the experts with LISS participants ($p = 0.003$, Pearson's Chi-squared test, $p = 0.002$, MW two-sided test), but not with the student sample ($p = 1$, Pearson's Chi-squared test, $p = 0.962$, MW two-sided test).

LISS panel participants, the average is 3.39 in High Var, 3.34 in Low Var and 3.38 overall. The average is 4.45 for students in High Var. Almost 22% of the experts make two or fewer prudent choices, and thus are classified as imprudent, in the High Var treatment. 38% are of experts in Low Var and 31% of experts overall are imprudent. Among LISS participants, 29% are imprudent under High Var, 32% in Low Var and 30% overall. 6% of the students are imprudent.

The experts are significantly less prudent than students ($p = 0.003$, Pearson's Chi-squared test, $p = 0.003$, MW two-sided test, both tests for the High Var data). However, the prudence level of the experts is not significantly different than that of LISS panel respondents ($p = 0.72$ in a Pearson's Chi-squared test, and $p = 0.936$ in a MW two-sided test, for the pooled data from both treatments). Thus, the experts are not systematically more or less prudent than the general population.[11]

Temperance: Histograms of the temperance choices under High Var are shown in the right panel of Figure 3, and in the right halves of each of the panels of Figure 4. The average number of temperate choices is 2.753 for financial experts in the High Var treatment, 2.511 under Low Var, and 2.624 in the pooled data from the two treatments. The LISS panel participants made an average of 3.021 temperate decisions in the High Var treatment, 2.668 under Low Var, and 2.935 overall. Students made an average of 3.119 temperate choices under High Var. Almost 41% of the experts made two or fewer temperate choices in High Var, 51% in Low Var and 46% overall, and thus are classified as intemperate. For comparison, among LISS subjects, 37%, 48% and 40% were temperate in High Var, in Low Var, and overall. 35% of students were intemperate. Experts are significantly more temperate then LISS participants ($p = 0.005$, Pearson's Chi-squared, $p = 0.028$, MW two-sided test). Experts are also less temperate than students, but not significantly ($p = 0.16$, Pearson's Chi-squared, $p = 0.18$, MW two-sided test). The difference between LISS panel members and students is not significant ($p = 0.96$, Pearson's Chi-squared, $p = 0.639$, MW two-sided test). Thus, we find that experts are less temperate than the demographically representative sample.

[11] In the PRUD_EU2 task, 62% of the experts chose the relatively prudent option. This is a similar percentage to the LISS respondents (59%), but lower than the students (83%). Experts are significantly less prudent than students ($p = 0.0004$, Pearson's Chi-squared test, $p = 0.0002$, MW two-sided test), but not different from the LISS participants ($p = 0.572$, $p = 0.519$, MW two-sided test).

We now turn to the comparison between the High Var and Low Var treatments shown in Figure 4. The figure gives the impression that behavior is quite similar in the two treatments, with the exception that the experts, shown in the left panel of Figure 4, make more prudent choices in High Var. Nearly twice as many experts make zero prudent choices under Low Var, and the number of participants making five prudent choices is 18 percentage points higher under High Var. Experts in the High Var treatment were significantly more prudent than those in Low Var (p=0.011, MW two-sided test). Noussair et al. (2014), on the other hand, found no difference between the treatments in the number of prudent choices for the LISS participants (p=0.274, MW two-sided test, shown in the right panel of Figure 4). For temperance, however, neither experts (p=0.370, MW two-sided test) nor LISS respondents (p=0.846, MW two-sided test) show a statistically significant difference between High Var and Low Var.

The appendices present the results of some additional analyses. In Appendix E, we report the results of our investigation regarding the relationships between the experts' job characteristics and their higher order risk attitudes, controlled by treatments Low Var and High Var. We observe no statistically significant relationships between risk-aversion, or temperance, and job-related characteristics. In Appendix F, we study the correlation between risk aversion, prudence, and temperance at the individual level. For our experts, we find a positive correlation between prudence and temperance.

5 Conclusions

In this paper, we measured the higher order risk attitudes of a sample of financial experts. We compared the results with those from students and a demographically representative sample of the Dutch population reported in Noussair et al. (2014). We found that the experts who participated in our experiments were significantly less risk-averse than students and the general population. They were also less temperate than the general population and the students, as well as less prudent than the students.

Our data do not allow us to pin down the mechanism whereby the correlation between being expert in financial risk and risk tolerance/ intemperance arises. It may be the case that those individuals who become expert in the domain are those who take risks

in general and who concentrate their risks in a subset of the states. This pattern characterizes individuals who like to combine good with good in the taxonomy of Eeckhoudt et al. (2009). It may be that those who combine good with good are those who end up being in a position in which they can acquire the relevant expertise about risk. It could also be the case that risk-seeking and intemperate individuals are more likely to become expert in non-financial domains as well, though determining this would require further research. Furthermore, there may be selection of risk tolerant individuals specifically into finance since and employee compensation is relatively variable compared to other occupations. There may be an additional selection for intemperate individuals, since income risks may be correlated leading income shocks to be concentrated into negative and positive clusters.

On the other hand, the causality might be in the other direction, that is, from expert to risk taker rather than from risk taker to expert. The reward structure in the financial industry may encourage individuals to take more risk and to behave in a less temperate manner. Dealing with risks frequently may reduce one's fear of taking on risk and of concentrating it in a small number of states. This behavior may then carry over to outside the workplace. The presence of a disproportionate percentage of such individuals in the financial industry specifically could contribute to the volatile market dynamics and excessive risk taking that affects the financial industry.

The financial industry also focuses on the management of downside risk, which is associated with prudent preferences. An emerging consensus is establishing that a strong majority of individuals in society is prudent. Our experts are at least as prudent as typical individuals, though not more than the university students that have been studied. Prudence is also strongly correlated with educational attainment (Noussair et al., 2014), and our sample is very educated compared to the overall population. However, one might argue that imprudence might be a trait that is selected for in the financial industry, and this selection may offset the effect of educational attainment so that the average level of prudence among our experts is close to that of the general population.

References

Abbink, K., & Rockenbach, B. (2006). Option pricing by students and professional traders: a behavioural investigation. *Managerial and Decision Economics*, 27(6), 497-510.

Abdellaoui, M., Bleichrodt, H., & Kammoun, H. (2013). Do financial professionals behave according to prospect theory? An experimental study, *Theory and Decision*, 74, 411-429.

Akiyama, E., Nobuyuki, H., & Ishikawa, R. (2017). It is not just confusion! Strategic uncertainty in an experimental asset market, *The Economic Journal*, 127(605), F563-F580.

Alevy, J. E., Haigh, M. S., & List, J. A. (2007). Information cascades: Evidence from a field experiment with financial market professionals. *The Journal of Finance*, 62(1), 151-180.

Barsky, R.B., Juster, F.T., Kimball, M.S. and Shapiro, M.D. (1997). Preference parameters and behavioral heterogeneity: An experimental approach in the health and retirement Study. *Quarterly Journal of Economics*,112, 537-579.

Benjamin, D., Brown, S.A. and Shapiro, J. (2013). Who is 'behavioral'? Cognitive ability and anomalous preferences. *Journal of the European Economic Association*, 11(6), 1231-1255.

Breaban, A. & Noussair, C. (2015). Trader characteristics and fundamental value trajectories in an asset market experiment, *Journal of Behavioral and Experimental Finance*, 8, 1-17.

Chen, D.L., Schonger, M. and Wickens, C., (2016). oTree - An open-source platform for laboratory, online, and field experiments. *Journal of Behavioral and Experimental Finance*, 9(1), 88-97.

Cipriani, M., & Guarino, A. (2009). Herd behavior in financial markets: An experiment with financial market professionals, *Journal of the European Economic Association*, 7, 206-233.

Cohen A., & Einav L. (2007). Estimating risk preferences from deductible choice, *American Economic Review*, 97 (3), 745-788.

Cohn, A., Engelmann, J., Fehr, E., & Maréchal, M. A. (2015). Evidence for countercyclical risk aversion: An experiment with financial professionals. *The American Economic*

Review, 105(2), 860-885.

Cohn, A., Fehr, E., & Maréchal, M. A. (2014). Business culture and dishonesty in the banking industry. *Nature*, 516(7529), 86.

Corgnet, B., DeSantis, M., & Porter, D. (2015). Revisiting information aggregation in asset markets: Reflective learning and market efficiency. Technical report.

Corrado, C. J., & Su, T. (1996). Skewness and kurtosis in S&P 500 index returns implied by option prices. *Journal of Financial Research*, 19(2), 175-192.

Cueva, C., Iturbe-Ormaetxe I., Mata-Pérez, E., Ponti, G., Sartarelli, M., Yu, H., & Zhukova, V. (2016). Cognitive (ir)reflection: New experimental evidence. *Journal of Behavioral and Experimental Economics*, 64, 81-93

Dohmen, T., Falk, A., Golsteyn, B., Huffman, D. and Sunde U. (2017). Risk attitudes across the life course, *Economic Journal* 127(605), F95-F116.

de Roon, F., & Karehnke, P. (2017). Addendum: A simple skewed distribution with asset pricing applications. *Review of Finance*, 21(6), 2401-2401.

Deck C., & Schlesinger H. (2010), Exploring higher order risk effects, *Review of Economic Studies* 77 (4), 1403 - 1420.

Deck C., & Schlesinger H., (2014). Consistency of higher order risk preferences, *Econometrica*, 82 (5), 1913-1943.

Donkers, B., Melenberg, B. and van Soest, A. (2001). Estimating risk attitudes using lotteries - a large sample approach, *Journal of Risk and Uncertainty*, 22(2), 165-95.

Ebert, S. (2013). Moment characterization of higher-order risk preferences. *Theory and Decision*, 74(2), 267-284.

Ebert S. & Wiesen, D., (2011). Testing for prudence and skewness seeking *Management Science*, 57 (7), 1334 - 1349

Ebert, S. & Wiesen, D. (2014). Joint measurement of risk aversion, prudence, and temperance, *Journal of Risk and Uncertainty*, 48 (3), 231-252.

Eeckhoudt, L., Gollier, C., & Schneider, T. (1995). Risk-aversion, prudence and temperance: A unified approach. *Economics letters*, 48(3-4), 331-336.

Eeckhoudt, L., & Schlesinger, H. (2006). Putting risk in its proper place. *American Economic Review*, 96(1), 280-289.

Eeckhoudt, L., Etner, J. & Schroyen, F. (2009). The values of relative risk aversion and

prudence: A context-free interpretation?. *Mathematical Social Sciences*, 58, 1-7.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., Sunde, U., (2018) Global evidence on economic preferences, *Quarterly Journal of Economics*, 133 (4), 1645 - 1692.

Finucane, M. L., & Gullion, C. M. (2010). Developing a tool for measuring the decision-making competence of older adults. *Psychology and aging*, 25(2), 271-288

Frechette G., (2015), Laboratory experiments: Students vs. professionals, Ch. 17 in *Handbook of Experimental Economic Methodology*, G. Frechette and A. Schotter eds., Oxford University Press, Oxford, United Kingdom.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic perspectives*, 19(4), 25-42.

Gilad, D., and Kliger, D. (2008), Priming the risk attitudes of professionals in financial decision making, *Review of Finance* 12 (3), 567 - 586.

Glaser, M., Langer, T., & Weber, M. (2007). On the trend recognition and forecasting ability of professional traders. *Decision Analysis*, 4(4), 176-193.

Haigh, M.S., & List, J.A. (2005). Do professional traders exhibit myopic loss aversion? An experimental analysis, *Journal of Finance*, 60, 523-534.

Harrison, G.W., Lau, M.I. and Rutstrom, E.E. (2007). Estimating risk attitudes in Denmark: A field experiment, *Scandinavian Journal of Economics*, 109, 341-368.

Harrison, G. W. and List, A. (2004), Field experiments, *Journal of Economic Literature*, 42 (4): 1009-1055.

Harvey, C. R., & Siddique, A. (2000). Conditional skewness in asset pricing tests. *The Journal of Finance*, 55(3), 1263-1295.

Holzmeister, F., Huber, J., Kirchler, M., Lindner, F., Weitzel, U., and Zeisberger, S. (2020). What Drives Risk Perception? A Global Survey with Financial Professionals and Lay People, forthcoming *Management Science*

Kaustia, M., Alho, E., & Puttonen, V. (2008). How much does expertise reduce behavioral biases? The case of anchoring effects in stock return estimates. *Financial Management*, 37(3), 391-412.

Kimball, M. S. (1990). Precautionary saving in the small and in the large. *Econometrica*, 58 (1), 53-73.

Kimball, M. S. (1992). Precautionary motives for holding assets (No. w3586). National

Bureau of Economic Research.

Kimball, M. S. (1993). Standard risk aversion. *Econometrica*, 61(3), 589-611.

Kirchler, M. , Lindner, F. & Weitzel, U. (2018). Rankings and risk-taking in the finance industry. *The Journal of Finance*, 73(5), 2271-2302.

Leland H. (1968). Saving and Uncertainty: The Precautionary Demand for Saving, *The Quarterly Journal of Economics*, 82(3), 465-473.

List, J. A., & Haigh, M. S. (2005). A simple test of expected utility theory using professional traders. *Proceedings of the National Academy of Sciences*, 102(3), 945-948.

Noussair, C., Trautmann, S.T., & Van de Kuilen, G. (2014). Higher order risk attitudes, demographics, and financial decisions. *Review of Economic Studies*, 81(1), 325-355.

Noussair, C., Tucker, J.S. & Xu, Y. (2016). Futures Markets, Cognitive Ability, and Mispricing in Experimental Asset Markets. *Journal of Economic Behavior & Organization*, 130, 166-179

Razen, M., M. Kirchler, and U. Weitzel, (2020). Domain-specific risk-taking among finance professionals, *Journal of Behavioral and Experimental Finance*, 27, 100331.

Sahm, C. (2012). How much does risk tolerance change?, *Quarterly Journal of Finance*, 2(4), 1-38.

Schildberg-Hörisch, H. (2018). Are Risk Preferences Stable? *Journal of Economic Perspectives*, 32 (2), 135-54.

Schwaiger, R., Kirchler, M., Lindner, F., & Weitzel, U. (2020). Determinants of investor expectations and satisfaction. A study with financial professionals. *Journal of Economic Dynamics and Control*, 110, 103675

Smith V. (1982). Microeconomic systems as an experimental science. *American Economic Review* 72(5), 923-955

Thoma, V., White, E., Panigrahi, A., Strowger, V., & Anderson, I. (2015). Good Thinking or Gut Feeling? Cognitive Reflection and Intuition in Traders, Bankers and Financial Non-Experts. *PLOS ONE*, 10(4), 1-17.

Toplak, M. E., West, R. F., & Stanovich, K. E. (2014). Assessing miserly information processing: An expansion of the Cognitive Reflection Test. *Thinking & Reasoning*, 20(2), 147-168.

Trautmann, S. T., & van de Kuilen, G. (2018). Higher Order Risk Attitudes: A Review of

Experimental Evidence. *European Economic Review*, 103, 108-124.

Weitzel, U., Huber, C., Huber, J., Kirchler, M., Lindner, F., & Rose, J. (2020). Bubbles and financial professionals. *Review of Financial Studies*, 33(6), 2659 - 2696.

Online Appendix

We include six Appendices. In Appendix A, the instructions of the experiment are provided. In Appendix B, the distributions of academic background, gender, age, and experience in the financial industry of participants are presented. Appendix C consists of the questions of the Cognitive Reflection Test that we administered, and the distribution of scores on the test. Appendix D contains the questionnaire on the professional experience and demographic characteristics that participants had to complete at the end of the experiment, and a summary of the responses. In Appendix E, we report an analysis of the relationships between risk attitudes and characteristics of our sample. In Appendix F, we investigate the correlations between risk aversion, prudence and temperance.

A Instructions for the experiment

A.1 Frame 1

Welcome to this online experiment!

This is a pure research work that attempts to investigate some behavioral attitudes of traders by collecting anonymous data.

The experiment consists of two sessions. You will now attend the first session only, lasting approximately thirty minutes. After concluding the first session, you will be able to attend the second session lasting twenty minutes during the remaining days of the conference by joining this laboratory at any time. Each session is independent. Therefore, the results of a session do not affect the results of the other one. The participation to the second session will make you eligible for a monetary reward up to 600 euro.

Indeed, your earnings will consist of:

A. Upon completion of the first session, when you leave this room you will receive a backpack as a reward for your participation. This compensation does not depend on the results in the experiment based on your choices and will be offered to you anyway.

B. Upon completion of the second session you may receive a monetary reward that depends on the results of the experiment. After carrying out the two sessions of the ex-

periment, the computer will choose a number between 1 and 10 with an equal probability. If this number is equal to 1, you will be paid on the basis of the outcomes determined by your choices made in one of the two sessions otherwise you will not receive any monetary reward. The rewarded session is randomly drawn. Therefore, you have 10% chance to win a monetary reward. You can win up to 600 euro in less than one hour! The amount earned will be paid by bank transfer. It is therefore absolutely necessary for you to complete the two sessions of the experiment in order to be eligible for receiving your monetary reward. If you want to carry out the second session today just after the first one, there is no problem. Tell us at the end of the first session and you can continue! If not, please attend the second session at the laboratory whenever you wish in the next days before the end of the Conference.

A.2 Frame 2

Let's now turn to the instructions of the first session:

This session consists of 3 parts:

1. You will first perform a task. It is during this game that you will be able to earn a monetary reward.

2. Secondly, you will answer questions with varying levels of difficulty. This task is not paid. Please do anyway your best!

3. Finally, you will answer a questionnaire about your personal and professional characteristics.

As previously mentioned, this session should last around 30 minutes. Each of the 3 parts is independent. At the beginning of each part you will receive specific instructions on the screen in order to be prepared to accomplish the current part of the experiment. Please read carefully the instructions. Please do not communicate on the content of the experiment with the participants of the conference in order to guarantee the validity of the experimental results. Thanks again for attending this session!

A.3 Frame 3

Instructions for Part One

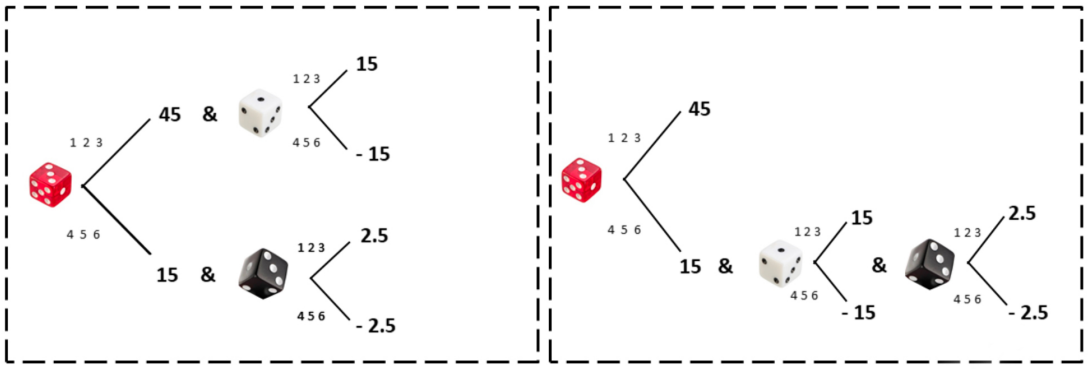
This task is about risk attitudes. Some people like to take risks while others prefer to avoid them. We ask you to make 17 choices between two options. Both options yield a prize, depending on rolls of six-sided dice performed by the computer. This questionnaire concerns your own preferences; there is no right or wrong answer.

There is a chance that you will be paid for real! At the end of the two experimental sessions, you will have ten percent chance to be paid according to the choices made during one of the two sessions. The session that will be paid will be chosen by chance. If you are selected by the computer to be paid for real on the basis of the outcome of this session, the computer will randomly select one of the 17 options you have chosen. The computer will then roll the dice to determine the prize from the option you have chosen.

Always choose the option you prefer. The option that you choose could be the one that is randomly selected by the computer to be paid for real. The currency used in this session is the ECU (for Experimental Currency Unit). All the amounts that will be displayed on the computer screen in this session will be in ECU. The exchange rate is 1 ECU equals 4 euro. Thus, if the option selected by the computer to be actually paid generates a monetary reward of 70 ECU, you will be paid $70 * 4 = 280$ euro!

A.4 Example of a choice task participants were faced with

Figure 5 displays an example of a temperance choice task and the related instructions below.



Option L Option R

The white and the black die are sometimes rolled.
As you see in the example, in "Option L" the white die is rolled if the roll of the red die is 1, 2, or 3, but the black die is rolled if the roll of the red die is 4, 5, or 6. In "Option R" both the white and the black die are rolled if the roll of the red die is 4, 5, or 6.

The rolls of the white die and the black die determine whether an amount will be added to, or subtracted from, the original prize resulting from the roll of the red die.
In the example, for both options, if the roll of the white die is 1, 2, or 3, 15 ECU are added to the prize resulting from the roll of the red die. If the roll of the white die is 4, 5, or 6, 15 ECU are subtracted from this prize. If the roll of the black die is 1, 2, or 3, 25 ECU are added to the prize resulting from the roll of the red die (and the roll of white die only in "Option R").clf the roll of the black die is 4, 5, or 6, 25 ECU are subtracted from the prize.

You can earn money.

Always choose the option you prefer. The option that you choose could be the one that is randomly selected by the computer to be paid for real. Please make your choices between "Option L" and "Option R."

Next

Figure 5: An example of a temperance choice task

B Distributions of Academic Background, Gender, Age, and Experience in the Financial Industry of Participants (n = 173)

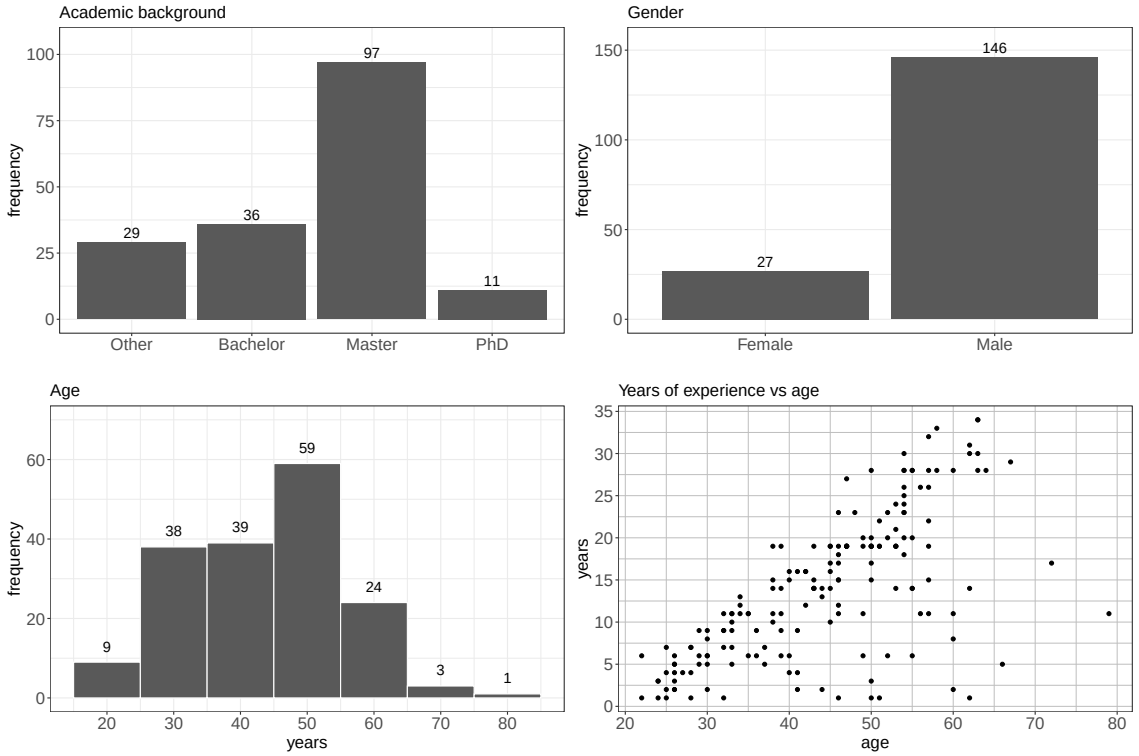


Figure 6: Bar plots of the academic background (top left), gender (top right), age (bottom left) and scatter plot (bottom right) of age (X-axis) versus years of experience (Y-axis), of the expert participants

C Cognitive Reflection Test

(1) If it takes 2 nurses 2 minutes to measure the blood pressure of 2 patients, how long would it take 200 nurses to measure the blood pressure of 200 patients? ____minutes. [Correct answer: 2 minutes; intuitive answer: 200 minutes]

(2) Soup and salad cost 5.50 € in total. The soup costs 5 € more than the salad. How much does the salad cost? ____(in cents of €). [Correct answer: 0.25 euro; intuitive answer: 0.5 euro]

(3) Sally is making sun tea. Every hour, the concentration of the tea doubles. If it takes 6 hours for the tea to be ready, how long would it take for the tea to reach half of

the final concentration? ____hours. [Correct answer: 5 hours; intuitive answer: 3 hours]

(4) If John can drink one barrel of water in 6 days, and Mary can drink one barrel of water in 12 days, how long would it take them to drink one barrel of water together? ____days. [correct answer: 4 days; intuitive answer: 9]

(5) Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class? ____students. [correct answer: 29 students; intuitive answer: 30]

(6) A man buys a pig for 60 €, sells it for 70 €, buys it back for 80 €, and sells it finally for 90 €. How much has he made? ____€. [correct answer: 20 €; intuitive answer: 10 €]

(7) Simon decided to invest 8,000 € in the stock market one day early in 2008. Six months after he invested, on July 17, the stocks he had purchased were down 50%. Fortunately for Simon, from July 17 to October 17, the stocks he had purchased went up 75%. At this point, Simon:
a. has broken even in the stock market,
b. is ahead of where he began,
c. has lost money.
[correct answer: c, because the value at this point is 7,000 €; intuitive response b].

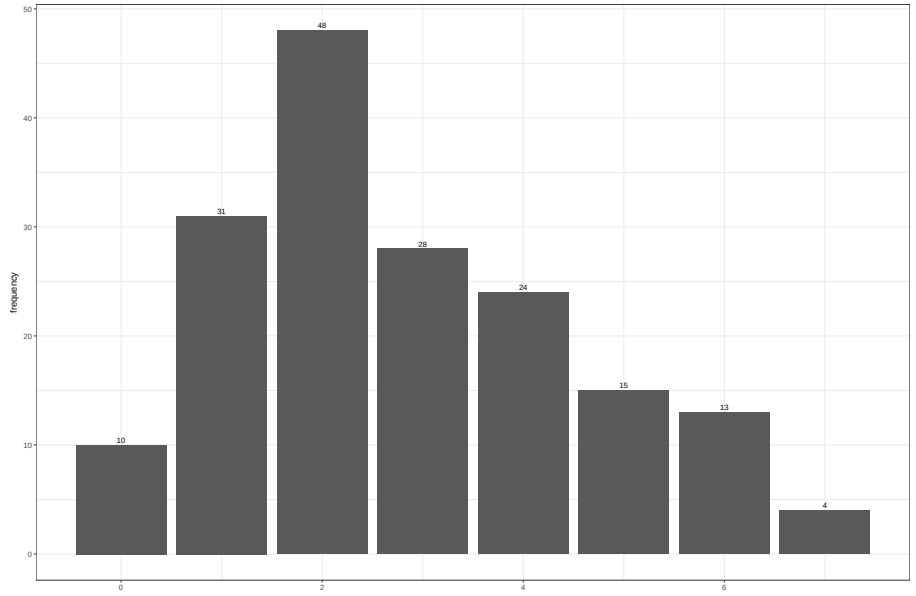


Figure 7: Bar plot of the number of correct answers in the seven-item CRT questionnaire, each individual is a unit of observation (n =173)

D Professional experience questionnaire

(1) What is your current job?

[1: Prop Trader; 2: Sales Trader; 3: Sales; 4: Market Maker; 5: Asset/Portfolio Manager; 6: Strategist/Economist; 7: Financial Analyst (buy side, sell side); 8: Risk analyst; 9: Private equity Manager; 10: Other]

(2) What is your employer?

[1: Bank; 2: Asset management company; 3: Trading company; 4: Broker; 5: Hedge fund; 6: Work for your own; 7: Private equity company; 8: Other]

(3) In which jobs in finance do you have your main experiences? (You can choose various jobs) ?

[1: Prop Trader; 2: Sales Trader; 3: Sales; 4: Market Maker; 5: Asset/Porfolio Manager; 6: Strategist/Economist; 7: Financial Analyst (buy side, sell side); 8: Risk analyst; 9: Private equity Manager; 10: Other]

(4) What is the main strategy you employ to trade assets?

[1: Technical Analysis; 2: Fundamentalist; 3: Trend following; 4: Event Driven; 5: Global Macro; 6: Arbitrageur; 7: Market Making; 8: Scalping; 9: Merger Arbitrage; 10: Other; 11: None]

(5) For how many years do you work on Financial Markets? [answer:]

(6) On which asset class are your working on?
[1: Money Market; 2: Forex Market; 3: Commodities; 4: Equity; 5: Bonds (Fixed Income); 6: Private Equity: 7: Real estate; 8: Hedge Fund; 9: Other]

(7) Do you work on:
[1: Spot Market; 2: Market Derivatives; 3: Both; 4: Other]

(8) What is your final academic degree?
[1: Bachelor; 2: Master; 3: PhD; 4: Other]

(9) How old are you? [answer:]

(10) What is your gender? [1: Female ; 2: Male]

(11) What is your annual income? [answer:]

(12) What is your annual income over the last 5 years? [answer:]

(13) What is the nationality of your company? [answer:]

(14) In which country do you work? ? [answer:]

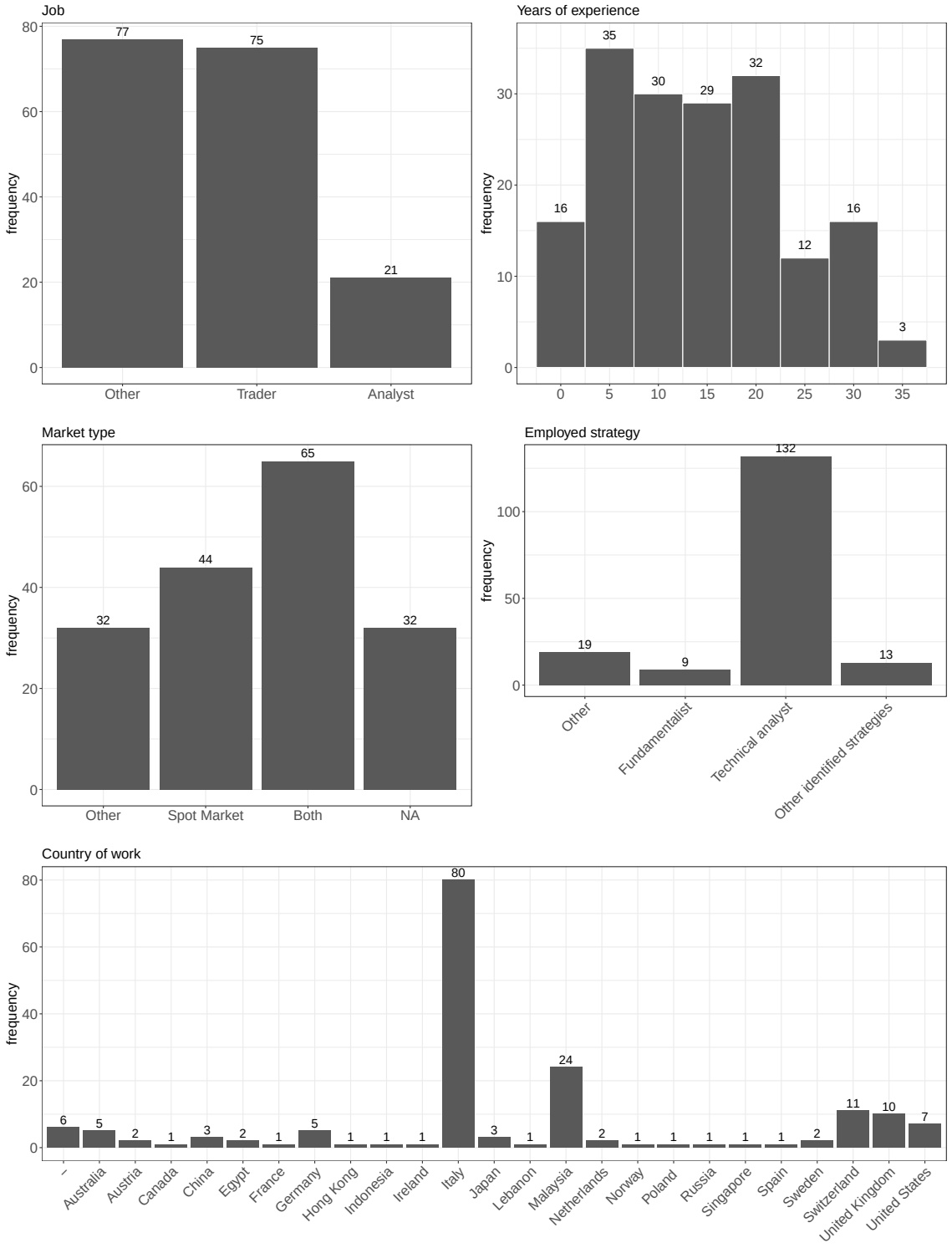


Figure 8: Histograms of Characteristics of Participants. Bar plots of the participants' job within their firm (top left), years of experience (top right), market in which they trade (middle left), strategy employed[12](middle right), and country of work (bottom).

[12]Other indicated strategies = Global Macro + Market Making + Scalping.

E Risk attitudes and demographic variables

In this appendix, we investigate some relationships between risk attitudes and individual characteristics. Table 2 reports results of OLS regressions of the risk aversion measure[13] on age, CRT score, education and gender (female = 1). Depending on the specification, the estimates include different groups of variables related to the preferred trading strategy, the nature of the employer, years of experience, and the type of the job held by the participant.

The estimates suggest that a higher CRT score is associated with lower risk aversion and this result holds in all of our specifications. This is in agreement with most of the experimental evidence on non-student populations, which shows that more reflective subjects are, on average, less risk-averse (Frederick, 2005; Benjamin et al., 2013; Cueva et al., 2016).

We conducted the same regression, replacing the CRT score with an equivalent score variable based on the number of incorrect intuitive answers[14]. We find no statistically significant correlation between risk aversion and intuitive incorrect answers. As Frederick (2005 , p. 27) writes, "...the three items on the CRT are easy in the sense that their solution is easily understood when explained, yet reaching the correct answer often requires the suppression of an erroneous answer that springs impulsively to mind." Use of the intuitive incorrect (erroneous) answer is taken as a measure of impulsiveness. The estimates indicate that while more reflective individuals in our sample are less risk averse, there is no relation between impulsiveness and risk aversion.

Turning to gender issues, our estimates provide weak evidence (at the 10% level of significance) that females exhibit lower risk aversion than males. While this finding contrasts with much of the previous literature, we do not think that this result warrants emphasis since the number of females in our sample is small and the effect is not significant at conventional levels. We find no significant correlation between age and risk aversion. Some other studies have found a convex relationship (Barsky et al. (1997),

[13] One subject declared an age of 0 and he/she has been discarded from the sample.

[14] Each question of the CRT has only one intuitive but incorrect response, and only one correct answer (see Noussair et al. (2016) for an analysis of different types of incorrect responses on the CRT test.). Please refer to the CRT questionnaire given in Appendix C for a full listing of the correct and incorrect intuitive answers for each question.

Table 2: Risk aversion scores and demographics/job correlates

VARIABLES	(1)	(2)	(3)	(4)	(5)
CRT	-0.190***	-0.183***	-0.184***	-0.191***	-0.187***
	(0.0613)	(0.0613)	(0.0630)	(0.0609)	(0.0615)
Female	-0.640*	-0.649*	-0.625*	-0.667*	-0.648*
	(0.361)	(0.365)	(0.373)	(0.361)	(0.370)
Age	0.0769	0.0833	0.0837	0.0985	0.0859
	(0.0647)	(0.0640)	(0.0644)	(0.0651)	(0.0662)
Age^2	-0.000843	-0.000887	-0.000896	-0.00108	-0.000916
	(0.000710)	(0.000720)	(0.000722)	(0.000728)	(0.000745)
Years of exp	0.00475				
	(0.0171)				
Postgraduate		-0.110			
		(0.245)			
Tech. analysis			0.0855		
			(0.300)		
Analyst				0.0503	
				(0.299)	
Other job				0.419	
				(0.255)	
Derivative					-0.0547
					(0.367)
Spot and Derivative					-0.0913
					(0.304)
Other markets					0.0130
					(0.377)
Constant	1.385	1.315	1.180	0.812	1.244
	(1.384)	(1.378)	(1.363)	(1.421)	(1.438)
Observations	172	172	172	172	172
R-squared	0.059	0.060	0.059	0.075	0.060

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the Risk aversion score on a scale of 0 - 5. Higher scores indicate greater risk aversion.

Cohen and Einav (2007), Harrison et al. (2007), Noussair et al. (2014)). A positive correlation between risk aversion and age has also been reported in some studies (Donkers et al., 2001; Sahm, 2012; Dohmen et al., 2017). In particular, Dohmen et al. (2017) use data from two different large panel surveys from the Netherlands and Germany and find that the willingness to take risks decreases with age.[15] The absence of correlation between age and risk aversion in our sample might be a consequence of the fact that those who take more risk might attain more senior positions in their company. This result is thus consistent with the absence of any significant relationship between years of experience and risk aversion, if age and seniority level exert countervailing effects.

Regarding the other control variables, related to education (Postgraduate), trading strategies (technical analysis), jobs (analyst, other), market type (Derivative, Spot and Derivative, Other), we do not find any significant correlation with risk aversion. The results are robust to changing the econometric specifications to ordered probit regressions. While we do find that experts are less risk averse than the general population, we do not observe any effects of job-related variables within our sample of experts.

Turning to prudence, Table 3 reports results of regressions with similar specifications as in the analysis of risk aversion. The dependent variable is the number of prudent choices in the experimental task. The analysis also includes a treatment dummy, which is significant in all specifications. The estimates confirm that participants in the High Var treatment are more prudent than under Low Var. We do not find any correlation between prudence and CRT scores or education variables. We do not identify any gender effect, and years of experience does not seem to affect prudence. There is a convex relationship between prudence and age. Those who answer "Other job", "Derivative" or "Other markets" are more prudent. It may be that experts working on markets with high leverage and risky positions such as some derivative markets, rather than the spot market, dislike downside risks and thus prefer associating an unavoidable risk with the high-wealth state. That is, they prefer assets with a positively-skewed payoff distribution.

Table 4 reports regressions in which temperance is the dependent variable. The estimates do not reveal any significant correlation between demographic variables and tem-

[15] Dohmen et al. (2017) have shown that self-reported subjective measures of risk attitudes are valid predictors of risk taking behavior.

Table 3: Prudence scores and demographics/job correlates

VARIABLES	(1)	(2)	(3)	(4)	(5)
Low Var Treat	-0.684**	-0.699**	-0.685**	-0.661**	-0.657**
	(0.285)	(0.286)	(0.284)	(0.285)	(0.279)
CRT	0.000256	-0.00647	-0.00716	-0.0116	0.0147
	(0.0894)	(0.0923)	(0.0910)	(0.0878)	(0.0831)
Female	-0.245	-0.239	-0.273	-0.234	-0.344
	(0.392)	(0.390)	(0.399)	(0.389)	(0.383)
Age	-0.121*	-0.121*	-0.122*	-0.101	-0.106*
	(0.0719)	(0.0635)	(0.0635)	(0.0623)	(0.0616)
Age^2	0.00135*	0.00135*	0.00137*	0.00110	0.00122*
	(0.000751)	(0.000700)	(0.000698)	(0.000680)	(0.000677)
Years of exp	-0.00108				
	(0.0179)				
Postgraduate		0.115			
		(0.295)			
Tech. analysis			-0.133		
			(0.375)		
Analyst				0.631	
				(0.487)	
Other job				0.590*	
				(0.306)	
Derivative					0.805*
					(0.436)
Spot and Derivative					0.618
					(0.385)
Other markets					1.319***
					(0.384)
Constant	6.242***	6.197***	6.370***	5.587***	5.194***
	(1.563)	(1.396)	(1.431)	(1.402)	(1.407)
Observations	172	172	172	172	172
R-squared	0.054	0.055	0.055	0.078	0.107

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the number of prudent choices, ranging from 0 to 5. Higher scores indicate greater prudence.

Table 4: Temperance scores and demographics/job correlates

VARIABLES	(1)	(2)	(3)	(4)	(5)
Low Var Treat	-0.264	-0.249	-0.241	-0.224	-0.244
	(0.274)	(0.277)	(0.274)	(0.277)	(0.280)
CRT	-0.0978	-0.105	-0.0851	-0.109	-0.102
	(0.0856)	(0.0889)	(0.0871)	(0.0862)	(0.0870)
Female	-0.341	-0.322	-0.251	-0.308	-0.333
	(0.419)	(0.409)	(0.417)	(0.416)	(0.414)
Age	-0.0796	-0.122*	-0.123*	-0.115*	-0.121*
	(0.0732)	(0.0646)	(0.0642)	(0.0636)	(0.0647)
Age^2	0.00118	0.00147**	0.00146**	0.00139**	0.00148**
	(0.000739)	(0.000681)	(0.000678)	(0.000672)	(0.000684)
Years of exp	-0.0282				
	(0.0188)				
Postgraduate		0.0292			
		(0.296)			
Tech. analysis			0.341		
			(0.357)		
Analyst				0.357	
				(0.485)	
Other job				0.197	
				(0.298)	
Derivative					0.331
					(0.406)
Spot and Derivative					0.210
					(0.369)
Other markets					0.243
					(0.419)
Constant	4.540***	5.373***	5.148***	5.143***	5.153***
	(1.625)	(1.476)	(1.457)	(1.445)	(1.492)
Observations	172	172	172	172	172
R-squared	0.045	0.033	0.039	0.037	0.037

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Dependent variable is the number of temperate choices in the experiment, ranging from 0 - 5. Higher scores indicate greater temperance.

Spearman Correlation	Risk Aversion	Prudence	Temperance
Risk Aversion	1		
Prudence	0.0430	1	
	(0.5746)		
Temperance	−0.0071	**0.2976**	1
	(0.9257)	**(0.0001)**	1

Table 5: Correlation coefficient between risk attitudes, each individual as unit of observation, significance level in parentheses.

perance, with the exception of age-related variables that are related to temperate attitude in a non-linear manner. As with prudence, there is a convex relationship between age and temperance. We do not detect a gender effect. As far as job-related variables are concerned, none of the estimates is statistically significant.

F Correlation between risk aversion, prudence, and temperance

Table 5 displays the Spearman correlations between risk aversion, prudence and temperance for our expert participants. This table reveals that there is only one significant correlation, a positive relationship between prudence and temperance.