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Higher Order Risk Attitudes, Demographics, and Financial Decisions

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Abstract:

We conduct an experiment to study the prevalence of the higher order risk attitudes of *prudence* and *temperance*, in a large demographically representative sample, as well as in a sample of undergraduate students. Participants make pairwise choices between lotteries of the form proposed by Eeckhoudt and Schlesinger (2006). The choices in these lotteries isolate prudent from imprudent, and temperate from intemperate, behavior. We relate individuals' risk aversion, prudence, and temperance levels to demographics and financial decisions. We observe that the majority of individuals' decisions are consistent with risk aversion, prudence, and temperance, in both the student and the demographically representative sample. An individual's level of prudence is predictive of his wealth, saving, and borrowing behavior outside of the experiment, while temperance predicts the riskiness of portfolio choices. Our findings suggest that the coefficient of relative prudence for a representative individual is approximately equal to two.

KEYWORDS: prudence, temperance, saving, portfolio choice, experiment

JEL CODES: C91, C93, D14, D81, E21

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1. Introduction

The analysis of the effect of risk attitudes on economic decisions has typically focused on the impact of risk aversion. Under expected utility, this amounts to an assessment of the impact of the second derivative of the utility function. However, many decisions also depend crucially on *higher order* risk attitudes. For example, changes in precautionary saving due to changes in the distribution of a future income stream are determined by individuals' *prudence* and *temperance* (Eeckhoudt and Schlesinger 2008; Kimball 1990; 1992; Leland 1968; Sandmo 1970). In the classical utility framework, prudence is equivalent to a positive third derivative of the utility function (convex marginal utility), and temperance is equivalent to a negative fourth derivative (concavity of the second derivative). The degree of prudence and temperance that individuals exhibit has implications in a wide range of economic applications, including bargaining (White 2008), bidding in auctions (Eso and White 2004), rent seeking (Treich 2009), sustainable development (Gollier 2011), tax compliance (Alm 1988; Snow and Warren 2005) and the valuation of medical treatments (Bleichrodt et al. 2003).[1]

In this paper, we report the results of an experiment designed to measure the extent to which a demographically representative sample, as well as a sample of university students, exhibits prudence and temperance. The data we have available about our participants allow us to consider how measures of prudence and temperance correlate with demographic variables, and with wealth and financial decisions outside of the experiment. We measure the correlation between risk aversion, prudence, and temperance among individuals, and provide estimates of prudence and temperance parameters for the constant relative risk aversion and expo-power utility specifications. We also conduct a direct test of whether, conditional on the expected utility hypothesis and constant relative risk aversion, relative risk aversion is greater than one and relative prudence is greater than two. These are critical thresholds in the comparative static results of a number of applications (Eeckhoudt et al. 2010; Eeckhoudt and Schlesinger 2008; Gollier 2001; Meyer and Meyer 2005; White 2008).

We use risk apportionment tasks to classify individuals by prudence and temperance. The tasks we employ, and the definitions of prudence and temperance we adopt, are due to

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[1] Prudence and temperance govern the response of individuals to changes in risk. For a prudent individual, the expected marginal utility of wealth increases if his income becomes riskier, since his marginal utility is convex in wealth. This means that, in response to an increase in income risk, he saves more. More generally, in these applications, prudence and temperance determine the optimal tradeoff between high risk options (uncertain future consumption, acquiring a good with an uncertain value, future uncertain wage offer) and low risk options (current consumption, cash saved from not bidding in an auction, acceptance of current guaranteed wage offer).

Eeckhoudt and Schlesinger (2006). They construct simple lottery choices, in which the decisions taken distinguish between prudent and imprudent, and between temperate and intemperate, individuals. A prudent individual has a preference for adding an unavoidable zero-mean risk to a state in which income is high, rather than adding it to a state in which income is low. Temperate individuals have a preference for disaggregating two independent zero-mean risks across different states, rather than aggregating them in a single state.

Under expected utility, classifying agents as prudent and temperate based on risk apportionment decisions is equivalent to doing so based on signs of the derivatives of their utility functions.[2] An expected utility maximizer makes a prudent risk apportionment decision if and only if he has convex marginal utility ($u''' > 0$, where u''' is the third derivative of the utility function). Similarly, temperate risk apportionment decisions always coincide with those of an individual with a concave second derivative of the utility function ($u'''' < 0$). However, a risk apportionment decision that classifies an individual as prudent (resp. temperate) does not imply that the individual is an expected utility maximizer with $u''' > 0$ (resp. $u'''' < 0$). Thus, an advantage of the use of risk apportionment tasks is that they retain their ability to classify individuals by prudence and temperance in a manner we view as intuitive, even if the expected utility hypothesis is violated (see e.g. Starmer 2000).[3]

[2] Eeckhoudt and Schlesinger (2006) show this equivalence in the following manner. Let x denote wealth, ε_1 be a mean zero risk, and $w_1(x)$ be the utility premium (the change in expected utility from taking on a lottery with mean zero) for an expected utility maximizer. Then $w_1(x) \equiv Eu(x + \varepsilon_1) – u(x)$, and, by Jensen's inequality, $w_1(x) \leq 0$ iff $u''(x) \leq 0$.That is, the utility premium is negative for a risk averse individual. Differentiating both sides yields $w_1'(x) \equiv Eu'(x + \varepsilon_1) – u'(x)$. It follows, again by Jensen's inequality, that $w_1'(x) \geq 0$, iff $u'''(x) \geq 0$. Thus, the utility premium is increasing in x, if and only if the individual is prudent. In other words, a prudent expected utility maximizer prefers to take on an unavoidable risk in a relatively high income state.

To show that a temperate individual prefers to disaggregate two risks, Eeckhoudt and Schlesinger (2006) argue that $u'''' < 0$ is equivalent to concavity of the utility premium in income, and that concavity of the utility premium is equivalent to a preference for disaggregation of risks. Taking the second derivative of the utility premium yields $w_1''(x) \equiv Eu''(x + \varepsilon_1) – u''(x)$. By Jensen's inequality, $w_1''(x) \leq 0$, iff $u'''' \leq 0$. Now suppose that a temperate individual (one who has $u'''' \leq 0$) faces an additional risk ε_2, and let $w_2(x) \equiv Ew_1(x + \varepsilon_2) – w_1(x)$. $w_2(x)$ is the expected change in the utility premium from taking on the second risk. Note that $w_2(x) \leq 0$, since $w_1(x)$ is concave. Substituting, it follows that $w_2(x) \equiv Eu(x + \varepsilon_1 + \varepsilon_2) - Eu(x + \varepsilon_2) - Eu(x + \varepsilon_1) + u(x) \leq 0$. Rearranging terms, we obtain $.5Eu(x + \varepsilon_2) + .5Eu(x + \varepsilon_1) \geq .5Eu(x + \varepsilon_1 + \varepsilon_2) + .5u(x)$. In other words, an individual prefers a lottery disaggregating the risks to one aggregating the risks, iff the individual is temperate.

[3] An analogous, model-free, concept of risk aversion has been proposed by Rothschild and Stiglitz (1970), who relate risk aversion to a distaste for mean preserving spreads. To take the simplest example, under expected utility, an individual with a concave utility function ($u'' < 0$) prefers a certain outcome over a lottery with the same expected value. A preference for the certain outcome over the lottery, however, can be used to classify a decision maker as risk averse, irrespective of whether he is an expected utility maximizer, and indeed, irrespective of the decision model he uses. The classification is intuitive as it corresponds to distaste for risk. Similarly, if the decision maker must accept a risk, and he prefers to have it when his income is relatively high, he is prudent. If he must accept a risk at a certain level of income, and he prefers to do so when he has no other risks, he is temperate.

The use of experimental methods allows direct measurement of prudence and temperance. Empirical estimates of relative prudence coefficients for representative individuals from a population vary widely, from insignificantly different from zero to levels greater than five (Dynan 1993; Eisenhauer 2000; Ventura and Eisenhauer 2006). Similarly, estimates of the fraction of saving that is precautionary also differ greatly, ranging from close to zero to 60 percent (Browning and Lusardi 1996; Lusardi 1998; Carroll and Kimball 2008; Dardanoni 1991; Guiso et al. 1992; Carroll and Samwick 1998; Ventura and Eisenhauer 2006). The evidence with regard to prudence from these studies is indirect, however, because it is inferred from saving, consumption, and investment behavior, and the level of prudence cannot be easily distinguished from other variables. Selection biases may also arise in empirical studies if prudence is not elicited directly. For example, measurements of precautionary savings are biased downward if prudent individuals select into occupations with low income risk (Dynan 1993; Fuchs-Schuendeln and Schuendeln 2005; Guiso and Paiella, 2008). Furthermore, virtually all empirical studies assume a specific utility framework. Widely used utility functions, such as the constant absolute (CARA) and the constant relative (CRRA) risk aversion families, exhibit both prudence and temperance by definition. Consequently, estimates that are based on such parametric forms presuppose the prevalence of these attitudes. These utility functions also imply restrictions on the relationship between risk aversion and higher order risk attitudes.[4] In light of these methodological issues and the diversity of the conclusions of empirical studies, Carroll and Kimball (2008) argue that direct measurement of prudence and temperance are required to obtain accurate estimates of their incidence in the population.

Experimental methods, which can elicit such direct measures, have been applied to measure higher order risk attitudes with the undergraduate student populations typically employed in experimental research. Tarazona-Gomez (2003) measures prudence using a price list format, in which certainty equivalents are elicited for various lotteries. She reports a modest incidence of prudence, with fewer than half of the students in her sample unambiguously categorized as being prudent. Ebert and Wiesen (2009) study the relationship between prudence, skewness preference, and risk aversion. They find that a majority of their subjects are prudent. Deck and Schlesinger (2010) measure both prudence and temperance.

[4] For example, for the CARA utility function, the coefficient of absolute risk aversion equals that of absolute prudence and absolute temperance. For CRRA, the coefficient of relative risk aversion equals 1 minus that of relative prudence, which in turn equals 1 minus that of relative temperance.

They present subjects with decision problems constructed with the decision-model-free definitions of Eeckhoudt and Schlesinger (2006), as we do here. Deck and Schlesinger (2010) find modest overall degrees of prudence and intemperance in their sample. Meier and Ruger (2010) find that a majority of individuals are prudent and temperate in both the gain and loss domains, and that risk aversion, prudence, and temperance are positively correlated. Ebert and Wiesen (2010), using a price list format to provide measures of prudence and temperance, also classify a majority of their subjects as risk averse, prudent and temperate. They also observe that prudence is more pervasive than temperance, and that risk aversion, prudence and temperance are positively correlated.

The use of a demographically representative sample allows us to consider whether the results of these prior experimental studies generalize to broader populations. Furthermore, the availability of extensive background data for our participants allows us to assess the relationship between prudence and temperance, and other variables. In particular, we are able to associate decisions in the experiment with demographic variables and with wealth, saving, and investment decisions. However, to generate a more straightforward comparison with previous experimental studies, we also conduct our experiment with 109 university student subjects in a laboratory setting similar to those employed in prior studies.

We find pervasive prudence in both the general population and the sample of university students, with the latter being even more prudent. A majority of decisions in both samples are temperate, but temperance is less widespread than prudence. Risk aversion, prudence, and temperance are positively correlated, and the most risk-seeking individuals are also imprudent and intemperate on average. Women are more risk averse and more temperate than men. Temperance is weaker when the risks involved are smaller. University students and more highly educated individuals are more prudent. Prudent decisions in the experiment are associated with greater wealth, a greater likelihood of having a savings account, and a lower likelihood of having credit card debt. Temperance is associated with less risky investment portfolios. Risk aversion exhibits no relationship with the financial status variables we have available.

While the elicitation method is model-free, we use our data to fit widely-used utility functions, and to provide estimates for the coefficients of relative risk aversion, prudence and temperance, under expected utility. Browning and Lusardi (1996, p.1808) emphasize the importance of such calibrations to restrict the precautionary saving model empirically, because of its many degrees of freedom. For a representative individual, we estimate a relative risk aversion coefficient between .89 and 1.43, and a coefficient of relative prudence between 1.68 and 2.24, depending on the data and the specification of the utility function employed.

In the next section, we discuss the theoretical foundations of our elicitation method. Section 3 describes the experimental design, the subject pool, and the background data we use. We then introduce the four treatment conditions that constitute our experiment. The treatments vary the strength of the financial incentives and the size of the risks. In two of our treatments choices are incentivized, while the other two have hypothetical incentives. Because most consumer surveys do not elicit incentivized choices (e.g., Barsky et al. 1997; Dohmen et al. 2010), the extent to which decisions involving hypothetical and real payoffs yield similar estimates is of interest. In section 4, we present the results regarding the prevalence of the risk attitudes, their correlation with each other, and the differences between treatments. Section 5 studies the relationship between our elicited experimental measures and wealth/financial profiles of participants. Section 6 reports the results of the parametric utility estimation, and section 7 concludes.

2. Theoretical Background and Elicitation Method

Within the classical utility framework, prudence and temperance are properties of the third and fourth derivatives of the utility function, respectively. In particular, prudence is equivalent to a convex marginal utility function, and temperance is equivalent to a concave second derivative of the utility function. Let X be a risky lottery, and x=E[X] be its expected value. Let u be a utility function. Then the condition E[u(X)]<u(x) implies concavity of u and risk aversion. The condition E[u'(X)]> u'(x) is equivalent to convexity of u' and thus to prudence.[5] The condition E[u"(X)]< u"(x) defines concavity of u"(x) and temperance. The two concepts of prudence and temperance can be defined locally or globally, and as weak versions which only require weak, rather than strict, inequalities.

Eeckhoudt and Schlesinger (2006) relate these higher order risk concepts to observable preferences in an analogous manner to Rothschild and Stiglitz (1970), who define risk aversion as distaste for mean preserving spreads. Eeckhoudt and Schlesinger (2006) define prudence and temperance in terms of principles of risk apportionment. Let x, y, k, $z_{1,}$ and z_2 be strictly positive monetary outcomes, and let y = x – k. Assume that realizations x and y, as

[5] This condition is equivalent to the presence of demand for precautionary saving in an intertemporal consumption model (Kimball 1990; 1992).

well as $+z_1$ and $-z_1$, are equally likely, and that the chance outcomes are all independent within, and between, lotteries L and R.[6] The condition for prudence is illustrated in Figure 1.

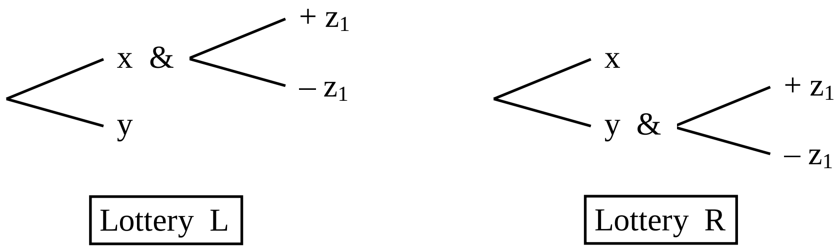

Figure 1: Risk Apportionment Task Identifying Prudence

In lottery L, a zero-mean risk, in which the individual can gain or lose z_1, occurs in the high wealth state. Lottery R is identical, except that the zero-mean risk occurs in the low wealth state. An individual who is prudent prefers lottery L over lottery R, while one who is imprudent prefers R to L. Intuitively, given wealth level x, the decision maker has to confront two harms, a sure reduction in wealth by an amount k, and the addition of a zero-mean lottery risk of size z_1. A prudent decision maker has a preference for disaggregating these two harms. Accepting the risk in the state of high wealth x is preferred over accepting it in the state of low wealth y.

The condition for temperance is shown in Figure 2. As in the case of prudence, the decision maker has the choice between aggregating (lottery R) or disaggregating (lottery L) two harms. The harms are two zero mean lotteries of sizes z_1 and z_2, both of which have equally likely positive and negative realizations.

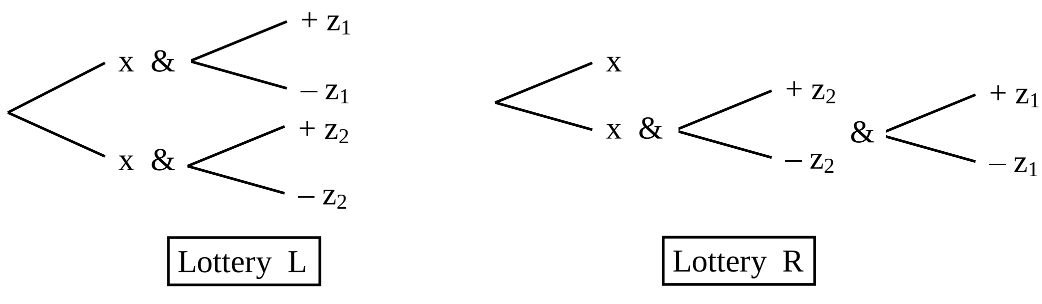

Figure 2: Risk Apportionment Task Identifying Temperance

[6] Under Eeckhoudt and Schlesinger's (2006) definition, the zero-mean risks are not restricted to be symmetric. Ebert and Wiesen (2009) show that asymmetry of the additional risks affects the higher order properties of the lotteries. In the current study we always use symmetric risks.

A temperate individual prefers lottery L, and an intemperate one prefers lottery R. A temperate decision maker thus has a preference for disaggregation of the two risks.[7]

We present our subjects with choices of the form described in Figures 1 and 2. To test two conditions regarding the strength of relative risk aversion and relative prudence under expected utility, we also include two additional choice problems. Eeckhoudt et al. (2010) provide conditions on lottery choices that, under expected utility, test whether the *coefficient of relative risk aversion*, RR(x) = –xu''(x)/u'(x), is greater than one; and whether the *coefficient of relative prudence*, RP(x) = –xu'''(x)/u''(x), is greater than 2. Intuitively, in one of these tasks, the choice of the safer lottery is discouraged by a lower expected value. In the other task, the choice of the prudent lottery is discouraged by a greater variance. That is, to justify a choice of the safer, and the more prudent, lottery in these situations, the decision maker must have sufficiently strong risk aversion, and prudence, respectively. Analogously to the relative coefficients defined above, we can define the *coefficient of relative temperance*, RT(x) = –xu''''(x)/u'''(x) (Kimball 1990; 1992), as well as absolute coefficients The *coefficient of absolute risk aversion*, AR(x) = –u''(x)/u'(x), the *coefficient of absolute prudence*, AP(x) = –u'''(x)/u''(x), and the *coefficient of absolute temperance*, AT(x) = –u''''(x)/u'''(x). The actual choices subjects faced are described in the next section.

3. Experimental Design, Subject Pools and Background Data

3.1. Subject Pools and Background Data

In total, 3566 subjects participated in the experiment. 3457 subjects were members of the LISS panel, an internet panel managed by CentERdata, an organization affiliated with Tilburg University. The LISS panel consists of approximately 9000 individuals, who complete a questionnaire over the internet each month. Respondents are reimbursed for the costs of completing the questionnaires four times a year. This payment infrastructure allowed us to provide incentivized monetary payments to participants.

The LISS panel is a representative sample, in terms of observable background characteristics, of the Dutch population. The random subsample invited to participate in the experiment was stratified to reflect the population. A large number of demographic variables are available for the LISS panel participants. In addition, we have extensive self-reported data

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[7] If a person is subject to the disposition effect, and is aware of it, it would make him more likely to make an imprudent decision. If the first lottery yields a relatively low outcome of y, the player would like to have a lottery available in order to possibly recoup his losses.

on their financial situation. Because of the close relationship between prudence and temperance, and precautionary savings, wealth, and portfolio choice, we relate the financial data to the level of prudence and temperance that we measure.

In addition, we also conducted the experiment at the CentER laboratory, located at Tilburg University, with undergraduate student participants. A total of 109 student subjects participated in the experiment. For the student sample, we have the background variables of age, gender, nationality, program of study, and the results of Frederick's (2005) cognitive reflection test that was included in the experimental session to measure the cognitive ability of students, available.

3.2. Experimental Design and Treatments

Subjects were presented with a total of 17 binary choices between lotteries. The 17 decisions were grouped in four parts, with part one consisting of five choices between a sure payoff and a risky lottery to evaluate a participant's degree of risk aversion. Part two consisted of five choices that tested for prudence, of the form shown in Figure 1. Part three comprised five choices testing for temperance, of the form shown in Figure 2. Part four was two choices testing for the two conditions on relative risk aversion and relative prudence under expected utility, described at the end of section two. Part one always came first and part four was always last. Parts two and three were counterbalanced.

A list of all choices is given in Table 1. For purposes of exposition, in Table 1 and the rest of the paper, we use the following notation to describe the lotteries. Let [x_y] denote a lottery that yields outcome x or outcome y, with equal probability. Then, compound lottery L in Figure 1 can be written as [(x+[z_1_–z_1])_y]. Similarly, compound lottery R in Figure 2 can be written as [x_(x+[z_2_–z_2] +[z_1_–z_1])].

Subjects were presented with one choice at a time. The five choices measuring risk aversion were ordered, such that the certain payoff increased monotonically (or decreased in counterbalanced conditions). The five choices for prudence and temperance varied in terms of (1) the initial endowment (or wealth level) x, (2) the reduced wealth level y (for prudence), and (3) the size of the risks z_1 and z_2. This variation allows us to study the effect of changes in endowment and risk magnitude. No lotteries were resolved before the end of the session. No indifference option was provided, i.e. subjects always had to choose one of the lotteries. The presentation of the lotteries with respect to the position on the left or the right sides of the screen was counterbalanced.

Table 1: List of Choice Situations

	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])]

Notes: [x_y] indicates an equiprobable lottery to receive either x or y; choice of the left lottery indicates risk aversion, prudence, and temperance, respectively.

All risks involved in the experiment were equiprobable lotteries, and all randomizations were conducted by the computer. For interpretation of the compound lotteries in terms of prudence and temperance, it is crucial to emphasize the independence of the multiple risks. We therefore presented the lotteries to subjects graphically by means of three differently colored dice, as shown in Figure 3, with the understanding that each die represented a computerized equal probability draw. Figure 3 is an example of the display participants saw for the most complex decision type in the experiment, that for temperance. An English translation of the instructions is given in Appendix A.

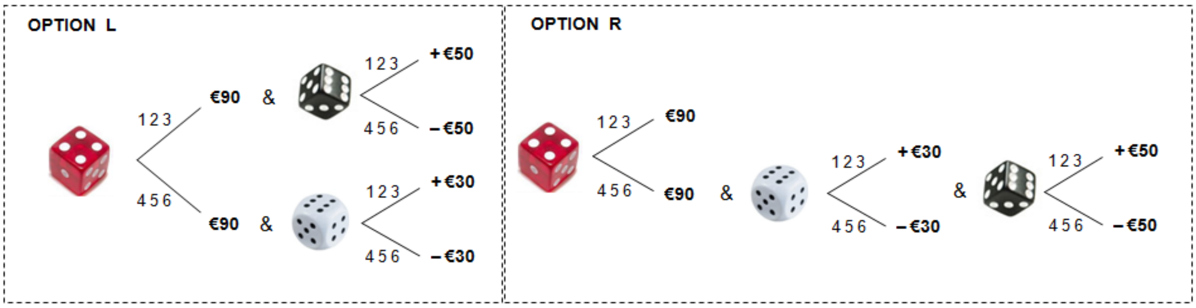

Figure 3: Graphical Presentation of Choice Situations

There were four different treatment conditions, as summarized in Table 2. Each subject participated in only one treatment. In the *Real* and *Real-lowvar* treatments, each individual had a 1 in 10 chance of being randomly selected to receive a real monetary payment. If an individual was selected, one of her 17 decisions was randomly chosen to count toward her earnings. The expected payoff, conditional on an individual being selected, was roughly €70, and the actual payoff ranged from €10 to €150.[8] *Real-lowvar* was identical to the Real treatment, except that the risk z_1 was 1/10th as great in Real-lowvar. The background risk z_2 in the temperance decisions was identical in the two treatments. The Real-lowvar treatment was inspired by a remark of Eeckhoudt and Schlesinger (2006), who speculate that individuals might be more likely to aggregate risks than to disaggregate them, if one of the risks is very small. In all treatments, zero or negative earnings were impossible.

Table 2: Treatments

	N	Stakes	Risk z_1
Real	1054+109	1/10 chance of EV = €70	± 10 to ± 50
Hypo	1066	Hypothetical EV = €70	± 10 to ± 50
Hypo-highpay	995	Hypothetical EV = €10500	± 1500 to ± 7500
Real-lowvar	342	1/10 chance of EV = €70	± 1 to ± 5

We also included two hypothetical treatment conditions with different payoff scales. The hypothetical nature was made clear to participants at the beginning of the experiment. The

[8] Combining large payoffs with a random selection of participants for real payment is often done in large-scale studies with the general public (e.g., von Gaudecker et al. 2010). In a study of risk attitudes, the procedure leverages incentives, and avoids the potential problem of relatively linear utility for small payoffs (see Abdellaoui et al. (2010) and references therein). Abdellaoui et al. (2010) show that random selection leads to stronger incentives than a downscaled payoff scheme, where all subjects are paid with certainty. Starmer and Sugden (1991) provide evidence that selecting one decision for payment, rather than all decisions, does not affect behavior.

Hypo treatment was identical to the Real treatment, except for the fact that no choices counted toward participant earnings. This allows us to test whether decisions are biased when they are not incentivized.

The *Hypo-highpay* treatment was identical to the Hypo treatment, except for the fact that payoffs were scaled up by a factor of 150. The factor was chosen so that the baseline endowment in 6 out of 10 prudence and temperance decisions, which was €90 in the other three treatments but €13,500 in Hypo-highpay, approximated the median annual net income of all panel members of €12,960. The framing in this treatment involved a range of payoffs that would have significant influence on individuals' wealth positions, comparable to a major financial shock such as temporary unemployment or uncovered medical expenses.

All four conditions were conducted with members of the LISS panel. The sample sizes for the different treatments are shown in Table 2.[9] All of the undergraduate students in the laboratory were assigned to the Real treatment. The student participants faced exactly the same procedures and choices as the subjects in the LISS panel, including the 1 in 10 chance of having one of their decisions count toward earnings. In contrast to the panel, students also received a €5 participation fee. General instructions were given at the beginning of the experiment, and specific instructions for each part were given immediately before the part began. Participants from the LISS panel received the instructions on their screen (see Appendix A). At any time, they could click on a link to go back to any point in the instructions for the current part of experiment. Students in the laboratory received the instructions on printed handouts. The laboratory sessions all took less than half an hour.

4. Prevalence of Prudence, Temperance, and Risk Aversion, and their Demographic Correlates

We first measure the incidence of prudence, temperance, and risk aversion in our sample, and then consider factors that correlate with these risk attitudes. We measure an individual's *risk aversion* as the number of safe choices he made, out of the five decisions involving a sure payoff and a risky lottery (decisions 1 – 5 in Table 1). As another measure of risk aversion, we calculate the certainty equivalent (CE) of the risky lottery resulting from these five

[9] Of the 3457 participants, a total of 31 people dropped out of the experiment at some point. Over all treatments, this reduces sample sizes by 3 for the risk aversion task, by 27 for the prudence task, by 23 for the temperance task, and by 31 for the expected utility based task.

decisions.[10] We measure *prudence* as the number of prudent choices in the five choice situations of the form shown in Figure 1 (decisions 6 – 10 of Table 1). We measure *temperance* as the number of temperate choices in the five choice situations of the form illustrated in Figure 2 (decisions 11 – 15 of Table 1). Table B1 in Appendix B gives the percentages of trials, in which each response was chosen, for each of the 17 questions.

Table 3: Prevalence of Risk Aversion, Prudence and Temperance

	All	Lab	Real	Hypo	Hypo-highpay	Real-lowvar
Risk aversion, i	3.38*	3.60	3.23	3.20	3.78°	*Included in Real*
CE(65_5), ii	24.93*	24.18	25.85	25.99	22.65°	*Included in Real*
Prudence, i	3.45*	4.45 [a]	3.39	3.43	3.47	3.34
Temperance, i	3.00*	3.12	3.02	2.96	3.12°	2.67[a]
RA_EU>1, iii	.50	.37[a]	.49	.48	.57°	*Included in Real*
Prud_EU>2, iii	.61*	.83[a]	.59	.62	.66	*Included in Real*

Note: Condition Real-lowvar identical to Real, except for prudence and temperance tasks. Real includes LISS panel participants only. Entries are i) the number of risk averse, prudent or temperate choices in five decisions, ii) the certainty equivalent in €, normalized by dividing by 150 for Hypo-highpay, and iii) the fraction of subjects choosing risk averse or prudent; *significantly different from random choice (i.e. 2.50 for risk aversion, prudence and temperance decisions (rows 1, 3, and 4), .50 in RA_EU and Prud_EU (rows 5 and 6) or risk neutrality with CE=€35.00 (row 2), at the 1% significance level, Wilcoxon test. [a] indicates Real-lowvar or the university student sample significantly different from Real treatment, Mann-Whitney test; °indicates Hypo-highpay significantly different from Hypo treatment, at 5% significance level, Mann-Whitney test; CE(65_5) excludes subjects who violated monotonicity.

The prevalence of risk aversion, prudence, and temperance. Table 3 presents results for the whole sample, as well as separately for each treatment and for the students in the laboratory. In each treatment, a significant majority of decisions are consistent with risk aversion, prudence and temperance. The only exception is for temperance in the Real-lowvar treatment. Risk aversion is also indicated in the average certainty equivalent, which is

[10] The *certainty equivalent* is defined here as the midpoint between the largest certain amount, for which the lottery was chosen, and the smallest certain amount for which the safe option was chosen. While the number of safe choices made can be calculated for all subjects, the certainty equivalent can only be calculated for subjects who behaved monotonically with respect to the safe option, and switched only once between the certain amount and the lottery in the ordered risk aversion choices.

significantly lower than the expected value of the lottery of €35 in all treatments. Prudence is more prevalent than temperance (Wilcoxon signed-rank test, p<.01).[11] Figure 4 provides more details about the distribution of choices. Strong risk aversion, prudence and temperance, with all five choices consistent with the attitude, is the modal outcome. Nevertheless, a considerable fraction of subjects choose intemperately in all five decisions. The next-to-last row of Table 3 indicates that the median relative risk aversion coefficient is exactly equal to 1 (50% chose the alternative consistent with a coefficient greater than one, and 50% did not). The last row of the table indicates that the coefficient of relative prudence is greater than two for a majority of individuals.

< sideways Figure 4 about here >

Columns 2 to 6 of Table 3 show the results for each treatment separately. We find treatment effects. Risk aversion is stronger in the Hypo-highpay treatment than in the Hypo treatment. This is indicated in the number of risk averse choices shown in row 1, the certainty equivalents given in row 2, and the responses to the task evaluating relative risk aversion in row 5. This is suggestive of increasing relative risk aversion. Prudence is stronger among the university students in the laboratory than among respondents in the LISS panel. Temperance is stronger in the Hypo-highpay than in the Hypo treatment. It is also less pervasive in the Real-lowvar than in the Real treatment, providing an affirmative answer to Eeckhoudt and Schlesinger's (2006) intuition that decision makers might be more likely to aggregate risks when one of the risks is small. There are no significant differences between the Real and the Hypo treatments for any of the measures. This suggests that non-incentivized choices provide unbiased estimates of the average attitudes of a population for similar real stakes.

Correlation between risk aversion, prudence, and temperance. An important empirical question concerns the correlation of risk aversion with higher order attitudes (e.g., Browning and Lusardi 1996, section 5.3). If the most prudent agents are also the most risk averse, they would select into jobs with low income risk. This is the case, for example, for the German civil servants discussed by Fuchs-Schuendeln and Schuendeln (2005). Consequently, they do not have a strong need for precautionary saving compared to less prudent agents in riskier occupations. Such self-selection makes the empirical identification of precautionary motives

[11] All tests in this paper are two-sided tests. There were some effects of counterbalancing the order and the presentation of the choices. Because counterbalancing always involved equally sized groups, we report population averages and include controls for counterbalancing in the regression analyses.

difficult. While Fuchs-Schuendeln and Schuendeln (2005) used the natural experiment of German reunification to identify such self-selection, we can study the relationship between risk aversion, prudence, and temperance directly.

Table 4: Rank Correlation Among Attitudes

	All Participants		Laboratory		LISS Panel	
	Risk aversion	Prudence	Risk aversion	Prudence	Risk aversion	Prudence
Prudence	.251***		-.039		.256***	
Temperance	.320***	.362***	.367***	.180*	.319***	.366***

Note: Spearman rank correlation coefficients reported; */*** denotes significance at the 10%/1% level.

Table 4 shows that there is substantial positive correlation among the three measures in the LISS sample. Students in the laboratory exhibit similar patterns, except that they show no correlation between risk aversion and prudence. Table 5 provides more detail. Each row contains the average number of prudent and temperate choices of individuals based on the number of safe choices they made in the risk elicitation tasks. On average, the most risk seeking subjects are both imprudent and intemperate, while risk averse subjects are both prudent and temperate. Both higher order attitudes increase monotonically with the level of risk aversion, though temperance is only significant for relatively strong levels of risk aversion. These results, indicating a strong correlation between risk attitudes, support the view that self-selection is an important factor to consider in empirical measurements of precautionary savings.

Table 5: Prudence & Temperance by Number of Risk Averse Choices

# risk averse choices	Prudence	Temperance
0 (n=317, risk seeking)	2.27** (imprudent)	1.73***(intemperate)
1 (n=228, risk neutral/risk seeking)	3.01***	2.34
2 (n=513, risk neutral/risk averse)	3.24***	2.59
3 (n=604, risk averse)	3.36***	2.81***
4 (n=468, risk averse)	3.55***	3.14***
5 (n=1409, risk averse)	3.87***	3.57***

Notes: **/*** denotes significance at the 5% /1% level, Wilcoxon test of the null hypotheses of random choice (prudence = temperance = 2.5)

Prudence, temperance, and the risk/endowment ratio. We next consider whether the likelihood of making a prudent or a temperate decision depends on the endowment to risk ratio of the decision task. For each prospect, we calculate the ratio of the zero-mean risk z_1 that has to be allocated (e.g., ±€20, z_1=20), to the expected value of the prospect (e.g., €75 for a prospect [90_60], thus *Ratio*=26.7%). The ratio is then included in a random effects probit regression where the dependent variable is a choice in favor of the prudent or temperate alternative, and each individual decision is the unit of observation. We conduct separate regressions for prudence and for temperance, each using the five available choices per subject. For temperance, we also control for the size of the zero-mean background risk z_2 (e.g., €30 for the prospect [90_(90+[30_-30] +[10_-10])], with Ratio=10/90=11%), which does not affect the ratio. In an additional specification we include controls for gender and age, and treatment dummies.[12]

We find a strong effect of the risk-to-endowment ratio on the temperance measure, with an approximately 0.16 percentage point (p.p.) increase per percentage point increase in the ratio ($z>4.58$, $p<0.01$). To illustrate, consider an increase in the ratio by 22 percentage points e.g. by going from [90_(90+[30_-30] +[10_-10])] to [90_(90+[30_-30] +[30_-30])]. This increases the preference for the respective temperate alternatives, [(90+[30_-30])_(90 +[10_-10])] and [(90+[30_-30])_(90 +[30_-30])], by 3.5 p.ps. This effect remains robust if we control for the size of the background risk (regression IId), or for treatments and background variables (regression IIb). The effect of the risk-to-endowment ratio is consistent with the relationship between the Real-lowvar treatment and temperance shown in Table 3. Indeed, comparison of regressions IIc and IIb shows that the effect of the Real-lowvar treatment disappears if the ratio is included.

[12] The Real-lowvar treatment has very small ratios, of between 1.33% and 5.33% for prudence, and between 1.11% and 5.55% for temperance. For the other treatments, this variation lies between 13.33% and 53.33%, and 11.11% and 55.55%, respectively. Thus, when controlling for treatment, the coefficient on Real_lowvar reflects effects of the ratio as well.

Table 6: Effect of Risk-to-Endowment Ratio on Prudent and Temperate Choices

	Ia	Ib	IIa	IIb	IIc	IId
	Prudent choice	Prudent choice	Temperate choice	Temperate choice	Temperate choice	Temperate choice
Ratio (in %-points)	.052	.048	.162	.144		.160
	(2.06)**	(1.83)*	(5.34)***	(4.58)***		(5.27)***
Background risk						.063
						(1.17)
Female		.332		7.239	7.240	
		(.20)		(3.63)***	(3.63)***	
Age (10y)		-1.711		1.644	1.661	
		(.68)		(.54)	(.54)	
Age (10y) squared		-.028		-.100	-.101	
		(.11)		(.31)	(.32)	
Student		16.385		4.653	4.645	
		(11.76)***		(.80)	(.80)	
Real-lowvar		0.663		-6.562	-11.413	
		(.22)		(1.64)	(2.88)***	
Hypo		1.412		-1.789	-1.791	
		(.69)		(.69)	(.69)	
Hypo_highpay		2.367		3.891	3.881	
		(1.15)		(1.51)	(1.51)	
N (subjects)	3539	3539	3545	3545	3545	3545
N (obs)	17695	17695	17717	17717	17717	17717

Notes: Random effects (panel) probit regressions; Five observations per subject; Ratio= absolute size of risk that has to be allocated divided by the expected value of the prospect; background risk=absolute size of the zero-mean risk z_2 in temperance; marginal effects reported in percentage points; z-statistics in parenthesis; */**/*** denotes 10% / 5% / 1% significance level;

For the prudence measure, there is an approximately 0.05 p.p. increase per percentage point increase in the ratio (z>1.83, p<0.067). Here, increasing the risk-to-endowment ratio by 27 p.ps. with a change from [90_(60+[10_-10])] to [90_(60+[30_-30])], increases the preference for the respective prudent alternatives, [(90+[10_-10])_60] and [(90+[30_-30])_60], by 1.35 p.ps. Overall, these relationships are consistent with decreasing absolute prudence and temperance, with stronger effects for temperance. These findings are consistent with the evidence for decreasing absolute prudence found by Tarazona-Gomez (2003) and Guiso et al. (1992, 1996).

Demographics. We now consider the influences of demographic characteristics on the indices for risk aversion, prudence and temperance. The demographic variables were selected on the basis of previous literature. We include all of the controls used in Fuchs-Schündeln and Schündeln's (2005) study of precautionary saving, as well as health status and a dummy for higher education (college). The latter two variables have strong influence on wealth accumulation, and are related to income uncertainty and risk preference (Guiso et al. 1996; Lusardi 1998, 2008; Viscusi and Evans 1990; Zeckhauser 1970). Although the dependent variables are in a discrete form and are censored at 0 and 5, we report OLS estimates here for ease of interpretation of the coefficients, and because fewer distributional assumptions are required. Table 7 shows the results. A random effects model, where each decision problem has a random effect, as well as ordered probit and tobit regressions, yield qualitatively identical results.

We find that women are more risk averse than men, which is consistent with previous research (Eckel and Grossman 2008; Croson and Gneezy 2009). Older people are less risk averse, but become so at a decreasing rate as they age. The hypothetical treatment with scaled up payoffs elicits greater risk aversion, which is consistent with increasing relative risk aversion (Holt and Laury 2002). Students in the laboratory are more prudent than others, and higher education is correlated with greater prudence. No gender effect exists for prudence, but the age effects are jointly significant ($p<.01$ in regression IIa and $p<.05$ in regression IIb), indicating a reduction in prudence with age. Females are more temperate. The Real-lowvar treatment leads to significant reductions in temperance. For all three attitude measures, the explained variance is low, suggesting that idiosyncratic features are of greater importance than demographics (Malmedier and Nagel 2010).

< Table 7 about here >

We also conducted a regression analysis for the student sample separately (not reported in the table), including Frederick's (2005) cognitive reflection test measuring cognitive ability, and whether the student was a Dutch national or a foreign student. Nationality had no influence on any of the attitudes. Higher scores on the cognitive reflection test were associated with greater prudence ($t=2.40$, $p<0.05$), but had no effect on risk aversion or temperance. This finding supports the view that prudence is particularly pervasive among people with high cognitive ability and high education.

5. Implications for Savings and Portfolio Choice

In principle, higher order risk attitudes influence, through their effect on precautionary motives, how much people save and how they allocate their savings among different asset classes. Several studies have tried to evaluate the empirical importance of the precautionary saving motive by regressing a measure of income risk on wealth holdings or wealth changes (Browning and Lusardi 1996; Carroll and Kimball 2008). The lack of a reliable measure of income risk, and the potential self-selection into occupations with different income risk, however, complicate the identification of precautionary motives (Lusardi 1997). Consequently, the literature has given a wide range of estimates of the degree of prudence and the fraction of saving that is precautionary. Our direct measurement of higher order risk attitudes, and the availability of wealth and saving data for our participants, allows us to approach this question with a different strategy. Instead of testing whether increased uncertainty leads to higher savings, implying prudence, we directly test whether our revealed preference measures of risk attitudes predict savings. If differences in income risk and other determinants of saving are sufficiently controlled for, the variation in the level of prudence and temperance would correlate with the variation in savings.[13] Similarly, higher order risk attitudes would correlate with the share of risky assets that people hold (Gollier 2001; Guiso, Jappelli, and Terlizzese 2006). Under decreasing absolute risk aversion (i.e., strong prudence and temperance), people would reduce their exposure to risky assets in the presence of greater background risk.

In this section, we evaluate the predictive power of our experimental measures of higher order risk attitudes, for saving and investment behavior outside the experiment. We conduct three different analyses. First, we consider the correlations between our measures and binary dependent variables that indicate whether or not individuals have savings, investments and credit card debt. These variables are presumably measured with little error. Second, we relate our measures to indices of participants' wealth, which are similar to those typically used in studies of precautionary saving and wealth. While these continuous wealth measures have more variation across households, they naturally involve more measurement error than simple

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[13] While this effect immediately follows for prudence, the impact of temperance relates to more specific changes in the risk profile an individual faces (Eeckhoudt and Schesinger 2008) and would therefore be harder to detect. Because we cannot control for self-selection of agents into occupations with low income risk, our estimates are lower bounds for the effects of prudence and temperance.

binary responses. Third, we correlate our measures to an index of the share of participants' portfolios that is allocated to risky investments.

5.1. Prudence, Temperance and the Presence of Savings, Investments, and Debt

We consider how risk attitudes relate to specific components of saving and wealth. We have data on whether or not each subject in the LISS panel has any (1) savings accounts or savings certificates, (2) risky investments, (3) real estate investment, (4) long-term insurance,[14] (5) loans or revolving credit arrangements, and (6) an unpaid credit card balance. We conduct probit regressions for each of these variables on the risk measures, including two different sets of control variables. The first set, Controls A, consists of the exogenous variables of gender, age and treatment, as in the regressions of type (a) in Table 7. The second set, Controls B, includes several variables that may affect the propensity to save. These variables are listed in the (b) regressions of Table 7.

Table 8 shows the estimates for savings and credit card debt, using different specifications. The models are estimated for the entire sample of participants, and for the subsamples consisting of (i) those who indicated that they made their household's financial decisions, and (ii) those who reported relatively high income uncertainty.[15] These two subsamples presumably exhibit more variation in saving behavior and wealth accumulation, and thus perhaps greater opportunity for the effect of prudence and temperance on saving and wealth to be detected. We find that prudence increases the likelihood that a participant has a savings account or certificate, and it reduces the likelihood that he has unpaid balances on a credit card. The former effect is very robust, while the latter effect is reduced if we include the large set of controls or restrict the sample to those people who report high income uncertainty. Females are less likely, and home owners, high income individuals, and highly educated respondents are more likely, to have savings accounts (not shown in the table). Older and

[14] In the Netherlands, many households have insurance contracts which, in the event of the death of the policy holder, pay off a mortgage he holds and provide a payment to his heirs, and also have the feature that they pay off a different sum if the policyholder is living when he reaches retirement age. Our variable "long-term insurance" indicates the value of such policies, which roughly correspond to life insurance, mortgage insurance, and 401K/IRA retirement savings accounts in the United States.

[15] The LISS panel data includes a question regarding the change in the financial situation of the participant over the last 12 months. Possible responses could range from "much worse", to "no change", to "much better." The high income uncertainty sample excludes subjects who indicate no change. The individuals who made the financial decisions for their household are also identified from responses in a previous survey.

higher income subjects are more likely, and home owners are less likely, to have a negative credit card balance.[16]

< sideways Table 8 about here >

Temperance reduces the likelihood of risky investments, as shown in the left portion of Table 9, in regressions 1–4. This effect is reduced for self-reported household financial decision makers, but is particularly strong for people facing high income uncertainty. Females are less likely, and older subjects, home owners, and highly educated subjects are more likely, to have risky investments. There is no robust effect of any of the three risk attitude measures on life insurance, real estate and loans. Perhaps surprisingly, risk aversion does not predict any of the financial variables for which we have data. As can be seen in the bottom three lines of both tables 8 and 9, if the regressions are conducted using each measure separately while excluding the two others, the results are similar.

< sideways Table 9 about here >

5.2. Prudence, Temperance and Precautionary Wealth

To consider the relationship between risk attitudes and wealth, we construct the following measure of wealth from quantitative information on assets and liabilities:

$$\begin{gathered} \textit{wealth} = \textit{savings balance} + \textit{long term insurance balance} + \textit{risky investments} + \\ \textit{real estate investments} - \textit{mortgage liabilities} - \textit{other loans}. \end{gathered} \tag{1}$$

We also consider a second wealth measure, which excludes long-term insurance, real estate, and mortgages. Thus, we exclude housing related assets and liabilities, and focus on the most liquid components of wealth. We run OLS regressions of log wealth on our three risk attitude measures, in conjunction with the two different sets of control variables. Table 10 shows the results.

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[16] As indicated earlier, risk aversion, prudence, and temperance are positively correlated. This raises the possibility of multicollinearity in the regressions reported in tables 8, 9, and 10, where all three attitudes are included in the set of covariates. In all of the regressions reported, however, both the variance inflation factors (VIFs) and the condition numbers are well below conservative thresholds of 5 for VIF and 15 for condition number. This indicates that multicollinearity is not a serious problem in our regression analyses. The tables also report results from regressions including each attitude alone, while excluding the two others from the estimated equation, to evaluate the robustness of our findings.

< sideways Table 10 about here >

The table contains the coefficients of our three risk attitude measures on log wealth. Risk aversion and temperance do not affect wealth in our sample, while prudence is associated with greater wealth. The effect of prudence varies between an 11% and a 25% increase in wealth per prudent choice in the experiment, depending on the specification. The effect is robust with respect to the wealth measure used, and also appears with similar force if we restrict the sample to those who report to be the main financial decision maker of a household, or to those who face high income uncertainty. For both wealth measures, inclusion of the full set of controls reduces the effect of prudence. The effect for financial decision makers is less pronounced than for the whole sample, and becomes insignificant if we include the full set of controls. The largest effects are observed for those participants who report significant income uncertainty.

Overall, the results give clear evidence that prudence is correlated with greater wealth. The regressions also reveal relationships between demographics and wealth (not shown in the table). Females and married people have lower wealth, while higher income, more highly educated, and home owning respondents hold more wealth. The effect of higher education also explains the reduction of significance if we include Controls B; education is strongly correlated with prudence as shown in Table 7. Similar results are obtained if each measure is included in the regressions separately while excluding the two others. The effect of temperance remains insignificant, while risk aversion becomes significant in some specifications. The effect of prudence is reinforced, becoming both economically greater and estimated with greater precision.

5.3. Prudence, Temperance and Portfolio Choice

To construct a measure of the share of a participant's portfolio that is composed of risky assets, we divide his total holdings of risky assets by the sum of his total holdings of risky assets plus his savings. Risky assets consist of holdings of growth funds, share funds, bonds, debentures, stocks, options and warrants. These are presumably the most liquid and flexible components of portfolio wealth, and are also relatively unlikely to be affected by factors unrelated to the riskiness of the holding. Because 83% of the participants hold no risky assets, there are many zero values for the risky portfolio share. Thus, in regressions 5 – 8 in Table 9, in which risky portfolio share is the dependent variable, we use a Tobit regression specification.

The regressions show that temperance is related to less exposure to risky assets. This is consistent with the finding reported in subsection 5.2, that temperance reduces the likelihood that people hold investments. The effect on portfolio shares becomes stronger, if the complete set of controls is included, or if we restrict the sample to the self-reported household financial decision makers. The strongest reduction in risky portfolio share per temperate choice is obtained for people who report high income uncertainty. Females hold less risky portfolios, and older, more highly educated and home owning subjects hold more risky portfolios.

6. Parametric Analysis

Most microeconomic level empirical studies of saving and portfolio decisions rely on a parametric expected utility framework. In this section we provide estimates of the coefficients of risk aversion, prudence, and temperance, for the widely used constant relative risk aversion and expo-power utility functions, under the assumption of expected utility. The CRRA family has sometimes been criticized because the empirical evidence suggests that relative risk aversion increases with wealth (Abdellaoui et al. 2007; Holt and Laury 2002). Our results support this view (see also Table 7 Ia and Ib, effect of the Hypo-highpay treatment). The *expo-power* family has been proposed as an alternative specification that combines the desirable features of decreasing absolute and increasing relative risk aversion. We estimate the two parameter specification employed by Holt and Laury (2002).

All 17 decisions that the subjects made are used to fit a maximum likelihood model of the CRRA and the expo-power utility functions. We estimate the models for pooled data from the Real, Real-lowvar and Hypo treatments together, as well as separately for the Hypo-highpay treatment, which had greater nominal payoffs. For the CRRA utility function, $u(x) = x^{1-\rho}(1-\rho)^{-1}$, the coefficients of relative risk aversion, prudence and temperance are given by ρ, $\rho + 1$, and $\rho + 2$, respectively. For the expo-power utility function, $u(x) = (1-\exp(-\alpha x^{1-r}))\alpha^{-1}$, the coefficient of relative risk aversion equals $RR(x) = r + \alpha(1 - r)\, x^{1-r}$. The expressions for the relative prudence and temperance coefficients are more complex, and we give closed forms, as well as the details of the estimation method and statistical tests, in Appendix C. For expo-power utility, all three coefficients depend on wealth. We evaluate the coefficients at the expected payoff over all choices. Thus, for the Real, Real-lowvar, and Hypo treatments, x is set equal to €70, and for the Hypo-highpay treatment x is set equal to €10,500. If both r and α

are positive, the utility function exhibits decreasing absolute and increasing relative risk aversion (IRRA). The estimation results are given in Table 11.

Table 11: Parametric Estimates of Relative Risk Aversion, Relative Prudence and Relative Temperance under Expected Utility

	CRRA		Expo-power	
Payoff size	Normal	High	Normal (α = .097; r = .484)	High (α = .089; r= .652)
Risk aversion	0.89	0.94	0.93	1.43
Prudence	1.89	1.94	1.68	2.24
Temperance	2.89	2.94	2.58	3.13

Note: Estimates for expo-power utility evaluated at x=€70 for the normal payoff size treatments (Real, Real-lovar, and Hypo), and x=€10500 for the treatment with high payoffs (Hypo-highpay).

The estimates for the CRRA model indicate significant risk aversion for both payoff magnitudes, with coefficients of .89 and .94. The estimates are in the range typically observed in direct measurements with lottery choices (Guiso and Paiella 2008, Harrison et al. 2007). The coefficient for the Hypo-highpay treatment is significantly greater than for the other treatments, suggesting increasing relative risk aversion. The estimation of the expo-power function results in significantly positive parameters α and *r*, and thus also indicates increasing relative risk aversion.[17] Relative risk aversion is greater than one for this functional form for the high payoff condition, but smaller than one for the other three treatments. Note that for expo-power utility the difference between the coefficients of relative risk aversion and prudence (and temperance) is less than one (than two).

In section four, we reported that the direct test of RR(x)>1 and RP(x)>2 proposed by Eeckhoudt et al. (2010) lends support only to the latter condition. This pattern, a coefficient of relative prudence exceeding that of relative risk aversion by a value greater than 1, is inconsistent with both the CRRA, and the expo-power, functional forms. The data in Table 10 illustrate the sensitivity of the estimated coefficients to whether a representative or a median individual is considered, and to the estimation methodology and assumptions. To model risk aversion and higher order attitudes more flexibly under expected utility, in order to account for the observed pattern, a different utility function might be more appropriate. Alternatively, we may allow for deviations from expected utility. Deck and Schlesinger (2010, section five)

[17] Holt and Laury (2002) also report DARA and IRRA (α=.029; r=.269), while Harrison et al. (2007) do not reject the CRRA model and estimate an α not significantly different from zero.

and Bleichrodt and Eeckhoudt (2005) discuss non-expected utility models that allow for more complex patterns of higher order risk attitudes.

7. Conclusion

In this study, we have measured prudence and temperance directly in a demographically representative sample of the Dutch population, and in a sample of undergraduate students. Prudence is widespread and positively correlated with financial well-being, education, and cognitive ability. The decisions taken on our prudence tasks predict financial status. The more prudent an individual, the greater is his wealth, the more likely he is to have a savings account, and the less likely he is to have credit card debt. Thus, we find a clear link between prudence and saving, as in the precautionary saving model (Kimball 1990). Prudence is correlated with educational attainment, and university students make more prudent choices than the overall population. Our results are consistent with previous studies of student populations that have found that a majority are prudent (Ebert and Wiesen 2009; 2010; Deck and Schlesinger 2010). Furthermore, within the sample of university students, those that perform better on a test of cognitive ability make more prudent choices. Prudence is not correlated with gender or age.

A majority of decisions are temperate, but temperance appears to be less pervasive than prudence. Temperance and prudence are positively correlated. Women are significantly more temperate then men are, and temperance is moderated when the risk involved is relatively small. The share of an individual's portfolio that is composed of risky investments is negatively correlated with his degree of temperance. The relationships are usually strongest for people reporting high income uncertainty, suggesting that background risk is an important influence on financial decisions (Eeckhoudt et al. 1996; Guiso and Paiella 2008).

We also find that the majority of individuals are risk averse, which is consistent with previous studies (see for example Holt and Laury 2002, or Harrison et al. 2007). Risk aversion is positively correlated with prudence and temperance; the more risk averse an individual, the more prudent and temperate she is likely to be. Risk aversion does not predict wealth or saving behavior. Women are more risk averse than men. Individuals exhibit increasing relative, but decreasing absolute, risk aversion. The coefficient of relative risk aversion for a representative individual, for the stakes we study, is close to one.

We make two observations concerning methodology. The first is that hypothetical elicitation yields very similar results to incentivized elicitation. Our results are consistent with the view that simple hypothetical questions to elicit prudence and temperance in policy surveys are a valid option for obtaining unbiased estimates of the average responses that would be observed under real monetary incentives. The second is that estimates of risk aversion and prudence coefficients depend considerably on the data and estimation methodology employed. For relative risk aversion, the estimates are in a close range for all methodologies. The median coefficient is exactly one for a binary decision which sorts individuals based on that threshold. Imposing functional forms on the utility function, and using multiple responses in the estimation, somewhat lowers the risk aversion estimate of the representative individual. For prudence, however, the estimates are more sensitive. While our binary choice to distinguish individuals with relative prudence of greater than two from those with less than two implies a median estimate greater than two, imposition of functional forms on the utility function gives mixed results, but with estimates close to two for a representative individual.

Our study shows that the methodology to measure higher order risk attitudes introduced by Eeckhoudt and Schlesinger (2006) can readily be implemented in surveys with general populations. It yields direct measurements of preferences, which have some predictive power for financial status variables. While measurements of risk aversion have successfully been included in survey instruments (Barsky et al. 1997; Guiso and Paiella 2008), prudence and temperance have not. Our results suggest that information about these attitudes can significantly improve predictions, especially if combined with the more sophisticated measures of income uncertainty available in some surveys (Fuchs-Schündeln and Schündeln 2005; Guiso et al. 1996; Nosic and Weber 2010). Explicitly accounting for heterogeneity in higher order risk attitudes may then help to solve some of the puzzles in the literature, such as the low saving rates for lower income classes (Hubbard et al. 1995), or the low consumption of highly educated young people with strong future income prospects (Browning and Lusardi 1996).

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Appendix [not intended for publication; will be made available online]

Appendix A: Instructions for the LISS Panel participants for the Real treatment (translated from Dutch, the instructions for the other treatments and for the students differed only slightly from those given here)

This questionnaire is about risk attitudes. Some people like to take risks while others prefer to avoid them. We ask you to make several 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.

[following paragraph appeared in Real and Real-lowvar treatments only]

There is a chance that you will be paid for real! At the end of the questionnaire, the computer will determine whether you will be paid for real. The chance that you will be paid for real is 1 in 10. If you are paid for real, the computer will randomly select one of the options you have chosen. The computer will then roll the dice to determine the prize from the option you have chosen. This prize will be transferred to your bank account.

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.

Explanation of part 1

In part 1, you choose between two options, called "Option L" (left) and "Option R" (right). An example of a choice is given below:

[Example of a risk aversion choice]

As you see, in both options, a red die is rolled. In this example, “Option L” yields €45 if the roll of the red die is 1, 2, or 3. If the roll of the red die is 4, 5, or 6, “Option L” yields €15. In the example, “Option R” yields €25, irrespective of the roll of the red die.

You can earn money
Always choose the option you prefer; any option can be selected by the computer to be paid for real. Please make your choices between “Option L” and “Option R.”

[5 risk averse questions]

Explanation of part 2
In addition to the red die, a white die will also sometimes be rolled in both options. An example of a choice is given below:

[Example of a prudence choice]

The white die is sometimes rolled
As you see in the example, the white die is rolled if the roll of the red die is 4, 5, or 6 in “Option L,” while the white die is rolled if the roll of the red die is 1, 2, or 3 in “Option R.”

The roll of the white die determines whether an amount will be added to, or subtracted from, the original prize resulting from the roll of the red die.
In the example, if the roll of the white die is 1, 2, or 3, €15 is 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 is subtracted from this 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.”

[5 prudence questions]

Explanation of part 3
In addition to the red and the white die, a black die will also sometimes be rolled under both options. An example of a choice is given below:

[Example of a temperance choice]

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

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, if the roll of the white die is 1, 2, or 3, €15 is 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 is subtracted from this prize.
If the roll of the black die is 1, 2, or 3, €25 is added to the prize resulting from the roll of the red die in the example. If the roll of the black die is 4, 5, or 6, €25 is subtracted from this 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."

[5 temperate choices]

Explanation of part 4, question 1 of 2

In the final part of this questionnaire, we ask you to make 2 additional choices between two options called, "Option L" and "Option R." There is no example choice; please choose between the options depicted below:

[choice RR_EU>1]

As you see, in both choices a red die will be rolled.

- Option L yields €40, if the roll of the red die is 1, 2, or 3.
- Option L yields €30, if the roll of the red die is 4, 5, or 6.
- Option R yields €50, if the roll of the red die is 1, 2, or 3.
- Option R yields €24, if the roll of the red die is 4, 5, or 6.

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 a choice between "Option L" and "Option R."

Explanation of part 4, question 2 of 2

Finally, please make a choice between the options depicted below:

[choice RP_EU>2]

As you see, in both choices a red die will be rolled first.

The white die is sometimes rolled

As you see, the white die is rolled if the roll of the red die is 4, 5, or 6 in Option L, while the white die is rolled if the roll of the red die is 1, 2, or 3 in Option R.

The roll of the white die determines whether an amount will be added to, or subtracted from, the original prize resulting from the roll of the red die.

If the roll of the white die is 1, 2, or 3, €25 is added to the prize resulting from the roll of the red die in "Option L". In "Option R", €15 is added.

If the roll of the white die is 4, 5, or 6, €25 is subtracted from the prize resulting from the roll of the red die in “Option L”. In “Option R”, €25 is subtracted.

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 a choice between “Option L” and “Option R.”

This is the end of the questionnaire. Thank you for your participation.

Appendix B: Choice percentages for each decision problem

Table B1: Raw Choice Proportions

	Left prospect	Right prospect	% of instances in which left prospect is chosen[a]	
			LISS Panel	Students
Riskav 1	20	[65_5]	49.6	42.2
Riskav 2	25	[65_5]	58.1***	53.2
Riskav 3	30	[65_5]	69.2***	79.8***
Riskav 4	35	[65_5]	78.2***	91.7***
Riskav 5	40	[65_5]	82.7***	92.7***
Prud 1	[(90+[20_-20])_60]	[90_(60+[20_-20])]	69.5***	89.0***
Prud 2	[(90+[10_-10])_60]	[90_(60+[10_-10])]	67.1***	88.1***
Prud 3	[(90+[40_-40])_60]	[90_(60+[40_-40])]	68.6***	91.7***
Prud 4	[(135+[30_-30])_90]	[135_(90+[30_-30])]	67.9***	87.2***
Prud 5	[(65+[20_-20])_35]	[65_(35+[20_-20])]	69.0***	89.0***
Temp 1	[(90+[30_-30])_(90 +[30_-30])]	[90_(90+[30_-30] +[30_-30])]	59.3***	53.2
Temp 2	[(90+[30_-30])_(90 +[10_-10])]	[90_(90+[30_-30] +[10_-10])]	58.5***	56.0
Temp 3	[(90+[30_-30])_(90 +[50_-50])]	[90_(90+[30_-30] +[50_-50])]	61.8***	69.7***
Temp 4	[(30+[10_-10])_(30 +[10_-10])]	[30_(30+[10_-10] +[10_-10])]	59.0***	65.1***
Temp 5	[(70+[30_-30])_(70 +[30_-30])]	[70_(70+[30_-30] +[30_-30])]	60.9***	67.9***
Ra_EU1	[40_30]	[50_24]	50.9	36.7***
Prud_EU2	[(50+[25_-25])_30]	[50_(30+[15_-15])]	61.0***	82.6***

Notes: [x_y] indicates a prospect with an equal probability of receiving either x or y; a: choice of left prospect indicates a safe choice, prudence, and temperance, respectively; *** indicates significant difference at 1% level from random choice between left and right option, binomial test, two- sided.

Appendix C: Utility Estimation Procedures and Results

C1. Closed Form Expressions

This section contains the closed form expressions for the relative and absolute coefficients of risk aversion, prudence, and temperance, for the Constant Relative Risk Aversion and Expo-Power utility functions, reported in section 6.

Table C1: Coefficients of Relative Risk Aversion, Prudence and Temperance

	CRRA	Expo-power
RR(x)	ρ	$r+(1-r)\alpha x^{1-r}$
RP(x)	$1+\rho$	$1+r+(r-1)\alpha x^{1-r}+\frac{(r-1)^2\alpha x}{(r-1)\alpha x - r x^r}$
RT(x)	$2+\rho$	$\frac{r(1+r)(2+r)x^{3r}-(r-1)r(4+7r)\alpha x^{1+2r}+6(r-1)^2 r\alpha^2 x^{2+r}-(r-1)^3 x^3\alpha^3}{r(1+r)x^{3r}-3(r-1)r\alpha x^{1+2r}+(r-1)^2\alpha^2 x^{2+r}}$

Table C2: Coefficients of Absolute Risk Aversion, Prudence and Temperance

	CRRA	Expo-power
AR(x)	$\frac{\rho}{x}$	$\frac{r}{x}+\frac{(1-r)\alpha}{x^r}$
AP(x)	$\frac{1+\rho}{x}$	$\frac{1+r}{x}+\frac{(1-r)\alpha}{x^r}+\frac{(r-1)^2\alpha}{(r-1)\alpha x - r x^r}$
AT(x)	$\frac{2+\rho}{x}$	$\frac{r(1+r)(2+r)x^{3r}-(r-1)r(4+7r)\alpha x^{1+2r}+6(r-1)^2 r\alpha^2 x^{2+r}-(r-1)^3 x^3\alpha^3}{r(1+r)x^{1+3r}-3(r-1)r\alpha x^{2+2r}+(r-1)^2\alpha^2 x^{3+r}}$

C2. Estimation Strategy and Statistical Tests

This section describes the methods used to estimate the coefficients of relative risk aversion, prudence, and temperance for a representative individual, and gives some additional detail about the estimates. The estimates are reported and discussed in section 6. We used maximum likelihood estimation to maximize the probability of observing the responses. The conditional likelihood function is:

$$\max_{\{\rho \text{ or } \alpha, r\}} : \ln L(\rho \text{ or } \alpha, r) = \Sigma_i \, [\ln(\theta(\Delta EU)|y_i = 1) + \ln(1-\theta(\Delta EU)|y_i = 0)],$$

where ΔEU is the difference in expected utility between the two lotteries given the parameter(s), θ(ΔEU) is a probit function translating ΔEU into a number between 0 and 1, and $y_i = 1$ (0) denotes a choice of the left (right) lottery in decision task *i*. We allow for clustering at the individual level. The estimation is conducted for the pooled data from the Real, Real-lowvar, and Hypo treatments (labelled as "normal"), and separately for Hypo-Highpay (labelled as "high"). The estimation results are given in Table C3.

Table C3: Maximum Likelihood Estimation Results

	Parameter	Estimate	Standard Error	95% Confidence Interval		–LogL
CRRA	ρ_{normal}	0.890*+	0.015	0.860	0.920	27633.94
	ρ_{high}	0.942*+	0.006	0.930	0.954	10720.19
Expo-power	r_{normal}	0.484*+	0.010	0.463	0.504	27550.80
	α_{normal}	0.097*+	0.007	0.083	0.111	
	r_{high}	0.652*+	0.008	0.636	0.668	10695.47
	α_{high}	0.089*+	0.003	0.083	0.095	

* (+) denotes significantly different from 0 (1) at the 1% level, based on a Wald test. normal: treatments Real, Real_lowvar, and Hypo; high: treatment Hypo_highpay

For the CRRA specification, respondents are significantly risk averse in both the normal and high conditions, and respondents are significantly more risk averse in the Hypo-highpay treatment, compared to the other treatments. Coefficients of risk aversion are significantly smaller than 1 in both cases. The estimation of the expo-power function results in significantly positive parameters α and r, indicating increasing relative risk aversion and decreasing absolute risk aversion. The coefficient r is significantly greater in the Hypo-highpay treatment than in the other treatments. The coefficient α does not differ among the two subsets of the data.

Sideways and large Tables/Figures

Table 7

Table 7: Demographic Correlates of Prudence and Temperance

	Ia	Ib	IIa	IIb	IIIa	IIIb
	Risk aversion		Prudence		Temperance	
Female	.402	.383	-.004	.007	.219	.233
	(7.30)***	(5.65)***	(.07)	(.10)	(3.55)***	(3.01)***
Age (10y)	- .199	-.209	-.069	-.083	.036	-.173
	(2.42)**	(1.62)	(.76)	(.58)	(.40)	(1.17)
Age (10y) squared	.017	.016	-.001	.001	-.002	.019
	(1.99)**	(1.28)	(.12)	(.08)	(.18)	(1.29)
Married	-	.062	-	.073	-	.144
		(.65)		(.72)		(1.34)
Divorced	-	-.234	-	-.149	-	.047
		(1.55)		(.93)		(.29)
# children	-	.023	-	.011	-	.051
		(.70)		(.31)		(1.33)
Log gross income	-	-.022	-	-.025	-	.020
		(1.44)		(1.49)		(1.09)
Home ownership	-	.056	-	.054	-	-.036
		(.67)		(.63)		(.40)
Health status (1= worst, 5 =best)	-	-.072	-	.068	-	.008
		(1.61)		(1.45)		(.16)
High education	-	.035	-	.190	-	-.138
		(.47)		(2.30)**		(1.57)
Civil Servant	-	.100	-	.071	-	.057
		(1.28)		(.57)		(.41)
Self-employed	-	-.185	-	-.100	-	-.005
		(1.05)		(.55)		(.03)
Student	.189	-	.849	-	.145	-
	(1.35)		(6.86)***		(.82)	
Real_lowvar	-.066	-.064	-.049	-.062	-.363	-.297
	(.64)	(.52)	(.44)	(.46)	(3.17)***	(2.16)**
Hypo	-.046	-.037	.037	.063	-.068	-.063
	(.63)	(.44)	(.48)	(.70)	(.86)	(.67)
Hypo_highpay	.526	.527	.074	.073	.095	.106
	(7.28)***	(6.29)***	(.93)	(.80)	(1.18)	(1.10)
N	3563	2427	3539	2413	3543	2416
R^2	.045	.058	.018	.018	.010	.011

Notes: OLS regressions; t-statistics in parenthesis; */**/*** denotes significance at the 10% / 5% / 1% level.

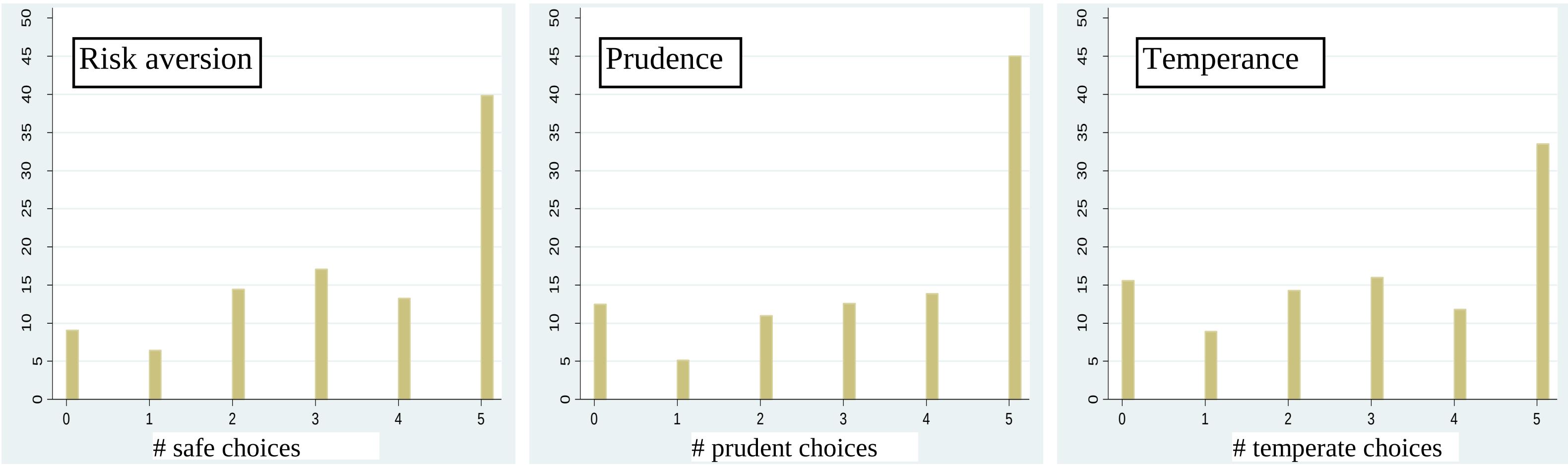

Figure 4: Distribution of Individuals' Safe (Risk Averse), Prudent, and Temperate Choices (all treatments, percentage of participants making number of safe, prudent, and temperate choices indicated on horizontal axis)

Table 8

Table 8: Savings, credit card debt, and higher order risk attitudes

	Presence of savings accounts				Presence of credit card debt			
	All	All	Main financial decision maker	High income uncertainty	All	All	Main financial decision maker	High income uncertainty
	1	2	3	4	5	6	7	8
Risk aversion	.304 (.58)	.111 (.21)	-.066 (.11)	.398 (.61)	-.179 (.73)	.025 (.12)	-.527 (1.34)	-.144 (.41)
Prudence	1.679 (3.55)***	1.291 (2.58)***	1.371 (2.65)***	1.911 (3.18)***	-.478 (2.20)**	-.362 (1.87)*	-.818 (2.38)**	-.367 (1.17)
Temperance	-0.548 (1.13)	-.526 (1.06)	.033 (.06)	-1.052 (1.71)*	.159 (.68)	.076 (.38)	.269 (.72)	.271 (.81)
Controls A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	No	No	Yes	No	No
N	2366	2158	1269	1462	2360	2153	1265	1457
Pseudo R^2	.0209	.0502	.0169	.0229	.0562	.1005	.0525	.0449
Risk aversion[a]	.595 (1.22)	.340 (.67)	.419 (.76)	.548 (.90)	-.224 (1.00)	-.030 (.16)	-.624 (1.77)*	-.108 (.34)
Prudence[a]	1.544 (4.59)***	1.111 (2.16)**	1.340 (2.70)***	1.596 (2.86)***	-.459 (2.35)**	-.332 (1.90)*	-.848 (2.73)***	-302 (1.08)
Temperance[a]	.149 (.34)	-.014 (.03)	.469 (.95)	-.240 (.43)	-.041 (.20)	-.029 (.16)	-.158 (.48)	.125 (.43)

Notes: probit regressions; marginal effects reported in percentage points; z-values based on robust s.e. in parenthesis; */**/*** indicate significance at 10%, 5% and 1% level. Self-reported main financial decision maker in household; High income uncertainty excludes participants who indicated that there was no change in their financial situation over the last year. a: coefficients from analogous regressions including each risk attitude measure alone and excluding the two other measures.

Table 9

Table 9: Investment, portfolio choice, and higher order risk attitudes

	Presence of risky investments (probit)				Portfolio share of risky investments (tobit)			
	All	All	Main financial decision maker	High income uncertainty	All	All	Main financial decision maker	High income uncertainty
	1	2	3	4	5	6	7	8
Risk aversion	.223 (.45)	.214 (.42)	.234 (.30)	.639 (1.08)	-.011 (.51)	-.006 (.28)	-.003 (.15)	.031 (1.13)
Prudence	.245 (.51)	-.155 (.31)	-.599 (.80)	.463 (.79)	.0003 (.01)	-.007 (.36)*	-.029 (1.39)	.009 (.33)
Temperance	-1.123 (2.41)**	-.902 (1.88)*	-1.042 (1.42)	-1.742 (3.11)***	-.032 (1.76)*	-.038 (2.05)**	-.044 (2.20)**	-.061 (2.55)**
Controls A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	No	No	Yes	No	No
N	2366	2158	1269	1462	1144	1078	673	709
Pseudo R^2	.0539	.1047	.0435	.0717	.0815	.1142	.0826	.1160
Risk aversion[a]	-.173 (.38)	-.157 (.33)	-.475 (.68)	.124 (.22)	-.023 (1.15)	-.021 (1.03)	-.028 (1.30)	.016 (.61)
Prudence[a]	-.110 (.25)	-.433 (.94)	-.925 (1.37)	-.009 (.02)	-.012 (.63)	-.020 (1.09)	-.042 (2.09)**	-.005 (.19)
Temperance[a]	-.982 (2.36)**	.898 (2.08)**	-1.172 (1.81)*	1.414 (2.83)***	-.035 (2.00)**	-.041 (2.37)**	-.052 (2.79)***	-.053 (2.31)**

Notes: probit regressions for presence of risky investments, marginal effects reported in percentage points; z-values based on robust s.e. in parenthesis; tobit regressions for portfolio share of risky investments, coefficients reported; */**/*** indicate significance at 10%, 5% and 1% level. Self-reported main financial decision maker in household; High income uncertainty excludes participants who indicated that there was no change in their financial situation over the last year. a: coefficients from analogous regressions including each risk attitude measure alone and excluding the two other measures.

Table 10

Table 10: Wealth and higher order risk attitudes

	Log wealth				Log wealth (liquid)			
	All	All	Main financial decision maker	High income uncertainty	All	All	Main financial decision maker	High income uncertainty
	1	2	3	4	5	6	7	8
Risk aversion	.083 (1.19)	.063 (.87)	.106 (1.09)	.109 (1.26)	.057 (.84)	.033 (.46)	.106 (1.13)	.085 (1.01)
Prudence	.198 (3.01)***	.118 (1.69)*	.176 (1.87)*	.25 (3.10)***	.184 (2.94)***	.117 (1.76)*	.167 (1.86) *	.241 (3.06)***
Temperance	-.037 (.59)	-.014 (.21)	.075 (.83)	-.123 (1.55)	-.055 (.91)	-.035 (.56)	.006 (.07)	-.141 (1.85)*
Controls A	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls B	No	Yes	No	No	No	Yes	No	No
N	2043	1854	1049	1247	2126	1929	1105	1296
R^2	.0335	.0939	.0571	.0413	.0331	.0882	.0593	.0400
Risk aversion[a]	.127 (1.97)**	.097 (1.43)	.193 (2.16)**	.138 (1.72)*	.094 (1.50)	.057 (.86)	.160 (1.86)*	.114 (1.47)
Prudence[a]	.203 (3.37)***	.128 (2.00)**	.232 (2.69)***	.235 (3.10)***	.178 (3.06)***	.112 (1.82)*	.198 (2.40)**	.208 (2.85)***
Temperance[a]	.049 (.85)	.041 (.70)	.165 (2.04)**	-.009 (.12)	.021 (.39)	.013 (.22)	.096 (1.24)	-.038 (.54)

Notes: OLS regressions; t-values based on robust s.e. in parenthesis; */**/*** indicate significance at 10%, 5% and 1% level. Self-reported main financial decision maker in household; High income uncertainty excludes participants who indicated that there was no change in their financial situation (in either direction) over the last year; parameters are growth rates; a: coefficients from analogous regressions including each risk attitude measure alone and excluding the two other measures.