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ON A SIMPLE SURVEY MEASURE OF INDIVIDUAL RISK AVERSION

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Abstract

We ask individuals for their reservation price of a specified lottery and deduce their Arrow-Pratt measure of risk aversion. This allows direct testing of common hypotheses on risk attitudes in three datasets. We find that risk aversion indeed falls with income and wealth. Entrepreneurs are less risk averse than employees, civil servants are more risk averse than private sector employees, and women are more risk averse than men. We analyze six different specifications of the lottery question in a single data set and find quite consistent results. We conclude that a simple lottery question is a promising survey instrument to extract differences in risk attitudes among individuals.

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1 INTRODUCTION

Suppose, an economist engages in empirical modelling of the decision to become an entrepreneur. Naturally, she assumes risk attitude to be a key variable. But if she then looks in the tool kit for the empirical counterpart, she finds it empty. Or she is told that we economists only believe in revealed preferences: an entrepeneur must not shy away from risk, since otherwise he would not be an entrepreneur, would he?

The example easily generalises. An individual's attitude towards risk is one of the salient characteristics that shows up in many analyses. A dichotomy between risk-aversion and risk-neutrality often coincides with marked differences in predicted behavior. It seems only natural then to develop an instrument to measure an individual's risk attitude, and to test whether indeed entrepreneurs are less risk averse than employees, whether civil servants are the risk avoiders they are commonly assumed to be, or whether risk aversion does fall with higher income and wealth.

Yet, in line with the dominant economic doctrine that only *revealed* preferences can be taken as reliable and stable, only few attempts have been made to obtain direct measurement. A typical example is Laffont (1993), who writes an entire chapter on "Measuring risk aversion and risk" without a single reference to empirical work, and in fact concludes "It is *of course*[1] difficult to obtain sufficient information about an agent's preferences, to know whether his absolute risk aversion increases or decreases (since this requires information about the third derivative of his utility function). However, such a comparative statics result is often used in an inferential way: since we must assume that absolute risk aversion decreases with wealth to obtain results that accord with both intuition and observations of rational behavior, we can infer that agents must satisfy this assumption in general. Consequently, we may legitimately invoke this assumption when we study comparative statics in uncertain environments" (o.c., p 24). Such a view is widely held in economics, but why not make a serious attempt to develop direct measurement? At least it would open up the road towards richer testing possibilities, and perhaps also towards better predictions. Here, we report on a direct and very straightforward approach. In a survey, we ask individuals for the amount they are willing to pay for participation in a specified lottery. From the answers, we deduce an individual's measure of risk aversion as defined by Arrow and Pratt. We then relate individual risk aversion to personal characteristics. In this way we try to contribute to filling a substantial gap in our knowledge. As Friedman and Sunder (1994, 44) note:"Reliable demographic data on individual risk attitudes is virtually nonexistent".

The only well developed body of direct empirical work on risk attitudes is contained in the experimental literature, often focussing on testing expected utility theory and alternatives (see, for example, Kahneman and Tverski, 1979; Van de Stadt, Antonides and Van Praag, 1984; Davis and Holt, 1993, Chapter 8; Kagel and Roth, 1995). In the experimental literature, expected utility theory has become suspect, as many violations of predictions and axioms have been established. But in the absence of a single dominant alternative model (Batallio et al, 1990; Harless and Camerer 1994), we will maintain the expected utility hypothesis for the interpretation of the survey answers. In fact, in several experiments, expected utility theory survives quite well (Hey and Orme, 1994; Evans, 1997) and in the survey by Camerer (1995) it has certainly not been killed and buried. When we derive the Arrow-Pratt measure of risk aversion from the lottery price, we employ expected utility theory. We

[1]Italics added.

might argue that this is not essential, as differences in reservation prices for a lottery are also revealing about individuals' risk attitude relative to others in a loose, more intuitive sense. But we still prefer to embed our measurement in the theory of choice under uncertainty.

In experimental research, individuals are asked to evaluate a lottery in a laboratory setting, usually involving actual payments. For example, the common Becker-De Groot-Marshak procedure asks for reservation prices for a lottery which is then matched with a randomly drawn offer price to determine the individual's pay-off (i.e. the offered price or the outcome of the lottery). This is too complicated for a survey setting where risk attitude is just one of the variables to be measured. Our purpose is similar to that of Barsky *et al.* (1997). Just as we are, they are motivated by the desire to develop a measure of risk aversion that can be used as an explanatory variable for individual behaviour predicted by economic theory.[2] In an experimental design, they confront individuals with the option of giving up their present job, at fixed salary, for a similar job with uncertain income. From accepting or rejecting alternatives they derive upper and lower bounds on the coefficient of risk aversion and accordingly group individuals in four categories. Their study is one of the very few to which we can compare our results. We will also relate our results to Binswanger (1980, 1981), who developed a measure of risk attitude to understand farming decisions in India. He reports on confronting labourers and farmers in rural India with lottery prospects. They can choose from 8 alternatives, one of which pays 50 rupees under all conditions (i.e. just a gift of 50 R). The alternatives have different pay-outs at the given probabilities of .5 for the high pay-out and .5 for the low pay-out. The alternatives are ranked by implied degree of risk aversion, and the individuals are labeled by the alternative they choose ("extreme", "neutral", etc). The labels are transformed into a scale and then regressed on personal characteristics. Donkers, Melenberg and Van Soest (1999) analysed several lottery questions included in a survey. In one type, probability equivalence, they contract individuals with a hypothetical increase in wealth and then give them the choice of keeping that wealth increase or switching to a lottery with a specified prize. Individuals are asked for the probability of winning the lottery prize that makes them prefer the lottery over the wealth increase. The question is asked for three different hypothetical increases in wealth. In the second type, they let individuals state their preference on two lotteries with specified probabilities and prizes. This question is asked for five comparisons. For the probability equivalence question the authors apply Cumulative Prospect Theory, a generalisation of expected utility in which probabilities and values are weighted separately. An innovative approach is Beetsma and Schotman (1997), who analyse behaviour of participants in a television game show; unfortunately, they cannot relate risk attitudes to individual characteristics, as they are unavailable in the data set.

Psychologists, by tradition less reluctant to seek direct measurement of preferences, have also developed test batteries to measure individual risk attitudes. Jackson, Hourany and Vidmar (1972) draw on that literature to conclude that four components, or categories of situations, have been distinguished in which risk taking of individuals may vary: monetary, physical, ethical and social risk taking. But in their own experiment, they conclude that they are strongly correlated: "Our results thus lend support to researchers who prefer to conceptualize risk taking as a broad personality dimension which is not contingent upon any single type of risk" (o.c., 499). Thus, it may certainly be worthwhile to search for a stable characterisation of individuals' risk attitude.

[2] We initiated our instrument in 1993, when the first author was supervising a thesis on entrepreneurship (Van Praag, 1996).

Experimental economics has made us aware of the many pitfalls, complications and even inconsistencies in attempts to measure risk attitudes. Sensitivity to framing, elicitation bias, preference reversal and the gap between willingness-to-pay and willingness-to-accept (see the discussion in Camerer, 1995) might well serve to put off any attempt to measure risk attitude by a simple question as we do here. However, we consider our attempt as only a step in a research project that may add complexities and refinements as we proceed. The strength of the present contribution is the analysis of three completely independent datasets, one of which even includes different specifications of the relevant pricing question. Results are highly similar across the datasets. We will return to the assessment of our results and directions for future research in the conclusions.

The paper is structured as follows. In the next section, we derive the link between the lottery reservation price and the Arrow-Pratt measure of risk aversion. Then, we relate individual risk aversion to explanatory variables in three separate surveys. In section 4, we compare results from three different specifications of the lottery question in one survey. In section 5 we take stock and relate our results to the few related studies in the literature, and conclude to some robust results.

2 *MEASUREMENT*

The proposed measure is quite simple. We ask an individual to state the reservation price for a lottery ticket, after specifying the probability of winning a prize of particular magnitude. Using expected utility theory, it is then straightforward to deduce Pratt's measure of risk aversion. Denote by Z the prize of the lottery, á the probability of winning the prize and ë the maximum price that the individual is willing to pay for the lottery ticket, i.e the reservation price. Assume a standard, twice differentiable, concave utility function U(W) in wealth W. Figure 1 illustrates. The individual has wealth W, which drops to W-ë by buying the lottery ticket and increases to W+Z-ë in case of winning the prize.

To deduce the value of the Arrow-Pratt-measure of absolute risk aversion ñ = -U"(W)/U'(W), note that expected utility theory implies that the utility of wealth W, without participation in the lottery, is equal to expected utility when participating at reservation price ë:

U(W) = (1-á)U(W-ë) + áU(W+Z-ë)

By developing a Taylor expansion of U(W-ë) and U(W+Z-ë) around U(W), we may write

U(W) = U(W) + áZU'(W) - ëU'(W) + U"(W) {(1-á)ë^2 + á(Z-ë)^2}/2

We can then solve for ñ as

$$r = (aZ - l)/\{ l^2/2 + a Z^2/2 - a lZ\} \qquad (1)$$

ñ depends on the units in which W is measured. If we multiply ñ by W we get the Arrow-Pratt measure of relative risk aversion, the wealth elasticity of the marginal utility of wealth, which is dimension free. In our empirical applications, we will not do this, as this would add all the measurement error in wealth (or income) to our variable of interest.

For ë =0 we get ñ = 2/Z, for ë = áZ (risk neutrality) we get ñ = 0 and for ë = Z, an incredible degree of risk loving (you value the lottery ticket at the full prize), we get ñ = -2/Z. The slope of the transformation is not constant, as we get

$$\frac{dr}{dl} = - \frac{r}{aZ - l} + r^2$$

The slope starts at 4(á - 0.5)/áZ^2 at ë = 0 and ends at 4(á - 0.5)/(á - 1)Z^2 at ë = Z. For values of Z = 1000 and á = 0.1, used in surveys below, the transformation is graphed in Figure 2, with ñ multiplied by 1000. In this case, the deviation from linearity is marginal.

To assess the magnitude of risk aversion, we shall calculate what we call C(5). It is the percentage change in expected income[3] that should compensate for the shift from a fixed income to an income drawn from a normal distribution, with a coefficient of variation of 5% (i.e. 2/3 of the realisations of income are no more than 5% below or above the average). From the standard formula for risk compensation, we know that the absolute compensation needed for certainty equivalence for standard deviation ó is

Ð = ½ ñ ó ^{2}.

Relative to income Y we may write

$$\frac{\Pi}{Y} = \frac{1}{2} r \frac{s^2}{Y} = \frac{1}{2} rY(s^2 / Y^2)$$

We shall calculate C(5) at specified values of ñ and Y at ó^2/y^2=0.05^2, i.e. C(5) = 0.00125-ñY. C(5) is the relative risk premium derived from relative risk aversion ñY for relative income variance of 5%.

We have included the lottery question (so far) in three datasets, the Brabant Survey, the Accountants Survey and the GPD Newspaper Survey. The *Brabant Survey* is a follow-up survey on 12 year old children in the Dutch province of Noord-Brabant. The original data were recorded in 1952, when the children were in sixth grade. New surveys were held in 1983 and 1993. The observations cover family background, IQ, schooling, labour market career and family situation, for about 2800 individuals. The data have been widely analyzed for many issues. More detail on the dataset is given in Hartog (1988) and Van Praag (1996). The lottery question was included in 1993. The *Accountants Survey* was held in 1999, by mailing a questionnaire to 3000 accountants (out of 9000) listed in the National Register of Chartered Accountants. The survey was held to assess the effect of different educational routes to qualification and contained questions on education, work experience, earnings and personal characteristics. 1599 accountants responded. We asked exactly the same question as in the Brabant survey:

3 We relate to income rather than wealth because of data availability.

Among 10 people, 1000 guilders are disposed of by lottery. What is the most that you would be willing to pay for a ticket in this lottery?

In January 1998, a syndicate of widely circulated regional Dutch newspapers (GPD) included a two-page questionnaire in their Saturday edition. Some 25 000 people responded to questions on income, work, health, politics and their personal characteristics. The *GPD Newspaper Survey* has six specifications of the lottery question.[4] The question was introduced for a lottery among 10 persons with a prize the size of their monthly salary. Five other combinations of number of participants and prize money were specified. Unfortunately, the ten people, 1000 guilders specification was not included. In section 3, we will only use the lottery of 5000 guilders among 10 participants. Hence, in that section, we analyze two identical lotteries and one lottery with the same probability of winning but a five times higher prize. In section 4, we will make use of the alternative specifications to test consistency and stability of results. The phrasing of the question does not explicitly state that the prize is allocated to one of the ten tickets by a random draw. However, this is implicit in the Dutch verb for "disposing of by lottery". We have no reason to assume that any participant will think of anything else than a random draw.

3 ANALYSING THREE DATASETS

3.1 The observations

In Appendix tables, we give the full frequency distribution of the lottery reservation prices. The clustering of the answers around particular values is remarkable. From a reservation of 5 guilders upward, all but two answers in the Brabant data are multiples of 5 guilders. In fact, the frequency distribution has four peaks, at zero, 10, 25 and 100 guilders. The largest peak is at 10 guilders, only 10% of the expected value of the lottery. The results for the Accountants are similar. For reservation prices above 5 guilders, only four answers are not a multiple of five. The distribution peaks at 10 guilders and at multiples of 25. In the GPD data, the distribution settles into multiples of 5 guilders above a reservation prize of 30; from 100 guilders on, the distribution peaks at multiples of 50.

It is unikely that such peaked distributions reflect true, exogenous tastes for risk. The answers might be molded by the association with actually available lotteries. Lottery tickets priced at 10 or 25 guilders are quite common. However, it is also conceivable that this reflects bounded rationality. Within the context of filling out the questionnaire, people don't consider it worthwhile to search out their reservation price to the last penny, and just give a quick answer. And this may hold for many real life choices involving uncertainty, so the information is not necessarily distorted.[5] Still, in an experimental setting with real payments we would get probably more precise answers.

In Table 1, we characterise the response in the three datasets. With respect to non-response

[4] We are grateful to Bernard van Praag and SEO Foundation for Economic Research at the University of Amsterdam for permission to use these data.

[5] In the regression analysis below, we might adjust for the discrete jumps in the answers, by using e.g. ordered response regressions. However, at this explorative stage there seems no need to, as for example the effect of explanatory variables is usually not affected by replacing a continuous regression by an ordered response interval model.

and response with reservation price equal to zero, there is a special problem here. Some people subscribe to a religion or ideology that considers gambling as morally objectionable. Of course, they cannot avoid choices involving risk, and each of them can have his own personal risk attitude. However, they will not participate in our imaginary lottery. Unfortunately, we cannot determine whether they express this in non-response or in a zero reservation price (it's obviously a target for refinement in later questionnaires). This makes the zero-answers a mixed bag: the answer can reflect truly strong risk aversion, or it can signal that the question is not suitable for eliciting information on risk attitude. Non-response can reflect a systematic moral objection as well as the usual variety of reasons for not answering. When correcting for selectivity bias in the stated reservation price, we will correct for non-response, but we will also consider sensitivity to correcting for zero response.

Clearly, risk aversion is the most frequent situation. GPD, with a higher prize but the same probability of winning, has the highest score for this attitude category. Accountants, with their substantially higher incomes, score much more frequently in the risk neutral or even risk loving category. This indeed suggests that increasing income (and wealth) reduce absolute risk aversion. But the high score for risk neutrality among accountants may also derive from a professional habit of valuing a risky prospect at its expected value. At the sample means, C(5) is about 2 to 12 % of income. Thus, shifting from a fixed income to a random income with the same mean but a standard deviation of 5% of the mean, would demand compensation of 2 to 12% of mean income. These are not a priori incredible numbers.[6] If we compare Brabant to GPD, both representative samples, we note that absolute risk aversion and C(5) are lower in the GPD data, where the prize is five times larger than in the Brabant data. Comparing the Brabant results to the Accountants results, we note that absolute risk aversion is lower for the high earning accountants, but relative risk aversion C(5) is higher. The relation between risk aversion and the probability of winning will be analysed more systematically below in section 4.

[6] If we multiply ñ by mean income, we get an indication of the degree of relative risk aversion: 65,93 and 20, respectively for the three datasets. In the finance literature there is a discussion on the U.S. equity premium puzzle: comparing returns on equity to risk free interest implies a degree of relative risk aversion of 26, which is a priori considered to be too high. The values found here point to the possibility of a reversal of the puzzle. See Fase (1997) for discussion and references. Beetsma and Schotman (1997) also find quite high values of relative risk aversion.

Table 1 Risk attitudes: sample characteristics

Dataset	Brabant	Accountants	GPD Newspaper
Frequencies (%)			
Non-response	4.5	8.4	22.6
ë =0	13.0	8.8	7.9
Risk averse	88.2	53.5	95.7
Risk neutral	10.2	37.1	3.7
Risk loving	1.6	9.4	0.6
N	2011	1599	17097
$\hat{\imath}$ [4]	25.05 (37.64)	65.45 (72.21)	76.86 (137.90)
$\hat{r}$ [5]	0.00154 (0.00070)	0.00077 (0.0011)	0.00034 (0.00011)
$\bar{Y}$ [6](annual, Dfl)	42280	121060	46470
C(5) at $\bar{Y}$, $\hat{r}$ [7]	0.0814	0.1203	0.0197

Note: risk attitudes calculated for respondents with non-zero reservation price

Table 2 Regression analysis of risk aversion ñ; Brabant survey

			Heckman two-step			
	OLS		response		risk aversion	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
intercept	1.698	(11.70)**	0.550	(1.24)	1.761	(8.00)**
female	0.166	(4.26)**	-0.020	(0.16)	0.166	(4.30)**
married	0.047	(0.84)	0.278	(2.12)**	0.034	(0.53)
IQ(100)	-0.0006	(0.49)	0.002	(0.61)	-0.0008	(0.56)
family background antisocial	-0.017	(0.26)	0.043	(0.20)	-0.017	(0.26)
father's job level						
high	0.063	(0.61)	-0.172	(0.60)	0.069	(0.67)
intermediate	0.044	(0.76)	0.044	(0.22)	0.043	(0.73)
independent	-0.002	(0.05)	-0.137	(1.20)	0.003	(0.08)
health impairment	-0.027	(1.44)	0.141	(2.53)**	-0.032	(1.52)
civil servant	0.003	(0.05)	0.033	(0.22)	-0.0004	(0.00)
unemployment	-0.038	(0.40)	-0.093	(0.38)	-0.034	(0.37)
self-employed	-0.129	(1.65)*	-0.318	(2.13)**	-0.114	(1.43)
disabled	0.043	(0.64)	0.097	(0.44)	0.040	(0.58)
not in labor force	-0.037	(0.67)	0.267	(1.54)	-0.047	(0.72)
reformed school	-0.019	(0.49)	-0.055	(0.46)	-0.016	(0.40)
non-religious school	-0.018	(0.22)	-0.024	(0.10)		

education						
basic	0.065	(1.22)			-0.067	(1.24)
lower general	-0.034	(0.64)			-0.040	(0.74)
lower vocational	0.036	(0.83)			0.032	(0.73)
higher general	-0.144	(1.23)			-0.153	(1.30)
higher vocational	-0.075	(1.21)			-0.087	(1.38)
university	-0.248	(2.05)**			-0.264	(2.16)**
education (years)			-0.046	(4.17)**		
income/100000	-0.183	(2.02)**			-0.184	(2.03)**
income missing	-0.015	(0.24)			-0.016	(0.24)
wealth, DFL. 1000						
100-250	0.013	(0.18)			0.012	(0.18)
250-500	-0.060	(1.12)			-0.061	(1.13)
>500	-0.100	(1.24)			-0.100	(1.24)
wealth missing	0.212	(6.11)**			0.214	(6.12)**
profit sharing, X-mas bonus	-0.096	(1.61)			-0.097	(1.61)
education children important	-0.014	(0.38)			-0.014	(0.39)
Mills ratio					-0.228	(0.41)
N	1920		2011		1920	
(pseudo-) R^2	0.0534				0.0535	

Risk aversion ñ has been multiplied by 1000
*,** significant at 10%, 5% (robust standard errors)

3.2 Regression analyses Brabant data

In Table 2 we present a regression analysis of the Brabant data. We present OLS estimates and selectivity-corrected estimates. The selectivity correction is included as it is quite conceivable that non-response is related to risk aversion, with unobservable variables both affecting risk attitude and the inclination to respond to the lottery question. We use the Heckman two-step procedure, with a probit for non-response and the Mills ratio derived from it as a regressor in the equation for the risk aversion coefficient ñ. We have also estimated the equations by Maximum Likelihood and Heckman two-step with a probit for zero reservation price and non-response deleted; we will report on the differences below. As is well known, identification is a thorny issue in selectivity corrected estimation, and results are very sensitive to specification. Not surprisingly, we also encountered these problems and therefore we start with OLS results.

It's important to realise that we are not interested here in a full explanation of differences in risk aversion between individuals. To the contrary: we want an instrument to measure these individual differences. To gain confidence in the measure, and get empirical validation, we want it to be related to some characteristics on a priori or intuitive grounds. But we do not expect, for example, the unemployed to be more or less risk averse than the employed.

As Table 2 shows, the type of family in which the respondent grew up as a child (measured at age 12) has no significant effect. Whether the family is rated antisocial by the child's teacher, whether the father has an intermediate or high job level, none of these background variables leave any traces. The same holds for having a father that operated his own business: risk aversion is unrelated to growing up in a risk taking environment. Perhaps one would not have been surprised had risk aversion been lower for those whose father was self-employed (mostly farmers, in this dataset), but that is not the case. Table 2 shows ñ also to be unrelated to marriage status, IQ, having an impaired health condition, being unemployed, disabled, not active in the labour force. One may take these results to be in line with intuitive predictions.

Risk aversion is significantly lower for the self-employed, and this is a significant result. The result survives in more structural modelling that we will discuss below (Van Praag, 1996; Cramer et al, 1999). A lower level of risk aversion is a widely adopted assumption to explain entrepreneurial activity (see Van Praag, 1999, for a survey), but as far as we know it has never been substantiated empirically.

The situation is similar for risk aversion falling with increasing income: a routine assumption, but without direct empirical evidence to back it up. Here we find a significant negative relation. If we add a quadratic term, we find in all our specifications that the linear term is insignificant but that the quadratic term is significantly negative. Income is measured as annual net household income. If we use the respondent's individual annual net income, we find the same result, with smaller coefficient and higher significance level. The latter results are similar if we use the respondent's own income rather than household income.

With respect to wealth, we also find support for the standard assumption of a negative relation. The questionnaire has seven intervals for wealth. We have also estimated a specification with six dummies. Plotting the coefficients against midpoints of the intervals brings out a hyperbolic relation with wealth, where the decline in risk aversion only starts for capital assets worth more than 100 000 guilders (about 2½ times the mean net annual household income of the sample). With three dummies for the highest intervals, using wealth below 100 000 guilders as the reference category, we find a clear negative relation. If wealth missing would be dominated by low levels of wealth, a plausible possibility, the effect would even be stronger.

Schooling level significantly reduces risk aversion, in particular for university education relative to lower levels (with education measured in years, the effect, though negative, is not significant). Since income and wealth are also included in the regression, this is a pure schooling effect. We have even corrected for childhood IQ (which is not significant). It is not possible to disentangle a true schooling effect from a selectivity effect, since we don't know risk aversion when deciding on schooling. One might perhaps have assumed that risk averse individuals choose more schooling, seeking a school diploma for a safer entrance to the labor market, like buying insurance. We have included a dummy for individuals responding that education is very important for their own children, but these individuals have no higher or lower degree of risk aversion than others. This counters the argument of schooling as an insurance policy. During the 1950's, when these respondents grew up, education was more costly to individuals. While pay-off to schooling was high, fear for failure to complete an advanced education may have put off the more risk averse students. Hence, with risk aversion a constant personal trait, selectivity may be responsible for the result. But it certainly is also conceivable that the education process really does reduce an individual's risk aversion. Perhaps also, schooling has made individuals more familiar with probability theory, generating some gravitation towards the expected value of the lottery.

Civil servants are not different in their risk attitude from private sector workers. This appears to invalidate an often made assumption, for example, in the context of wage comparisons. The same result is found in a switching regression for public and private sector wages estimated on this dataset (Jonker, 1996).

Women have a substantially higher degree of risk aversion than men. The mean value of ñ is 1.535, so a difference of 0.16 or 10 % is not negligible. To us, this is really a novel result. If substantiated, it may certainly help explain their behaviour, for example in job choices.

The response equation has been estimated to correct for possible selectivity, and is not very interesting by itself. Perhaps it is remarkable that the self-employed are significantly less in-clined to respond on the lottery valuation, but we see no obvious explanation.

We noted earlier that respondents may have objections of principle to participate in a lottery, as in certain religious denominations. Our data were collected in the province of Noord Brabant, which is predominantly catholic. However, there are pockets of calvinism, of an often very strict variety. We included the denomination of the school that the respondent attended, with "reformed school" sorting out the orthodox calvinist school attendants. While these individuals indeed are less inclined to participate, the effect is not significant. It is significant, however, if we include zero-response in the probit equation. Those who have attended a reformed school are apparently significantly more inclined to state a zero reservation price for the lottery. It's quite possible that this reveals their objections of principle.

The Mills ratio has no significant effect, indicating that the error terms for non-response and valuation of the lottery are uncorrelated. The Maximum Likelihood estimate produces the same result. If we exclude the non-response on the lottery question from the sample, and then correct for selectivity with a probit on a reservation price zero, on the argument that a stated price zero may also mean non-response on the evaluation (objection of principle may be expressed in valuation zero), we find mostly similar results in the regression for ñ. Gender and self-employment status are no longer significant, while the education effect becomes more pronounced. Excluding response zero from the regression for ñ is not warranted, when the zero valuation signals high risk aversion, rather than objections of principle to the gamble. With women more inclined to respond with zero valuation and the self-employed less inclined, these results indicate the importance of the zero-response for some of the effects we found.[7]

3.3 Results for chartered accountants

Table 3 presents regression results for risk aversion ñ for the chartered accountants. The group is homogenous on account of having the same education and the same occupation. This eliminates several variables available in the Brabant data.

As before, marital status and parental background have no effect on risk aversion, except for mother's education. Highly educated mothers reduce risk aversion, but it is not easy to see an explanation for this effect. Mother's education is known to have a positive effect on level of education, but with identical education for all respondents that is not relevant here.

Women have significantly higher risk aversion, just as in the Brabant survey. Income, which in the Brabant survey had a strong effect, now does not show a relation with risk aversion. The result is unaffected if we add income squared: both terms are insignificant. Perhaps this is due to the selective nature of the sample, as a sample of only one occupational group. As noted accountants are a more homogenous group then some cross-section of the population. Their income variation is also less, in the sense that their coefficient of variation is half that for the Brabant survey. Civil servants are now more risk averse than private sector workers, supporting the usual assertion. The self-employed are not significantly different from employees. This effect is poorly identified in the present data as truly self-employed are lumped together with partners in the firm. Partnership in a large firm no doubt dampens the risk.

The survey among the accountants was organized to collect information on cause and effect of choosing different educational routes: a university education topped off with accountancy training, or a dual track where work in an accountancy firm is combined with professional schooling. We conjectured that those choosing for the dual track might be more risk averse than those choosing the academic route. And we conjectured this might also show up in the motives stated to be important for choosing between the two routes. However, neither of these conjectures proved to be correct. We have used ñ in a structural modelling of the choice of type of accountancy training, but the effect turned out insignificant. Thus, with sufficient faith in the validity of our measure, we may conclude that risk attitude is not relevant for the training choice. Among these accountants, risk attitude does not correlate with investing in shares (i.e. not significantly, the sign is rightly positive) but we did not attempt structural analysis of this relation.

[7] If we estimate this specification (non-response excluded, correction for response zero with a probit) with Maximum Likelihood, the estimation routine does not converge.

Table 3 Regression results for risk aversion ñ; accountants

			Heckman two-step			
	OLS		response		risk aversion	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
intercept	1.060	(5.30)**	2.110	(6.70)**	0.888	(3.86)**
female	0.224	(1.89)*	-0.147	(0.69)	0.808	(1.89)*
married	-0.020	(0.22)	0.004	(0.02)	-0.040	(0.44)
age	-0.007	(1.75)*	-0.015	(2.37)**	0.053	(1.25)
father's education low	0.022	(0.31)	-0.022	(0.20)	0.109	(1.16)
father's education high	0.069	(0.85)	0.011	(0.08)	0.028	(0.32)
mother's education low	0.068	(1.00)			0.069	(1.03)
mother's education high	-0.320	(2.43)**			-0.320	(2.44)**
income	-0.476 E03	(0.00)			-0.0008	(0.04)
accountancy training						
dual track	-0.031	(0.43)	0.073	(0.69)	-0.0003	(1.49)
mixed	0.074	(0.86)	-0.168	(1.18)	0.757	(1.57)
reason to prefer dual track or university track:						
probability to graduate	-0.010	(0.13)			-0.013	(0.18)
training for broad job set	-0.042	(0.64)			-0.045	(0.68)
dual track job near home	-0.108	(1.47)			-0.111	(1.51)
civil servant	0.158	(2.28)**	-0.077	(0.63)	0.471	(2.11)**
self-employed/partner	-0.061	(0.62)	-0.047	(0.39)	0.125	(0.77)
not invested in shares	0.071	(1.13)			0.067	(1.08)
Mills ratio					-16.435	(1.43)
N	1462		1584		1462	
(pseudo-) R^2	0.023				0.024	

Risk aversion ñ has been multiplied by 1000
*,** significant at 10%, 5% (robust standard errors)

3.4 Results from the GPD newspaper survey

Results for the GPD survey are given in Table 4. Risk aversion is significantly related to most of the explanatory variables that we have included, confirming results from the other datasets, and adding new ones. Once again, women appear more risk averse than men. Risk aversion falls with income and education. It is lower for the self-employed. It increases significantly with age.

New results, in comparison with the other datasets, refer to family status and church attendance. The reference category for family status is being married. Single parents have no different risk attitude. But those who live together without formal marriage status are significantly less risk averse than married couples. A marriage contract is therefore a constraint that increases the cost of breaking up the relationship. It makes sense to expect that the married are more risk averse, as they are the ones that will be more likely to reduce the risk of the partners running off. Frequent church visits (forty times or more per year) correlate with higher risk aversion. Perhaps religiously active people are just more prudent. Perhaps also, one might interpret this activity and church attendance as a form of insurance premium: it might foster the chances for a good afterlife. The more risk averse are then willing to pay more "premium".

Only in this dataset, the coefficient on the Mills ratio indicates that unobservables increasing the likelihood of non-response also increase risk aversion, or, conversely, those with above average risk aversion are less likely to respond. Non-response is significantly lower for women, for those who vote for orthodox protestant political parties (GPV, SGP) and falls with age; it increases with income, but is not related to education. OLS and two-step regression generate virtually the same results. The significance of the Mills ratio however barely affects the results for the other variables, except for civil servants: they are only significantly more risk averse after selectivity correction.

Signs and significance levels are essentially unchanged if we lump non-response and reservation price zero in the probit equation and if we delete missing observations and apply a probit to reservation price zero. In some cases the magnitude of coefficients changes a little. This implies that the significant effects of the explanatory variables are not dominated by the effect on the inclination to respond with a zero reservation price. We have expressed our concern that a reservation price zero might not reflect a high risk aversion proper, but might reveal an objection against a lottery, for reasons of principle or otherwise. Whatever the validity of this concern, it does not invalidate our regression results.

3.5 Collecting results

While results from a single regression analysis on a new and perhaps unorthodox variable may be suspect, it is interesting that we now have results from three completely different and independent sources. The consistency of results strengthens their credibility. First, we found that in all three datasets women are significantly more risk averse than men. We take this as a strong, robust result. It is also found by Barskey et al (1997) and by Donkers, Melenberg and Van Soest (1999). It ties in with findings in other disciplines. In the educational testing literature, there are differences in scores between boys and girls for multiple choice tests versus free-response tests. These outcomes have been attributed to greater tendency of boys than of girls to guess the answers to multiple-choice questions, which suggests that boys are more likely to take a gamble (Bolger and Bellaghan, 1990). At a deeper level, there may be biological reasons, with women's position in procreation relative to men's requiring them to be more risk averse.

Second, we found that increased income reduces risk aversion in two of our data sets (not in the accountants data). This is a routine assumption in economic analyses, but commonly without reference to empirical evidence. Our own findings are backed up by similar findings by Binswanger (1980, 1981) and by Donkers et al (1999).

Third, we found in two of our data sets that civil servants are more risk averse than those working in the private sector (not in the Brabant data). The risk averse civil servant is a stereotype that is often evoked[8]. Empirical support is only available from a study by Bellante

[8] A striking example of risk aversion among civil servants is given by Abe Lenstra, a superb Dutch football

and Link (1981), who use a probit equation for choosing between public and private sector jobs and include an index of risk aversion based on revealed preference (buying insurance, using seat belts, smoking and drinking habits). The index of risk aversion significantly affects sector choice, in the expected direction. Remarkably, but consistently, more structural modelling with the Brabant data gave negative results. Jonker (1996) has used the Brabant data to estimate an endogenous switching model for working in the private sector or the public sector, including sector-specific wage equations. Sector choice is not affected by risk attitude, thus supporting the conclusion from our results with this data set.

Fourth, in two of our datasets we found that the self-employed are less risk averse than employees (it was not found for the accountants, where self-employed and partners in the firm could not be distinguished). This again is almost considered trivially true and routinely assumed, but never related to direct empirical evidence. The exception is Van Praag (1996) who has developed and estimated a structural model for entrepreneurship. Using the same Brabant dataset analyzed here, she first estimates a probit equation for the question whether respondents have ever started as an entrepreneur. With gender, childhood IQ, family background and schooling as other regressors, she finds that higher levels of risk aversion significantly reduce the probability to start as an entrepreneur. In the structural model, where both the decision to start as an entrepreneur and entrepreneurial ability measured by the size of the business are modelled, risk aversion as measured here again has a highly significant negative effect on the inclination to work as an entrepreneur. A related but simplified model produces the same result (Cramer, Hartog, Jonker and Van Praag, 1999). Lower risk aversion for the self-employed is also reported by Barsky et al (1997).

The effect of education on risk aversion is negative in the two datasets that allow for measuring its effect (in the Accountants data, individuals have identical schooling). The result is also reported by Binswanger (1980, 1981) and by Donkers et al (1999). In dummy specifications for educational levels and types, however, some deviations may occur.

The wealth effect on risk aversion could only be tested in the Brabant survey. The negative effect we found is also reported by Binswanger (1980, 1981).

The relation between risk aversion and age is not unequivocal. In the GPD data we find a solid positive relation with age, in the Accountants data we find a negative relation in OLS that becomes insignificantly positive in the selectivity corrected estimate. Barskey et al (1997) report a negative relation (up to age 60-64), Donkers et al (1999) a positive relation.

4. *VARIATIONS OF THE LOTTERY*

The GPD newspaper survey had a more extensive set of questions on lottery valuation, and included several alternatives. In full, the questionnaire stated[9]: "Suppose, you are offered a

player in the 1950's. While playing as an amateur for the Dutch team of Heerenveen, the Italian club Fiorentina offered him Dfl 100 000 in cash and a weekly salary of Dfl 600, at a time when the average worker made less than Dfl 100. After inquiring with the mayor if he could return to his City Hall job after the two-year contract would expire, and getting a negative answer, he declined Fiorentina's offer. Source: *NRC Handelsblad*, 28-08-98.

[9] We inserted answers with the code Dfl L(P,N) where N is the number of participants in the lottery and P is

ticket for a lottery in which ten people participate (so, your chance of winning is 1 in 10). The prize is an amount equal to your monthly wage. How much would you at most be prepared to pay: *DLF L (M,10)*. Please answer also for the following lotteries:

Five people participate	Prize Dfl. 1000	I pay Dfl L (*1000,5*)
Five people participate	Prize one monthly wage	I pay Dfl L (*M,5*)
Ten people participate	Prize Dfl 5000	I pay Dfl L (*5000,10*)
Hundred people participate	Prize Dfl 1000	I pay Dfl L (*1000,100*)
Hundred people participate	Prize Dfl 1.000.000	I pay Dfl L (*1.000.000,100*)"

For the questions with a prize equal to a monthly wage (L (M,10) and L (M,5)), we only considered individuals who reported non-zero income from work, even though many people answered these lottery questions while having no monthly wage.

To test the reliability of our measure of ñ, we calculated rank correlations for the different specifications (Table 5). The two lotteries for a monthly wage correlate highly: a correlation of .87 between the two specifications certainly gives confidence in the measure. The correlation is equally high for L(5000,10) and L(1000,5). The correlation between lotteries with a given nominal prize and a monthly wage as prize are low, but this is understandable from the variation in M given that ñ will not be an individual constant. The lottery we used in our analyses above, L(5000,10), correlates at .46 or better with the other lotteries, even at .71 with the million guilders lottery. The lowest correlations are the two monthly wage lotteries with the cheapest lottery, L(1000, 100), which only has an expected value of 10 guilders.

We can apply two simple tests for consistency: the same prize with more participants cannot rationally have a higher reservation prize.[10] 599 respondents are inconsistent by specifying L (M,10) > L (M,5) and 299 respondents by specifying L (1000,100) > L (1000,5). With 39 individuals in both sets, this leaves 859 individuals with inconsistent answers: 8% of the sample for which we have observations on monthly income. These respondents have actually been deleted from all our analyses throughout the paper.

the prize, equal to the stated amount or monthly salary M.

[10] This holds even for risk lovers, as is easily shown by deriving the compensation in reservation prize ë for decreasing probability of winning ñ as the slope of constant-expected utility indifference curve. As long as marginal utility is positive, this marginal rate of substitution dë/dñ is positive.

Table 4 Regression OLS analysis of risk aversion r ; GPD data

	OLS		Heckman two-step			
			response		risk aversion	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
intercept	3.760	(21.89)**	3.898	(22.52)**	3.539	(13.91)**
female	0.295	(15.99)*	-0.129	(5.47)**	0.291	(12.18)**
vote orthodox	0.029	(0.50)	-0.606	(10.52)**		
age	0.223	(8.42)**	-0.880	(24.00)**	0.146	(2.08)**
income	-0.044	(5.20)**	0.039	(4.44)**	-0.023	(2.20)**
education (years)	-0.353	(8.51)**	0.019	(1.62)	-0.277	(4.50)**
single parent	-0.068	(1.58)			-0.028	(0.50)
living together	-0.098	(3.12)**			-0.087	(2.65)**
single	-0.047	(2.34)**			-0.038	(1.39)
civil servant	0.012	(0.50)			0.045	(1.83)**
self-employed	-0.179	(5.39)**			-0.148	(3.86)**
frequent church visits	0.065	(2.04)**			0.101	(2.81)**
family status missing	-1.250	(2.00)**			-1.719	(2.63)**
education missing	-0.962	(9.17)**			0.780	(5.12)**
Mills ratio					0.384	(1.86)*
N	13225		17097		13225	
(pseudo-) R^2	0.040				0.037	

*, ** significant at 10%, 5% (robust standard errors); $\tilde{n}$ multiplied by 10000

Table 5 Rank correlations of $\tilde{n}$ and number of observations, GPD lotteries

	1	2	3	4	5	6
1. L(M,10)	1.000 7497					
2. L(M,5)	0.871 7350	1.000 8549				
3. L(1000,5)	0.461 7342	0.422 8488	1.000 13279			
4. L(1000,100)	0.179 7002	0.118 8082	0.586 12495	1.000 12589		
5. L(5000,10)	0.512 7337	0.465 8506	0.866 13105	0.516 12497	1.000 13225	
6. L(1000000,100)	0.454 6862	0.430 8002	0.608 11956	0.226 11429	0.714 12008	1.000 12278

In Appendix Table 2, we have characterised the response in the different lotteries for the comparable dataset of all individuals with monthly wage available. The mean reservation price follows a consistent pattern: higher for L (M,5) than for L (1000,5) than for L (1000,100). In fact, it neatly rises with the expected value of the lottery, for lotteries with prizes not in monthly wages. If we proxy the expected value of the M lotteries as probability of winning times mean income (Dfl 4950 per month), the results for the M lotteries also fit in.

Remarkably, L (1000,100) has a mean reservation price above the expected value of 10 guilders.[11], whereas the reverse holds in the other cases. Among the absolute-prize lotteries, L (1000,100) stands out for generating relatively strongly risk loving results. This may be related to the fact that it has the lowest expected returns, and thus in case of risk neutrality would have the lowest reservation price: it is a "cheap" lottery.

We have replicated the analysis of Table 4 for the other lotteries in the GPD data.[12] The regressions for the two lotteries on a monthly wage performed poorly. None of the coefficients was significant and sign reversals were frequent. An immediate explanation for this result is the high measurement error in the individual's wage (or income). This makes the prize of the lottery a poorly measured variable and makes it very hard to detect systematic relations.

The lottery L(1000,5) performs quite well, with similar results as the L(5000,10) we analysed earlier. Only significance levels are lower, but most t-values are still above critical thresholds. The lottery L(1000,100) also has quite low significance levels in some cases. The million guilder lottery L(1 000 000,100) performs quite well, except for insignificance of the age effect and of living together. But civil servants are significantly more risk averse on this high-prize lottery.

At this stage, we conclude that a lottery with the prize specified as a monthly wage is not attractive to elicit risk attitudes. It makes it too hard for the researcher to retrieve the value of the prize. And the lottery L(1000,100) has perhaps too low an expected value to take individuals to a decision area where risk attitudes make the difference. That would leave three more attractive lotteries: L(1000,5), L(5000,10) and L(1 000 000,100). In that perspective, it is assuring that these three lotteries correlate reasonably on the implied ñ, at .87, .61 and .71. Interestingly, the results are loosely in line with results stressed as preference reversal (Camerer, 1995, p. 658). Preference reversal occurs as individual reservation prices for a gamble primarily relate to pay-offs, while choice between gambles relates more to probabilities. Loosely speaking, one might then anticipate a lower correlation of reservation prices for lotteries with equal probability of winning and different pay-off (L(1000,100) and L(1 000 000, 100)) than for lotteries with equal pay-off and different probability of winning (L(1000,5) and L(1000,100)). With correlation coefficients of 0.226 and 0.586 this is indeed the case.

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[11] This might be rationalized from Kahneman and Tversky's (1979) prospect theory where for low probabilities of winning people assign decision weights to the outcome of winning exceeding the true probability. But note that it does not hold for the other lotteries. Consistency with prospect theory requires more precize testing which we will undertake in a separate paper.

[12] At one stage, we estimated the regression equations for the six lottery specifications simultaneously by SURE but this generated no different results from separate estimation.

Pursuing the structure of the answers a little further, we analysed the relation of ñ to the probability of winning and the magnitude of the prize. In particular, we estimated the following model

$$ñ_{ij} = è_0 + è_1 á_j + è_2 Z_j + è_3 á + ì_i + å_{ij} \qquad (2)$$

where $á_j$ is the probability of winning in lottery j and Z_j is the prize of lottery j. The error term is decomposed in an individual random effect $ì_i$ constant over all the lotteries, and a general error term $å_{ij}$. Table 6 presents the results. When we include the lotteries that have the prize defined on monthly wage, we find no significant effects. If we drop these lotteries, which implies we have 4 lotteries left, we get highly significant results. This underlines our earlier conclusion that the lotteries with a prize specified in a monthly wage are inadequate specifications for the present purpose. The results on the 4 lotteries show that for probabilities higher than 0.13, risk aversion is reduced when the probability increases. This result also holds when instead of random effects, we use fixed effects. When pooling the data with fixed effects, risk aversion is reduced for probabilities higher than 0.04. Similarly, risk aversion decreases when the prize of the lottery (Z) increases. This negative coefficient of Z holds for both random and fixed effects. These results are very interesting, as they fit in with the literature. The signs of the coefficients are in line with expected utility theory. Risk aversion goes up as risk increases (probability decreases). Risk aversion falls with the magnitude of the prize, just as it falls with increasing income. These results are only suggestive of course, because we only have four datapoints on á and Z.

Table 6 Risk aversion across lotteries; GDP data

Variables	M lotteries included	M lotteries excluded
$á_j$	0.006	0.005
	(1.117)	(18.906)**
Z_j	-6.59E-11	-6.36E-11
	(0.216)	(4.571)**
á	-0.025	-0.021
	(1.038)	(15.970)**
Intercept	8.00E-06	1.36E-05
	(0.032)	(1.173)
$ó_ì$	0	0
$ó_å$	0.0236	0.001
R^2	0	0.016
N	67,376	51,337

t-values in parentheses; **; significant at 5% (robust standard errors)

5. *TAKING STOCK*

We have proposed to use a simple question on the reservation price of a specified lottery to elicit individual risk attitude, with the aim of obtaining a measure for use in applied work. All it requires is just one simple question in a survey. We have indicated how the reservation price can be transformed to the Arrow-Pratt measure of absolute risk aversion. Using three different datasets, we find substantial empirical support for the claim that risk aversion is higher for women and for civil servants, lower for the self-employed, falling in income and wealth, falling in education. The relation with age is not unequivocal. Our results are in line with the very few studies that also attempt direct measurement of individual risk attitude.

When we compare results from different specifications of the lottery question, we conclude that specifying the lottery prize as a monthly income is not adequate for our purpose, as the answer has too much noise. Also, a lottery with expected value of only 10 guilders (5 dollars) is probably too low to bring out systematic information on risk attitudes. Taking these factors into account we find highly consistent results across different specifications of the lottery in the same dataset. Our finding that risk aversion is increasing in risk and decreasing in the size of the prize fits in with expected utility theory. But not all results are identical across datasets. The self-employed among accountants are not significantly less risk averse, a finding we related to the data limitation of taking truly self-employed and partners in a firm as a single category. Income is also insignificant for accountants, perhaps due to their relative homogeneity as a group in expected lifetime income (their annual incomes have smaller coefficient of variation than incomes in the Brabant survey).

Our approach has the virtue of simplicity. The lottery question is meant for use in surveys on issues where individual risk attitude is assumed to be relevant. Thus, it does not have the refinements and variations that can be used in experimental designs, such as applied by Binswanger (1980, 1981) and by Barskey et al (1997). But in all its simplicity it appears a promising instrument to characterize individual risk attitude.

The present paper was only exploratory in nature, with the character of a validation study. Thus, in the relation between risk attitudes and other variables we aimed neither for structural relation nor for causality. But of course, future work will attempt just that. We already referred to structural modelling of the relation between self-employment status and risk attitude (Cramer et al, 1999). The strong and consistent findings that women are more risk averse than men also opens up routes for interesting modelling of choices under uncertainty: higher risk aversion among women can have a role in their career investments (breaking through the glass ceiling requires investment with uncertain pay-off), in explaining differences between men and women in migration decisions, employment status, etc. Many other applications for empirical testing follow.[13] And as a final argument against scepticism on using hypothetical data: Binswanger (1981) reports absence of significant difference in his analytical results between individuals participating in an experiment with real money or only playing a hypothetical game.

The robustness of our results is perhaps remarkable against the backdrop of all the problems, variability and inconsistencies outlined in the experimental literature on decision making under uncertainty. The experimental literature does not, as we do, aim for

[13] Farrell and Walker (1996) find that women participate less frequently in actual lotteries than men.

characterising the population by risk attitude. It seeks to answer, deeper, perhaps preceding, questions. But we take from that literature that we should do more work on the robustness of our results under different phrasing and framing of the question (e.g. not just a plain lottery, but a choice among alternatives in a labour market setting) and in particular study the correlation among individual results in different specifications. Perhaps it would also be interesting to put the variables in the context of prospect theory rather than expected utility theory, thereby benefitting from its greater flexibilty.

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Appendix Table 1a Distribution of lottery reservation price ë; Brabant survey

ë	Frequency
0	249
1	141
2	56
3	14
5	135
7	1
10	583
12	2
15	14
20	11
25	362
50	116
60	1
75	5
80	1
99	1
100	198
110	6
120	1
125	4
150	5
200	9
250	3
500	2
no response	91
total	2011

Appendix Table 1b Distribution of lottery reservation price ë; Accountants survey

e	Frequency
0	140
1	25
2	1
3	2
5	36
9	1
10	171
15	8
20	5
25	184
35	2
40	5
45	1
50	220
55	1
60	1
63	1
70	1
75	24
80	6
90	7
95	1
99	6
100	491
101	1
105	1
110	9
120	2
125	12
150	44
175	1
200	38
250	8
300	2
400	1
500	1
1000	4
no response	135
Total	1599

Appendix Table 1c Distribution of lottery reservation price ë; GDP data

ë	Frequency	ë	Frequency
0	1051	210	1
1	202	220	1
2	210	225	1
3	38	250	379
4	8	256	1
5	709	260	1
6	4	275	1
7	39	300	109
8	3	325	1
10	2094	333	1
12	16	350	18
13	1	360	1
15	296	375	1
17	3	400	74
18	1	420	1
20	340	425	1
25	2511	450	10
26	1	480	1
27	5	490	3
30	149	495	1
35	29	499	1
40	63	500	489
45	5	510	2
50	1644	525	3
52	1	550	6
55	1	575	2
60	21	600	12
65	3	650	2
70	6	700	4
75	141	750	10
80	13	800	1
85	1	1000	30
90	4	1009	1
100	1731	1375	1
120	1	1500	1
125	49	2000	2
150	187	2500	1
160	1	2502	1
170	1	3500	1
175	2	5000	4
180	3	no response	3870
200	458	Total	17 097

Note: t-values in parentheses; ** significant at 5% * at 10%

Appendix Table 2 Response to the lottery question (reservation price ë); GDP data

	lottery	missing	N	ë=0	E(L)[b]	mean	standard deviation
a	L (M,10)	2753	6706	732	495	67.71	121.18
c	L (M,5)[a]	1595	7864	403	990	120.65	256.81
b	L (1000,5)	1594	7865	406	200	50.81	95.46
e	L (1000,100)	2011	7448	518	10	11.46	25.02
d	L (5000,10)	1603	7856	404	500	89.98	155.65
f	L (1.000.000,100)	1996	7463	0	10000	313.00	1320.73

		averse	neutral	loving
a	L (M,10)	68.3	0.0	31.7
c	L (M,5)	80.5	0.0	19.5
b	L (1000,5)	77.7	4.6	17.7
e	L (1000,100)	35.3	29.4	35.3
d	L (5000,10)	79.1	3.6	17.3
f	L (1.000.000,100)	78.4	0.8	20.8

[a] Two cases, with ñ > 100, have been deleted.
[b] For M lotteries, we take the expectation as probability of winning times mean monthly wage
Only observations for which monthly wage is available.

Figure 1. The value of lottery ticket

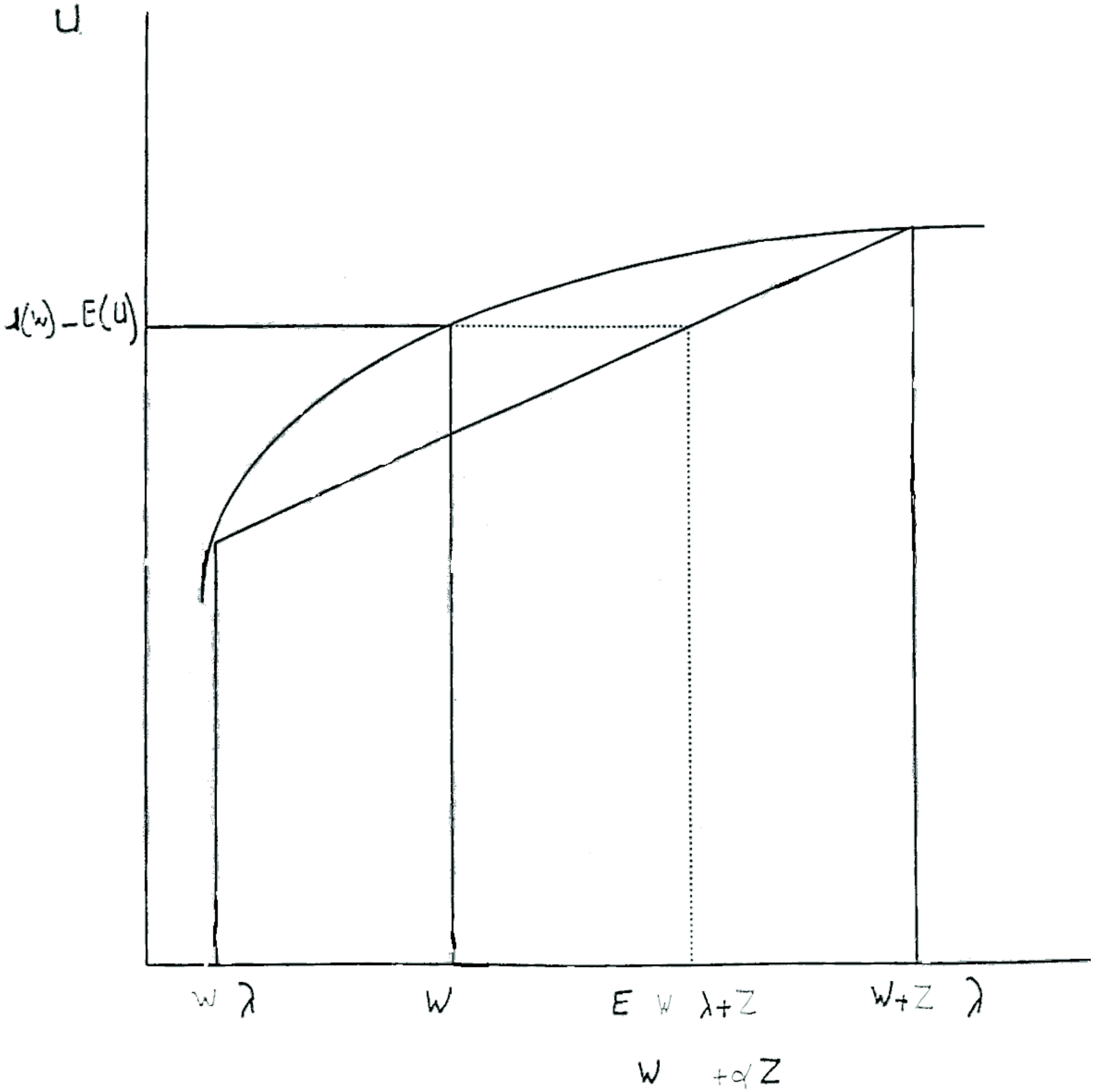

Figure 2   Risk aversion against price lottery ticket