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## RISK AVERSION, WEALTH AND BACKGROUND RISK

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# RISK AVERSION, WEALTH AND BACKGROUND RISK

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# ABSTRACT

## Risk Aversion, Wealth and Background Risk*

We use household survey data to construct a direct measure of absolute risk aversion based on the maximum price a consumer is willing to pay to enter a lottery. We relate this measure to consumers' endowment and attributes and to measures of background risk. We find that risk aversion is a decreasing function of endowment – thus rejecting CARA preferences – but that the elasticity to consumption is far below the unitary value predicted by CRRA utility. We also find that households' attributes are of little help in predicting their degree of risk aversion, which is characterized by massive unexplained heterogeneity. Consumers' environment, however, affects risk aversion. Individuals who are more likely to face income uncertainty exhibit a higher degree of absolute risk aversion, consistent with recent theories of attitudes towards risk in the presence of uninsurable risks. We also find that risk attitudes have considerable predictive power over several household decisions, including occupation and portfolio choice, moving decisions and health status.

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Keywords: background risk, heterogeneous preferences, prudence, risk aversion

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# NON-TECHNICAL SUMMARY

This Paper offers evidence on the relation between absolute risk aversion, on the one hand, and the level of resources and background risk, on the other. We use data from the 1995 wave of the Bank of Italy Survey of Household Income and Wealth (SHIW), which collects information on household willingness to pay for a lottery, and on the subjective probability distribution of future earnings, in addition to household characteristics, wealth, income and consumption. The responses to the lottery question allow us to recover a measure of the Arrow-Pratt degree of absolute risk aversion and relate it to indicators of consumers' endowment and employment-related risk, as well as to a set of demographic characteristics that control for individual preference heterogeneity.

The relationship between a consumer's attitude towards risk, as indicated, for instance, by the degree of absolute risk aversion or of absolute risk tolerance, and wealth is central to many fields of economics. As was argued by Arrow as long as 35 years ago, 'the behavior of these measures as wealth varies is of the greatest importance for prediction of economic reactions in the presence of uncertainty'. How risk aversion varies with wealth, whether it increases or decreases and its curvature affects consumers' decisions in a variety of situations. Common sense, introspection, casual observation of behavioural differences between the rich and the poor, and *a priori* reasoning have all been used to draw conclusions on the nature of the relationship. The consensus view is that absolute risk aversion should decline with wealth. Furthermore, if one agrees that preferences are characterized by constant relative risk aversion – a property of one of the most commonly used utility functions, the isoelastic – then absolute risk aversion is decreasing and convex in wealth, while risk tolerance is increasing and linear. Yet, only very indirect evidence is available on the sign of the relationship between risk aversion or tolerance and wealth and none is available, even indirect, on the curvature of this relationship. The latter has been shown to be relevant in a number of contexts. For instance, the curvature of absolute risk tolerance with respect to consumption may determine whether the portfolio share invested in risky assets increases or decreases over the consumer life cycle, an issue that is receiving increasing attention. Moreover, if risk tolerance is concave, wealth inequality can help elucidate the risk premium puzzle. Furthermore, the curvature of risk tolerance and the nature of risk aversion may explain why the marginal propensity to consume out of current resources, rather than being constant, declines as the level of resources increases.

The usual definition of risk aversion and tolerance developed by Arrow and Pratt is based on the assumption that initial wealth is non-random. It is also constructed in a static setting or in settings where full access to the credit market is assumed. Recently it has been shown that under certain conditions

on preferences that make the consumers' endowment risky, assuming that this risk cannot be diversified away (what is known as background risk), consumers behave in a more risk-averse manner. This has relevant behavioural implications as it implies that individuals will react to background risk by reducing their exposure to avoidable risks. One important consequence is that individuals facing high exogenous labour income risk – which is normally uninsurable – will avoid exposure to portfolio risk by holding less or no risky assets, which may explain why so few households hold stock.

Out of 3,458 individuals who were willing to participate in the hypothetical lottery the great majority (96%) turn out to be risk averse; 144 individuals – the remaining 4% – are either risk neutral or risk lover. Among the group of risk-averse consumers the cross-sectional distribution of the degree of relative risk aversion (obtained by multiplying our measure of absolute risk aversion by household consumption), is right-skewed and the median of relative risk aversion is 4.8. This is somewhat higher than the commonly cited value of 3, but with considerable heterogeneity ranging from 0.2 to 36.3. Furthermore, 90% of the cross-sectional distribution comprises of between 2.2 and 9.9, with 56% of the households falling in the range 2.5–6.5. These figures are far from the high values of relative risk aversion that would be necessary to resolve the equity premium puzzle.

Formal regression analysis shows that absolute risk aversion is a decreasing function of consumers' resources, while risk tolerance is increasing and concave: thus, we reject both CARA and CRRA preferences. Our characterization of preference implies decreasing absolute risk aversion and increasing relative risk aversion. We show that this type of preferences can help explain some portfolio puzzles and that they are consistent with preference parameters estimated from Euler equations for consumption. Consistent with recent theories, aversion to risk is higher among consumers who face more background risk, proxied by the variance of shocks to GDP in the province where consumers live. Our estimates also show that exogenous consumer attributes, such as their year of birth and number of siblings, have very little explanatory power on their attitude to bear risk. This is also unaffected by past unfortunate events – such as spells of unemployment – and the risk aversion of the father. Exceptions are the consumer gender, with males being less risk-averse than females, and the region of birth, which can have some predictive power on risk attitudes. Our estimates show, however, that these variables, taken together, can only explain a small amount of the sample variability in attitudes towards risk. Even after controlling for individual characteristics, endowment and background risk, there remains a large amount of unexplained variation reflecting partly genuine differences in tastes. We also find that our measure of attitude towards risk has considerable explanatory power on a number of household decisions including occupation and moving/staying choices, the demand for risky financial assets, insurance and health status. For instance, increasing the degree of risk aversion by one standard deviation lowers the probability of being self-employed by 1.6

percentage points (9% of the sample share of self-employed) but increases the probability of being in the public sector by 2% (corresponding to 7.5% of the unconditional probability). More risk-averse consumers have a 1.1% lower chance of holding risky securities (7.5% of the sample mean), a 2% lower probability of being a mover, a 1.4% probability of changing job at least once and a 1% lower chance of incurring a chronic disease.

# 1 Introduction

The relationship between a consumer's attitude towards risk, as indicated for instance by the degree of absolute risk aversion or of absolute risk tolerance, and wealth is central to many fields of economics. As it was argued by Kenneth Arrow as long as 35 years ago "the behavior of these measures as wealth varies is of the greatest importance for prediction of economic reactions in the presence of uncertainty" (p.35).

Most of the inference on the nature of this relation is based on common sense, introspection, casual observation of behavioral differences between the rich and the poor and a priori reasoning and concerns the sign of the relation, whereas no evidence at all, even indirect, is available on its curvature. The consensus view is that absolute risk aversion should decline with wealth.[1] Furthermore, if one agrees that preferences are characterized by constant relative risk aversion - a property of one of the most commonly used utility functions, the isoelastic - then absolute risk aversion is decreasing and convex in wealth, while risk tolerance is increasing and linear. The curvature of absolute risk tolerance has been shown to be relevant in a number of contexts. For instance, Gollier and Zeckhauser (1997) show that it determines whether the portfolio share invested in risky assets increases or decreases over the consumer life cycle, an issue that is receiving increasing attention. Moreover, if risk tolerance is concave, wealth inequality can help elucidate the risk premium puzzle (Gollier, 2001). Furthermore, the curvature of risk tolerance and the nature of risk aversion may explain why the marginal propensity to consume out of current resources, rather than being constant, declines as the level of resources increases (Carroll and Kimball (1996), Gollier (2001)).

The aim of this paper is to provide empirical evidence on the nature of the relationship between risk aversion and wealth. Using data from the Bank of Italy Survey of Household Income and Wealth (SHIW), we employ the information on household willingness to pay for a lottery to recover a measure of the Arrow-Pratt index of absolute risk aversion and relate it to indicators of consumers' endowment, as well as to a set of demographic characteristics to control for individual preference heterogeneity.

The usual definition of risk aversion and tolerance developed by Arrow (1970) and Pratt (1964) is based on the assumption that initial wealth is non-random. It is also constructed in a static setting or in settings where

[1] It is on these grounds that quadratic and exponential utility, though often analytically convenient, are regarded as misleading representations of preferences.

full access to the credit market is assumed. Recently it has been shown that attitudes towards risk can be affected by the prospect of being liquidity-constrained and by the presence of additional uninsurable, non-diversifiable risks. Gollier (2000) shows that the possibility that consumers will be subject to a liquidity constraint in the future makes them less willing to bear risk presently, i.e. increases their risk aversion. Pratt and Zeckhauser (1987), Kimball (1993) and Eekhoudt, Gollier and Schlesinger (1996) establish a set of conditions on preferences that define classes of utility functions whose common feature is that the presence of background risk makes the individual behave in a more risk-averse manner. They call these classes of utility functions "proper", "standard" and "risk vulnerable", respectively.[2] The main implication is that even if risks are independent, individuals will react to background risk by reducing their exposure to avoidable risks. One important consequence is that individuals facing high exogenous labor income risk - which is normally uninsurable - will be more risk-averse and thus avoid exposure to portfolio risk by holding less or no risky assets. Similarly, they should tend to buy more insurance against the risks that are insurable (Eekhoudt and Kimball (1992))[3]. Furthermore, insofar as income risk evolves with age, under standardness, background risk may help explain the life cycle of asset holdings. Several papers have cited background risk and risk vulnerability (or standardness) to explain the portfolio puzzles.[4] In all these studies, standardness or risk vulnerability is just assumed, but it is not tested because of lack of evidence on individual risk aversion.

The evidence presented in this paper sheds light also on the empirical relevance of these concepts. The availability of information on the subjective

[2] Pratt and Zeckhauser (1987) define as "proper" the class of utility functions that ensure that introducing an additional independent undesirable risk when another undesirable one is already present makes the consumer less willing to accept the extra risk. Kimball defines as "standard" the class of utility functions that guarantee that an additional independent undesirable risk increases the sensitivity to other loss-aggravating ones. Starting from initial wealth $w$, a risk $\widetilde{x}$ is undesirable if and only if it satisfies $Eu(w - \widetilde{x}) \leq u(w)$, where $u(w)$ is an increasing and concave utility function. A risk $\widetilde{x}$ is loss-aggravating if and only if it satisfies $Eu'(w + \widetilde{x}) \geq u'(w)$ . When absolute risk aversion is decreasing, every undesirable risk is loss-aggravating, but not every loss-aggravating risk is undesirable. See Kimball (1993) and Gollier and Pratt (1996). Finally, Eeckhoudt, Gollier and Schlesinger (1996)'s risk vulnerability implies that adding a zero-mean background risk makes consumers more risk averse.

[3] Guiso, Jappelli and Terlizzese (1996) find that households facing greater earnings risk buy less risky assets; Guiso and Jappelli (1998) show that households buy more liability insurance in response to earnings risk.

[4] See Weil (1992), Gollier and Zeckhauser (1997), Gollier (2000), Coco et al. (1998), Heaton and Lucas (2000).

probability distribution of future earnings allows us to relate our index of risk aversion to indicators of employment-related risk.

Our findings show that absolute risk tolerance is an increasing and concave function of consumers' resources: thus, we reject both CARA and CRRA preferences. Furthermore, we find that, when income risk is proxied by the variance of shocks to GDP in the province where consumers live, risk aversion is positively affected by background risk. Our estimates, however, show that these variables can only explain a small amount of the sample variability in attitudes towards risk. Even after controlling for individual characteristics there remains a large amount of unexplained variation reflecting partly genuine differences in tastes. We also find that our measure of attitude towards risk has considerable explanatory power on a number of household decisions including occupation and moving/staying choices, the demand for risky financial assets, insurance and health status.

The rest of the paper is organized as follows. Section 2 describes our measure of risk aversion when wealth is non-random and when there is background risk. Section 3 presents descriptive evidence on absolute risk aversion in our cross-section of households. In Section 4 we discuss the empirical specification we use to relate absolute risk aversion to the consumer endowment, his attributes and then to his environment. Section 5 presents the results of the estimates. In Section 6 we check the robustness of the main findings to the endogeneity of consumption and wealth, non-responses and the possible presence of outliers. Section 7 presents evidence regarding the effects of background risk on the propensity to bear risk. In Section 8 we characterize empirically the regime of the attitude towards risk to which households belong (i.e. whether they are risk-averse or either risk-neutral or risk lovers). Section 9 provides evidence on whether risk attitudes help predict consumers choices. Section 10 discusses the consistency with observed behavior of our findings on the shape of the wealth-risk aversion relation. Section 11 summarizes and concludes.

## 2 Measuring risk aversion

To measure absolute risk aversion and tolerance, we exploit the 1995 wave of the Survey of Household Income and Wealth (SHIW), which is run biannually by the Bank of Italy. The 1995 SHIW collects data on income, consumption, financial wealth, real estate wealth, and several demographic variables for a representative sample of 8,135 Italian households. Balance-sheet items are end-of-period values. Income and flow variables refer to 1995.[5]

The 1995 wave has a section designed to elicit attitudes towards risk. Each participant is offered a hypothetical lottery and is asked to report the maximum price that he would be willing to pay to participate. Specifically:

> "We would like to ask you a hypothetical question that we would like you to answer as if the situation was a real one. You are offered the opportunity of acquiring a security permitting you, with the same probability, either to gain 10 million lire or to lose all the capital invested. What is the most that you are prepared to pay for this security?"

Ten million lire corresponds to just over Euros 5,000 (or roughly $5,000). The ratio of the expected gain of the hypothetical lottery to average household consumption is 16 percent; thus, the lottery represents a relatively large risk. We consider this as an advantage since expected utility maximizers behave as risk neutral individuals with respect to small risks even if they are risk-averse to larger risks (Arrow, 1970). Thus, facing consumers with a relatively large lottery represents a better strategy to eliciting risk attitudes.[6] The interviews are conducted personally at the consumer's home by professional interviewers. In order to help the respondent understand the question, the interviewers show an illustrative card and are ready to provide explanations. The respondent can answer in one of three ways: a) declare the maximum amount he is willing to pay to participate, which we denote $Z_i$; b) don't know; c) unwilling to answer.

Clearly, $Z_i < 10$ million lire, $Z_i = 10$, and $Z_i > 10$ million lire imply risk aversion, risk neutrality and risk loving, respectively. This characterizes attitudes towards risk qualitatively. But we can do more; a measure of the Arrow-Pratt index of absolute risk aversion can be obtained for each consumer. Let $w_i$ denote household $i's$ endowment, which for a moment is assumed to be non-random. Let $u_i(\cdot)$ be its utility function and $\widetilde{P}_i$ be the random prize of the lottery for individual $i$, taking values 10 million and $-Z_i$ with equal probability. The maximum entry price is thus given by:

[5] See the appendix for a detailed description of the survey contents, its sample design, interviewing procedure and response rates.

[6] In this vein, Rabin (2000) argues that if an expected utility maximizer refuses a small lottery at all levels of wealth than he must exibit clearly unrealistic levels of risk aversion when faced with large-scale risks. This again suggests that offering large lotteries is a better way to characterize the risk aversion of expected utility maximizers.

$$u_i(w_i) = \frac{1}{2}u_i(w_i + 10) + \frac{1}{2}u_i(w_i - Z_i) = Eu_i(w_i + \widetilde{P}_i) \quad (1)$$

where $E$ is the expectations operator. Taking a second-order Taylor expansion of the right-hand side of (1) around $w_i$ gives:

$$Eu_i(w_i + \widetilde{P}_i) \approx u_i(w_i) + u_i'(w_i)E(\widetilde{P}_i) + 0.5u_i''(w_i)E(\widetilde{P}_i)^2 \quad (2)$$

Substituting (2) into (1) and simplifying we obtain:

$$R_i(w_i) \approx -u_i''(w_i)/u_i'(w_i) = 4(5 - Z_i/2)/\left[10^2 + Z_i^2\right] \quad (3)$$

Equation (3) uniquely defines the Arrow-Pratt measure of absolute risk aversion in terms of the parameters of the lottery in the survey. Absolute risk tolerance is defined by $T_i(w_i) = 1/R_i(w_i)$. Obviously, for risk-neutral individuals (i.e. those reporting $Z_i = 10$, implying that the expected loss is equal to the expected gain), $R_i(w_i) = 0$ and for the risk-prone (those with $Z_i > 10$, so that the expected loss exceeds the expected gain), $R_i(w_i) < 0$. According to (3) absolute risk aversion may vary with consumer endowment and with all the attributes that are correlated with his preferences. A few comments on this measure and on how it compares with those used in other studies are in order. First, our measure requires no assumption on the form of the individual utility function, which is left unspecified. Second, it is not restricted to risk-averse individuals but extends to the risk-neutral and the risk lovers. Third, our definition provides a point estimate, rather than a range, of the degree of risk aversion for each individual in the sample. These features mark a difference between our study and that of Barsky, Juster, Kimball and Shapiro (1997) who only obtain a range measure of (relative) risk aversion and a point estimate under the assumption that preferences are strictly risk-averse and utility is of the CRRA type. More, their sample consists of individuals aged 50 or above, which makes it hard not only to study the age profile of risk aversion but also to test its relationships with background risk since this is likely to matter most for the young.[7] The study

[7] However, the Barsky et al. measure of risk aversion has other advantages. Since the risk tolerance question is asked in both wave I and II of the survey they use and a subset of the respondents is common to both waves, they can account for measurement errors in their measure of relative risk aversion. Furthermore they collect information on intertemporal substitution and can thus study its relation with risk aversion. But they have no direct information on background risk.

of this relationship is instead one of the aims of this paper.

## 2.1 Risk aversion with background risk

The measure of risk aversion in (3) is for non-random initial wealth, but it is easily generalized to the case of background risk using the results of Kihlstrom, Romer and Williams (1981) and Kimball (1993). For this purpose we have to restrict the analysis to risk-averse individuals (i.e. those reporting $Z_i < 10$).

Let $\widetilde{y}_i$ denote a zero-mean background risk for individual $i$, whose variance is $\sigma^2$ . Denoting with $E_x$ $(x = y, P)$ the expectation with respect to the random variable $\widetilde{x}$, our indifference condition for undertaking the lottery and paying $Z_i$ becomes

$$E_y u_i(w_i + \widetilde{y}_i) = E_P E_y u_i(w_i + \widetilde{y}_i + \widetilde{P}_i) \tag{4}$$

where we have implicitly assumed that the background risk and the lottery are independent, which is assured by construction. If preferences are risk-vulnerable as in Gollier and Pratt (1996), we can use the equivalence:

$$E_y u_i(w_i + \widetilde{y}_i) = v_i(w_i) \tag{5}$$

where $v_i(w_i)$ is a concave transformation of $u_i$, which implies that $v_i(w_i)$ is more risk-averse than $u_i(w_i)$. In other words, if consumers $h$ and $j$ are both risk-averse and their preferences are risk-vulnerable, then, assuming $w_j = w_{h,}$ $h$ is more risk-averse than $j$ if $\widetilde{y}_h$ is riskier than $\widetilde{y}_j$, i.e. if he faces more background risk.[8]

We can thus account for background risk by expressing our measure of risk aversion in terms of the utility function $v_i(w_i)$ to get

$$R_i(w_i) \approx -v_i''(w_i)/v_i'(w_i) = 4(5 - Z_i/2)/\left[10^2 + Z_i^2\right] \tag{6}$$

[8] Preferences are said to be risk-vulnerable if the presence (or the addition) of an exogenous zero-mean background risk increases the aversion to any other independent risk. An alternative, but slightly more restrictive, preference property leading to analogous behavior is "standardness", developed by Kimball (1993). Standardness corresponds to vulnerability with respect to the set of risks that are marginal-utility increasing.

Risk aversion will now vary not only with the consumer's endowment and attributes but also with any source of uncertainty characterizing his environment. If measures of the latter are available, one can directly test for standardness of preferences.

Interestingly, the shape of the relation between $R$ (or risk tolerance) and $w$ can have implications for the sign of the effect of background risk on absolute risk aversion. Hennessy and Lapan (1998) show that a positive and concave relation of risk tolerance with wealth is sufficient for preferences to be standard as in Kimball (1993). Similarly, Eekhoudt, Gollier, and Schlesinger (1996) show that a sufficient (but not necessary) condition for absolute risk aversion to increase with background risk is that it is a decreasing and convex function of the endowment, an assumption that is satisfied, for instance, by CRRA utility. Gollier and Pratt (1996) argue that the convexity of absolute risk aversion should be regarded as a natural assumption[9], ".. since it means that the wealthier an agent is, the smaller is the reduction in risk premium of a small risk for a given increase in wealth". Though plausible, this assertion is not backed by any empirical evidence. Our results lend support to this conjecture in that they imply that absolute risk aversion is a convex function of the endowment.

## 3 Descriptive evidence

The lottery question was submitted to the whole sample of 8,135 household heads, but only 3,458 answered and were willing to participate. Out of the 4,677 who did not, 1,586 reported a "do not know" and 3,091 overtly refused to answer or to participate with positive price (25 bet more than 20 millions). This is likely to be due to the complexity of the question, which might have led some participants to skip it altogether because of the relatively long time required to understand its meaning and to provide an answer.[10]

Table I reports descriptive statistics for the whole sample of 8,135 households, for the sample of 3,458 lottery respondents and, for the latter, for

[9] Notice that if consumers are risk-averse at all levels of wealth and if absolute risk aversion is a strictly decreasing function of wealth, then absolute risk aversion must be convex in wealth.

[10] On the basis of these considerations and of the actual amounts reported (relative to the values reported for household wealth) it is likely that some respondents misunderstood the question and gave erroneous answers. In Section 4, we argue that measurement error due to misunderstanding of the lottery question is unlikely to affect the consistency of our analysis.

several sub-samples. Out of 3,458 individuals willing to participate in the lottery the great majority (96 percent) are risk averse, in that they report a maximum price lower than the prize of the lottery; 144 individuals are either risk neutral (125, or 3.6 percent of the sample), or risk lover (19, only a tiny minority). The table reports characteristics also for these three sub-samples. Those who responded to the lottery question are on average 6 years younger than the total sample and have higher shares of male-headed households (79.8 compared to 74.4 percent), of married people (78.9 and 72.5 percent respectively), of self-employed (17.9 and 14.2 percent) and of public sector employees (27.5 and 23.3 percent respectively). They are also somewhat wealthier and slightly better educated (1.3 more years of schooling). These differences seem to suggest that there are some systematic effects explaining the willingness to respond. At the same time, however, the small difference in education between the total sample and the sample of respondents seems to suggest that - in so far as education is also a proxy for better understanding - non-responses can be ascribed only partly to differences in the ability to understand the question.[11]

The two sub-samples of risk-lovers and risk-neutrals on the one hand and risk-averse consumers on the other, exhibit several interesting differences. For most characteristics the pattern has a clear ordering with the highest (or lowest) value for the risk-lovers-risk- neutrals and the lowest (or highest) for the risk-averse. Risk averse are younger and less educated; they are less likely to be male, to be married and to live in the North. Strong differences also emerge comparing the type of occupation: among the risk averse the share of self-employed is 17.4 percent, among the risk-prone or risk neutral it is much higher at 29.2 percent. This ordering is reversed for public sector employees. The risk-lovers and risk-neutral are public employees in 27 percent of the cases, while the risk-averse in 28 percent. These differences are likely to reflect self-selection, with more risk averse individuals choosing safer jobs. Finally, notice that the risk-averse are significantly less wealthy than the risk-lovers or neutrals (170 million lire of median net worth compared to 330 million). In Section 9 we will return to the relation between risk attitude and the level of wealth.

Figure 1 focuses on the group of risk-averse consumers and shows the cross-sectional distribution of the degree of relative risk aversion, obtained by multiplying our measure of absolute risk aversion by household consumption.

[11] A probit regression suggests that the probability of responding to the lottery question is higher among younger, more educated, healthy, male-headed households. Single persons are less likely to respond. In addition, the response probability is higher among public employees and depends positively on the number of earners.

The distribution is right-skewed and the median of relative risk aversion is 4.8, somewhat higher than the commonly used value of 3, but with considerable heterogeneity ranging from 0.2 to 36.3. Furthermore, 90 percent of the cross-sectional distribution is comprised between 2.2 and 9.9, with 1,878 households (56 percent) falling in the range 2.5-6.5. As we will see, most of this variability cannot be explained by any observable characteristics.

Table I also reports also the characteristics of the modestly risk-averse consumers (at or below the sample median of the reported price $Z_i$) and of the high risk-averse (above median). Highly risk-averse consumers are on average two-year older, somewhat less well educated, less likely to be married and much more likely to live in the South. They are also less wealthy than the modestly risk-averse, both in terms of net worth, financial wealth and consumption (the median net worth of the two groups is 154.9 and 198.5 million lire respectively). Finally, the share of the self-employed is 15.6 percent for the highly risk-averse and 20.1 percent for the modestly risk averse, but that of public sector employees is 28.3 and 26.3 percent. Thus, being risk-averse as opposed to risk-lover or risk-neutral, as well as differences in the degree of risk aversion seem to explain sorting into riskier occupations.

## 4 Empirical Specification

Most of the literature assumes that agents are risk averse and is interested in assessing how risk aversion varies with the consumer's attributes and in particular with his endowment. Accordingly, the next four sections focus on risk-averse individuals. In Section 8 we look at the determinants of the regime of risk attitudes.

To estimate the relation between our index of absolute risk aversion and consumption or wealth we use the following specification (we omit the household index $i$ for brevity) :

$$R(c) = \frac{ae^{\gamma H+\eta}}{c^{\beta}} = \frac{\kappa}{c^{\beta}} \tag{7}$$

where $c$ is consumption, $H$ is a vector of consumer characteristics affecting individual preferences, $\eta$ is a random shock to preferences, $a$ is a constant and $\gamma$ and $\beta$ are two unknown parameters.[12] Equation (7) is a generalization of absolute risk aversion under CRRA preferences; the latter obtain when $\beta = 1$ in which case $\kappa = ae^{\gamma H+\eta}$ measures relative risk aversion. Notice that $R(\ )$ is always positive and is decreasing in $c$ for all positive values of $\beta$. Furthermore, if $\beta > 0$, it is always convex in $c$. Though simple, this formulation is flexible enough to allow us to analyze the curvature of absolute risk tolerance, which is defined as:

$$T(c) = \kappa^{-1} c^{\beta}. \tag{8}$$

Thus, if $\beta > 0$, risk tolerance is an increasing function of $c$; furthermore, it will be concave, linear or convex in $c$ depending on whether $\beta$ is less than, equal to or greater than 1. Since $\beta$ measures the speed at which $R()$ declines with wealth, $T()$ is a concave (respectively convex) function of $c$ if absolute risk aversion falls as consumption increases at a speed lower (respectively greater) than that characterizing CRRA preferences. Since most theoretical ambiguities rest on the curvature of $T$, not $R$, our approach is not restrictive.

Although equation (7) is assumed, a utility function that gives rise to a measure of absolute risk aversion as in (7) is

$$u(c) = \int e^{-\frac{ae^{\gamma H+\eta} c^{1-\beta}}{1-\beta}} = \int e^{-\frac{\kappa c^{1-\beta}}{1-\beta}} \tag{9}$$

which converges to the CRRA utility $u(c) = \frac{c^{1-\kappa}}{1-\kappa}$ as $\beta$ tends to 1.

Taking logs on both sides of (7), our empirical specification becomes:

$$\log(R) = \log a + \gamma H - \beta \log c + \eta \tag{10}$$

The relation between absolute risk aversion and consumption as well as the curvature of absolute tolerance is thus parameterized by the value of $\beta$.

As pointed out earlier, when background risk, $\widetilde{y}$, is present our measure of risk aversion must be interpreted as measuring the risk aversion of the

[12]Notice that our empirical specification (7) does not allow for heterogeneity in the $\beta$ parameter. If $\beta$ varies across individuals our estimates would be affected by heteroschedasticity. However, a formal test cannot reject the null hypothesis that the error term is homoschedastic.

indirect utility function $v(c) = Eu(c+\widetilde{y})$. The question that arises is whether we can draw implications for the relation between the risk aversion of $u()$ and the level of the endowment from the relation between the risk aversion of $v()$ and the endowment.[13] In the Appendix we show that taking a second order Taylor expansion of the indirect utility function around $c$, yields the following index of the absolute risk aversion of this approximated utility:

$$R_v(c,s) = \kappa c^{-\beta}[\frac{1+p_u t_u s^2/2}{1+p_u r_u s^2/2}]$$

where $\kappa$ is a constant, $s$ is the coefficient of variation of the consumer's endowment and $r_u$, $p_u$ and $t_u$ denote, respectively, the degree of relative risk aversion, relative prudence and relative tolerance of the utility function $u()$.[14] Notice that $\kappa c^{-\beta}$ is the absolute risk aversion of $u()$ and that $R_v(c,s) > \kappa c^{-\beta}$ if, given $s > 0$ and assuming the consumer is prudent (i.e. $p_u > 0$), relative risk tolerance is larger than relative risk aversion. Furthermore, since the term in square brackets is increasing in $s$, $R_v()$ too is increasing in $s$. Taking logs and using the relations between $r_u$, $p_u$, and $t_u$ spelled out in the Appendix, when there is background risk our empirical specification becomes

$$\log(R_v) = \log k - \beta \log c + \delta s^2 + \eta \tag{11}$$

where $\delta = \beta p_u$. This formulation allows to test directly whether background risk affects risk attitudes. It requires two conditions to hold: consumers must be prudent ($p_u > 0$) and risk aversion must be decreasing ($\beta > 0$).

# 5 Results

Table II shows the results of the estimation of equation (10) using different measures of consumer resources. The analysis is conducted on the sample of risk-averse consumers. Possible misinterpretations of the survey question, as well as difficulties in figuring out the maximum price to be paid suggest

[13]The indirect utility function inherits several properties of $u()$. In particular, if $u()$ is DARA then also $v()$ is DARA. Furthermore, as shown by Kihlstrom, Romer and Williams (1981), comparative risk aversion is preserved by the indirect utility if $u()$ is non-increasing risk aversion

[14]See the Appendix for the definition of relative prudence and tolerance.

that the left-hand-side variable, $R$, is likely to suffer measurement error. This will be reflected in the residual $\eta$ but, in so far as it is uncorrelated with the explanatory variables in equation (10), it will not lead to bias but only to a loss of efficiency.

In the first column of the Table we regress $log(R_i)$ only on (log) consumption and do not include any consumers characteristics that can proxy for differences in tastes. As a measure of consumption we use total expenditure on durable and non-durable goods. Since preliminary estimates show that OLS residuals are far from being normal, we report boostrapped standard errors computed with 100 replications. The estimate of $\beta$ is 0.0902 and is highly statistically significant leading to the rejection of preferences with constant absolute risk aversion. The estimated value of $\beta$ implies that absolute risk aversion declines with wealth but at a rate that is far slower than that implied by constant relative risk aversion preferences. In fact, the hypothesis that $\beta = 1$ can be strongly rejected ($F$ =5,039.47). It follows that absolute risk tolerance is a concave function of consumer resources.

In the second column of the table we include a set of strictly exogenous individual characteristics, such as gender, age, region of birth and number of siblings. If tastes are impressed in our chromosomes or evolve over life in a systematic way or are affected by the culture of the place of birth or by the possibility of relying on the support of a brother or sister, then these variables should have predictive power. The analysis shows that only age and the region of birth in fact do, with risk aversion increasing with age. Being male has a negative effect on the degree of risk aversion but it is not statistically significant. Furthermore, a test of the hypothesis that the coefficients on gender, age and number of siblings are jointly equal to zero cannot be rejected at the standard levels of significance ($F = 3.63$, $p$-value = 0.0124). Finally, the joint significance of the 19 regional dummies[15] included in the regression, capturing the region of birth, cannot be rejected (see the bottom of Table II). Furthermore, the coefficients on these dummies (not shown) reveal a pattern: compared to those born in the central and southern regions, consumers born in the North are somewhat less risk-averse. One possible interpretation is that the dummies are capturing regional differences in culture, which are transmitted by the upbringing. In addition to these variables, we insert in the regression also a dummy equal to one if the consumer has ever experienced unemployment or temporary layoffs and two

[15] The Italian territory is divided into 20 regions and 95 provinces. The latter correspond broadly to US counties. We will use the provincial partitioning in Section 7 where we look at the effect of background risk and liquidity constraints on risk aversion.

dummies for his father occupation: the first dummy is equal to 1 if the consumer's father is/was a self-employed (zero otherwise); the second dummy is equal to 1 if he is/was a public sector employee (zero otherwise). This allows us to test to what extent unfortunate past events, such as experiences of unemployment spells and temporary layoffs, affect one's willingness to undertake risk in the future and to check whether parents attitudes towards risk - as reflected in their occupation choice - are transmitted to their children. The estimates show that none of these variables has a significant effect on the degree of risk aversion. Yet, as we show in Section 9 the degree of risk aversion has considerable explanatory power on the occupation choice of the consumer. In turn, the occupation choice is strongly affected by the parents occupation, implying strong intergenerational persistence in the tradition of Galton (1869).[16] Since we find that parents' occupation has no effect on their kids attitudes towards risk, our results suggest that taste persistence across generations is unlikely to be an explanation for the observed persistence in occupation choice. Inquiring further into the role of other demographic variables such as family size or education by including them in the regression is problematic since these variables are to some extent endogenous. Thus, the interpretation of their coefficients would be unclear; accordingly we elect to focus only on this set of controls that are not subject to the respondent's choice.

The last two columns of the table show a set of results based on total and financial wealth, instead of consumption. The basic findings are confirmed: absolute risk aversion is a decreasing and convex function of wealth (total or financial) but CRRA preferences are strongly rejected. The elasticity of absolute risk aversion to total wealth and to financial wealth is lower than to consumption, but not greatly so, suggesting similar degrees of aversion to consumption, wealth and financial risk. In all cases most of the variance of observed risk aversion is left unexplained, as the low $R^2$s show, suggesting that most of the taste heterogeneity across consumers cannot be accounted for by the set of variables that we can observe. The estimated relation between absolute risk aversion and consumer resources is consistent with Arrow's (1965) hypothesis that absolute risk aversion should decrease as the endowment increases while relative risk aversion should increase: but the latter is consistent with the former only if the wealth elasticity of absolute risk aversion is less than one, as our findings indicate.

[16] In the probit regression for the decision to be self-employed (to become a public sector employee) reported in panel $A$ of Table VIII a dummy variable indicating whether the father is/was a self-employed (public sector employee) has a coefficient equal to 0.461 with a $t$-statistic equal to 7.655 (0.326, $t = 4.589$).

# 6 Robustness

## 6.1 Endogenous consumption and wealth

The results we have reported thus far do not take into account that consumption and wealth are endogenous variables which are themselves affected by consumer preferences. Thus, the estimated coefficients are potentially affected by endogeneity bias. The direction of the bias, however, is not clear a priori. If more risk-averse individuals choose safer but less rewarding prospects, they may end up being poorer and consume less than the less risk-averse. This would tend to overstate the negative relation between risk aversion and wealth. However, if the more risk averse are also more prudent, ceteris paribus, they will compress current consumption, save more and end up accumulating more assets.[17] In this case, our estimates of the relationship between risk aversion and wealth will be biased towards zero, which could partly explain why, in our estimates, risk aversion declines only slightly as wealth increases. On the other hand, the relation between risk aversion and consumption would be biased downward, implying that the true elasticity of absolute risk aversion to consumption is even less than what we obtain.

To address this issue we re-estimate equation (10) with instrumental variables. Finding appropriate instruments for consumption and wealth is no easy task. We rely on three sets of instruments. First, we rely on characteristics of the father of the household head, namely his education and year of birth, on the ground that wealth is likely to be correlated with that of one's family, proxied by the father's education and cohort. Second, we use measures of windfall gains, such as a dummy for the house being acquired as a result of a bequest or gift, the value of transfers received and an estimate of the capital gain on the house since the time of acquisition. Third, we use consumer characteristics that are likely to be correlated with wealth and consumption and are at least partly exogenous, such as education attainment and education interacted with age. Overall, the instruments explain about 30 percent of the variance of (log) consumption, almost 25 percent of the variance of (log) total wealth and about 17 percent of that of (log) financial wealth.

Table III shows the results when consumption, total wealth and financial wealth are used. We report the specification including age, gender, number

[17] Risk aversion and prudence usually go together. If the utility function is exponential, absolute risk aversion and prudence are measured by the same parameter; if it is CRRA, absolute prudence is equal to absolute risk aversion + $1/c$; if preferences are described by equation (11) absolute prudence is equal to absolute risk aversion + $\beta/c$.

of siblings, past labor market experience, occupation of the father of the household head and region of birth. Since for some consumers the information on their parents' characteristics or on some other instruments were missing the sample size is smaller by about 200 observations with respect to the OLS estimates.[18] In all cases the instrumental variables estimates result in a larger estimate (in absolute value) of the parameter $\beta$. For instance, when consumption is used as a measure of consumer's endowment the estimated $\beta$ is 0.161, almost twice as the OLS estimate. But the difference with respect to the OLS estimates does not change the previous conclusions: absolute risk aversion is a decreasing function of wealth and both CARA and CRRA preferences are rejected. Figure 2 shows the risk aversion-consumption relation when the OLS and IV estimators are used and compares these profiles to those implied by the assumption of constant relative risk aversion.

To further verify the robustness of our results, we have estimated our basic instrumental variable specification on a restricted reference sample of 2,158 households. This was obtained from the sample of risk-averse consumers by excluding households with total wealth below 20 million lire (594 observations), corresponding to twice our hypothetical lottery prize (in fact, it could be argued that responses are affected by the size of the lottery that individuals face); those who reported non-positive financial assets (147 observations),[19] (below age 21 or above age 75, 54 observations) in an attempt to take into account mis-reporting and underreporting of assets; and those who are either too young or too old on the ground that difficulties in grasping the lottery question should probably be concentrated at the two tails of the age distribution. The results based on consumption as scale variable, shown in the last column of Table III, confirm those obtained on the whole sample, shown in the first column.[20]

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[18] Differences in results between the OLS and the IV estimates are not due to differences in sample. Using OLS on the smaller sample yealds estimates of the parameters similar to those in Table III.

[19] In the survey, financial assets include also currency, in addition to bank and postal deposits and bonds and stocks.

[20] Another possibility is that the *quality* of our indicator of risk aversion depends on the size of the lottery relative to the resources of the consumer; in particular, it may be that for some consumers the lottery is too large making them unwilling to accept. Notice that the framing of the question is such that the consumer chooses the maximum loss he is willing to incur, which he can choose as small as he wishes. To address this issue further we have estimated our basic equation splitting the sample below and above median wealth. Results are very similar to those for the whole group. The OLS estimate of $\beta$ is 0.1294 for households with below median wealth and 0.1691 for those with above median wealth. Both coefficients are statistically significant but we cannot reject the hypothesis that they

### 6.2 Sample selection

One additional concern with our results, given the relatively small number who answered the lottery question, is that non-response may be systematically related to attitudes towards risk. To address this problem we have re-estimated our model using Heckman (1976) two-step estimator correcting the second stage estimates of risk aversion for selection bias. In the first-stage probit equation, we have included, in addition to gender, age, number of siblings and region of birth, a set of explanatory variables that are likely to affect willingness to participate in the survey, such as education, education interacted with age, age squared, marital status, household size, number of earners and employment sector. The results, not shown for brevity, confirm the estimates of Tables II. The Mills ratio has a small coefficient and is only statistically significant in one case, when total wealth is used as the scale variable, implying that self selection is unlikely to be a problem.

### 6.3 Quantile regressions

Finally, we check our results for departure of the distribution of residuals from symmetry by estimating least absolute deviation regressions using Amemyia (1982) two-stage estimator to account for endogeneity bias. Given the considerable heterogeneity in the measure of risk aversion, quantile regressions may help give a sense of the determinants of risk aversion for the median consumer. In addition, unlike the conditional mean, quantiles are invariant to monotonic transformations such as taking logs, as in equation (10), our empirical specification. Table IV shows the results from the estimation when consumption, total wealth and financial wealth are alternatively used to measure the endowment. The main predictions of the OLS and IV analysis reported in Tables II and III are confirmed: for the median consumer absolute risk aversion declines with endowment and the sensitivity is somewhat larger for consumption than for wealth. Furthermore, the estimates of $\beta$, though significantly different from zero (contrary to CARA preferences) are far below 1 in absolute value (rejecting CRRA utility).

## 7 Risk aversion and background risk

In a world of incomplete markets the attitude towards risk, measured by the willingness to accept a fair lottery, may vary between consumers not

are equal.

only because of differences in taste parameters but also because they face different environments. In Section 2 we have discussed how risk aversion can be affected by background risk. In this Section we test whether the attitudes towards risk are affected by the presence of uninsurable, independent risks. For this we need a measure of background risk. We use two proxies. The first is obtained from a special section of the 1995 SHIW in which households were asked a set of questions designed to elicit the perceived probability of being employed over the twelve months following the interview and the variation in earnings if employed. We use this information to construct measures of the first two moments of the distribution of future earnings following the methodology developed in Guiso, Jappelli and Pistaferri (1998). The second proxy relies on per capita GDP at the provincial level for the period 1952-1992, which we use to compute a measure of the variability of GDP in the province of residence.

As to the first measure, it is based on four questions on labor income expectations that are asked to half of the overall sample in a special section of the 1995 SHIW questionnaire. The selection of the sub-sample is random, based on whether the year of birth of the household head is even or odd. The employed and job seekers are asked to report, on a scale from 0 to 100, their chances of keeping their job or finding one in the next twelve months. Each individual assigning a positive probability to being employed is then asked to report the minimum and the maximum income he expects to earn if employed and the probability of earning less than the midpoint of the distribution of future earnings conditional on working. These data can be combined to obtain an estimate of expected earnings and their variance, which we use as a gauge of background risk. Since these questions were addressed to only half the sample and of those interviewed only 4,218 individuals (in 2,605 households) replied, when combined with the information on the lottery, we end up with a reference sample of 1,335 observations, of which 1,295 are risk-averse. The survey elicits information on the probability distribution of individual earnings, rather than household income. Since the lottery question is put to the household head, to match background risk with the risk-aversion measure we rely on heads' expectations. This raises two issues. First, for the variance of the earnings of the household head to be able to identify background risk, income risk must be exogenous. However, as we show later, the attitude towards risk affects job choice, with more risk-averse individuals choosing safer occupations. This tends to produce a negative correlation between earnings risk and risk aversion, counteracting the background-risk effect. Second, the household head's willingness to bear risk may well depend on the exposure to risk of other family members. If the head's job choice is not affected (or is only slightly affected) by the earnings risk faced by other members of the household - for instance because occupational choice takes place before meeting the spouse - then the earnings riskiness of the other members can help identify the effect of background risk. Thus, we will provide also estimates that take the variance of the earnings of the spouse and of the an additional earner in the household as explanatory variables.

Table V reports the estimation results. The first column adds to our basic specification the square of the coefficient of variation of the endowment obtained dividing the standard deviation of the earnings of the household head by household consumption. If the household head does not work, we set his or her earnings variance equal to zero. The estimated coefficient of the coefficient of variation of the earnings of the household head is statistically significant but is negative, which suggests that the self-selection effect dominates any background-risk effect. To try to identify the latter, in the second column, in addition to the household head's earnings variance, we add that of the spouse and of an additional earner scaled by the square of family consumption. If the spouse does not work, we set her or his earnings variance equal to zero. Similarly, if there is no additional earner we replace his earnings variance with a zero. Interestingly, while the own-earnings variance still carries a negative and significant coefficient, the variance of the earnings of the additional earner and of the spouse have a positive impact on the degree of risk aversion, consistent with the background risk explanation. Their precision, however, is too low to permit conclusions. Furthermore, if occupational choices within the household are a collective decision, the riskiness of the occupation of one member may affect the job choice of another and our estimates would be biased downward.

To address this problem we use the second indicator of background risk, obtained from time series data on provincial GDP. For each province we regress the (log) GDP on a time trend and compute the residuals. We then calculate the variance of the residuals and attach this estimate to all households living in the same province. This is an estimate of aggregate risk and should be largely exogenous unless risk-averse consumers move to provinces with low variance GDP (we return to this issue shortly). The third column reports the estimates using this measure as a proxy for background risk and consumption as scale variable.[21] The degree of risk aversion is increasing in the variance of per capita GDP in the province of residence even after controlling for gender, age, number of siblings, labor market history,

[21] Notice that the dimension of this term is that of a coefficient of variation.

occupation of the father of the household head and region of birth, and the effect is highly statistically significant. This is consistent with background risk models: increasing our measure of background risk by one standard deviation increases absolute risk aversion by about 3 percent. If risk-averse individuals tend to move from high-variance to low-variance provinces this would tend to generate a negative correlation between risk aversion and background risk; thus the above is, if anything, a lower bound of the true effect of background risk. The estimates are robust to a cluster correction for province effects as well as to the use of wealth instead of consumption to measure household resources.[22] Furthermore, as shown in the fourth column they are robust to the presence of outliers: using LAD estimates, the coefficient of background risk is somewhat lower but more precisely estimated.

There is however one final concern. As shown in Section 4, the coefficient of the background risk term is $\delta = \beta p_u$; if $0 < \beta < 1$, as our analysis suggests, then $p_u = \beta + kc^{(1-\beta)}$ and depends on the level of consumption (see the Appendix). So far, our estimates have ignored this interaction between the level of the endowment and background risk and the implied restrictions on the parameters $\beta$ and $k$. To tackle this issue we use a non-linear instrumental variable estimator imposing the above definition of $p_u$ and relative restrictions. More specifically, we estimate the equation

$$\log R = k_0 + \delta X - \beta \log c + \beta[\beta + \exp(k_0 + \delta X)c^{1-\beta)}]s^2 + \eta \qquad (12)$$

where $X$ is a vector including the gender dummy, age, number of siblings and the dummies for labor market experience, for the occupation of the father of the household head and for the region of birth. The values of the estimated parameters are reported in the last column of Table V. The point estimate of $\beta$ is 0.187, it is highly statistically significant (standard error equal to 0.0276) and its value is slightly larger than the estimate of $\beta$ reported in column 3 (0.159).[23]

[22] When the cluster correction is used the point estimate (which is obviously unchanged) of the coefficient of the variance of the shocks to provincial GDP retains its significance. When wealth is used instead of consumption, the point estimate is somewhat greater and estimated with greater precision.

[23] One final concern with these results is that the indicator of background risk may be proxying for liquidity constraints. As argued by Gollier (2000), liquidity constraints act to reduce the consumer's horizon, thus limiting his opportunities to time diversify any risk currently taken, accentuating risk aversion. If intermediaries are more conservative in

## 8 Wealth, risk loving and risk aversion

Thus far we have limited the analysis to the determinants of the degree of risk aversion among individuals who are risk-averse. As Table I shows, while the vast majority of the sample are risk-averse, 4 percent of the respondents are not and are either willing to pay the expected value of the lottery - i.e. are risk-neutral - or are ready to pay more than the expected value - i.e. are risk lovers. In this section we look at the determinants of the regime of the attitude towards risk. To this purpose, we construct a discrete variable that is equal to 1 for the risk-averse and zero otherwise. We then estimate a probit model relating this variable to a set of observable exogenous individual characteristics and to measures of consumer endowment. Results are shown in Table VI. Past spells of unemployment, as well as the parent's attitudes towards risk (proxied by their occupation) have no predictive power on whether a person is risk averse. The risk attitude regime is also independent of age (or, equivalently, year of birth) and of the number of siblings but is strongly affected by gender, with men 3.5 percentage points less likely to be risk-averse than women, which is consistent with some of the findings of Schubert, Brown, Gysler and Brachinger (1999). Overall, the hypothesis of joint significance of the demographic characteristics cannot be rejected. Furthermore, region of birth is systematically related to being risk-averse as opposed to being risk-neutral or lover: those born in the southern regions are more likely to be risk-averse than those born in the North. However, since a large fraction of those born in an area continue to live there, the

their lending policy in provinces where income is more volatile, then the individual probability of being liquidity constrained is higher in areas with high background risk. To check this possibility, we have added to the set of explanatory variables a mesure of liquidity constraints. This is obtained by using information contained in the SHIW on individuals who have been turned down by a financial intermediary or who are discoraged borrowers (see the appendix for details). We compute the share of households in a province that are discouraged borrowers or rejected applicants by pooling the survey years 1989, 1991, 1993 and 1995 and impute to each household in a province this average as a measure of the probability of incurring into a liquidity constraint. This procedure can be justified on the grounds of systematic differences in access to credit between local credit markets. Such differences can result from differences in the degree of judicial enforcement (Generale and Gobbi, 1996), or in social capital (Guiso, Sapienza and Zingales, 2000). The credit rationing indicators based on the provincial averages exhibit considerable variation, ranging from 0.3 to 8.8 percent, with a median of 2.1 percent. Results are robust to accounting for credit constraints. The coefficient on the measure of background risk is essentially unaffected while that of the indicator of liquidity constraints is positive but is not statistically significant. In sum, this evidence suggests that background risk and liquidity constraints have an indipentend role in forging consumers willingness to bear risk.

region of birth may be picking up not only features of preferences that can be traced back to the upbringing but also the impact of the culture and tastes of the present area of residence.

The regressions in the table also include a second order polynomial in a measure of household endowment: in the first column we include the level of consumption; in the second, total wealth and in the third financial wealth. The analysis suggests that the probability of being risk-averse is high but decreasing at low values of wealth and again high and increasing for high values, whereas it is low for values of wealth in between. These results are consistent with the model of Friedman and Savage (1948), which implies that the utility function may be concave (implying risk aversion) at very low and at very high levels of wealth and convex (or perhaps linear) at intermediate levels (implying risk loving or neutrality). This hypothesis reconciles the theoretical prediction that individuals should not enter fair lotteries, and much less unfair ones, with the evidence that individuals (particularly low-income individuals) gamble and even purchase unfair lotteries. In addition, it is consistent also with the evidence that many consumers buy both lottery tickets and insurance.[24]

# 9 Predicting behavior with risk aversion

Attitudes towards risk should affect consumers' willingness to bear risk in a variety of situations. In this section we document that our measure of risk preferences does have predictive power with respect to consumer choices. If different jobs differ not only in expected return but also in the riskiness of those returns, individuals should sort themselves into occupations on the basis of their risk aversion. Similarly, the willingness to hold riskier portfolios should be lower among risk-averse consumers than among the risk-neutral or risk-prone and among the former should be lower for those who dislike risk more strongly. Similar arguments can be made for the demand for insurance, the decision to migrate, the propensity to change job and the consumer health condition in so far as it depends on how cautious a consumer is. Table VII checks these predictions.

## 9.1 Choice of occupation

Panel A of Table VII reports the results of estimating probit regressions for occupation choices. We focus on the decision to be self-employed (first two

[24]See Friedman and Savage (1948) for a thorough analysis.

columns) and to become a public sector employee (last two columns). All regressions include as controls the worker's age, number of siblings, household size and number of earners, dummies for gender, marital status, education, region of birth, homeownership and dummies for the occupation of the household's head father. The first column shows the regression for the whole sample including as explanatory variables a dummy for risk-averse consumers. The benchmark is the group of risk neutral and risk-lover consumers. Risk-averse consumers are less likely than risk-lovers and risk neutral to be self-employed, and the coefficient is statistically significant at less than the 0.5 percent level. The differences is economically relevant: being risk-averse rather than risk-lover or neutral lowers the probability of being self-employed by 11 percentage points, or 61 percent of the sample share of self-employed. This evidence suggests that self-selection is indeed an important feature and thus supports our interpretation in Section 7 of the negative correlation between the degree of absolute risk aversion and the variance of earnings. The second column restricts the sample to risk-averse households and uses as explanatory variable our measure of absolute risk aversion. Since the group of risk-lovers and neutral includes relatively few observations we feel more confident exploiting the variability in the degree of risk aversion rather then differences in the regime of attitudes towards risk. Obviously, within the class of risk-averse individuals those who are more strongly risk-averse should be less likely to choose risky jobs. This is confirmed by the estimates, which imply a negative coefficient for the degree of risk aversion: increasing absolute risk aversion by one standard deviation lowers the probability of being self-employed by 1.6 percentage points (9 percent of the unconditional probability).

The third and fourth columns estimate the probability of being a public sector employee on the whole sample and the sample of risk-averse individuals. Consistent with the general perception that public jobs are more secure,[25] our estimates show that risk-averse individuals are more likely than the risk-lovers and neutral to work in the public sector, though the coefficient is only significant at the 18 percent level. Compared with risk-prone, the risk-averse have a 1.7-point higher chance of being in the public sector (corresponding to 6 percent of the unconditional probability). Furthermore, among the risk-averse, the probability of choosing the safer occupation is an increasing function of the degree of risk aversion: increasing the latter

[25] In Italy for instance, public sector employees cannot be laid off except in a few extreme circumstances of misconduct. In addition, public sector jobs secure less variable on-the-job wages (see Guiso, Jappelli and Pistaferri, 1998).

by one standard deviation raises the probability of being a public sector employee by 2 percentage points (about 7.5 percent of the sample mean), suggesting again that risk preferences have a strong impact on job choice.

### 9.2 Asset allocation

The second panel of Table VII shows the effect of the risk attitude indicators and of the degree of risk aversion on the ownership and portfolio share of risky financial assets, i.e. private bonds, stocks and mutual funds. A second order polynomial in total financial assets is added to the right hand side controls. When estimated on the whole sample of households, the probability of holding risky financial assets (first column) is less than half as great among risk-averse consumers as among the risk-neutral and risk lovers. Compared to the latter, risk-averse investors have a 20-point lower chance of holding risky securities, corresponding to 130 percent of the sample mean (equal to 15.5 percent). Among risk-averse consumers (second column), the probability of holding risky assets is a decreasing function of our measure of absolute risk aversion, and the coefficient is precisely estimated. A one standard deviation increase in absolute risk aversion lowers the probability of holding risky assets by 1.1 percentage points (7.5 percent of the unconditional probability). The third and fourth columns report Tobit estimates of the portfolio share of risky assets (ratio of risky to total financial assets). This set of estimates confirms the probit estimates: the share invested in risky assets declines as the degree of risk aversion increases, consistent with the predictions of the classical theory of portfolio choice, and is lower among the risk-averse than among the risk-neutral and risk lovers (although the coefficient is not statistically significant).

### 9.3 Insurance demand

The third panel of Table VII reports the estimates of the effect of risk attitudes on the demand for life, health and casualty insurance, respectively. Standard insurance theory predicts that, provided that insurance premiums depart from fair pricing, more risk-averse individuals should buy more insurance. We test this prediction by focusing on the sub-sample of risk-averse individuals and estimate a Tobit model for the amount of insurance purchased (i.e. the value of insurance premiums) scaled with consumption. Second order polynomials in wealth and earnings are included among the right hand side variables. In all cases we find that more-risk averse consumers buy less insurance, and the effect is statistically significant. This finding contradicts simple models of insurance demand but is not necessarily in contrast with extended models. One possible explanation is that insurance companies are able to price-discriminate on the basis of customers' risk aversion. This would lead to higher premiums (which we do not observe and therefore cannot control for) for more risk-averse consumers, who would then reduce insurance demand. This explanation relies on risk aversion being observable. Another, perhaps more convincing, explanation is that individuals can undertake activities to self-insure against the consequences of adverse events. This leads them to replace market insurance with self-insurance. It can be shown that if market insurance is sold at highly unfair prices, while self-insurance is relatively efficient - in the sense that one extra euro of current spending results in a large reduction in the loss - an increase in risk aversion can reduce market insurance and increase self-insurance.[26]

## 9.4 Moving decisions, job changes and health status

Compared with staying in the region of birth, moving to another region entails undertaking a risky prospect. Similarly, leaving a well known job and

[26] Consider the static insurance model and assume that the loss $L$ is a decreasing and convex function of the investment $s$ in self-insurance (i.e $L' < 0, L'' > 0$). Let $a$ be the insurance coverage, $\Pi$ the market insurance premium, $w$ initial wealth and $p$ the probability that the adverse state occurs. The consumer chooses $a$ and $s$ so as to maximize expected utility :

$pu(w - (1-a)L(s) - s - a\Pi) + (1-p)u(w - s - a\Pi)$

To illustrate, assume utility is exponential with absolute risk aversion parameter $\theta$ and let $\mu > 1$ be the mark up on the fair insurance premium. From the first order conditions the following two equations relating $a$ and $s$ can be obtained:

$a = 1 - (1/\theta L(s)) \log(\mu(1-p)/(1-\mu p))$ [from the foc on $a$, call this the $aa$ locus]

$a = 1 + (1/\mu p L'(s))$ [from combining the foc on $s$ and $a$, call this the $ss$ locus]

Both functions are downward sloping with slopes $da/ds_{|aa} = (L'/\theta L^2) \log(\mu(1-p)/(1-\mu p))$ and $da/ds_{|ss} = -(L''/p\mu L'^2)$ , respectively. The relative slope of the two loci depend on the efficiency of self insurance (how fast the loss declines with $s$, i.e. on $L'$) and on the efficiency of market insurance, i.e. on $\mu$. If self insurance is relatively efficient ($L'$ is large in absolute terms) and market insurance is relatively inefficient ($\mu$ is large) the $aa$ locus will be steeper than the $ss$ locus. Notice now that an increase in the degree of absolute risk aversion shifts the $aa$ locus upwards but leaves the $ss$ locus unchanged. Thus, starting from an internal solution, if the $aa$ locus is steeper than the $ss$ locus the increase in risk aversion leads to a decline in market insurance and an increase in self insurance. By international standards departures from fair insurance are stronger in Italy and this may perhaps explain the difference between our results and those of Barsky et al. (1997) who find a positive effect of a measure of risk aversion on the demand for insurance in the US.

taking a new one implies incurring new risks. Thus, one expects risk-averse (or more risk-averse) individuals to be less likely to move and to change job than the risk-neutral and lovers (or the less risk averse). Also, since risk-averse consumers should avoid risky behavior and act more prudently, they should have better health status. In panel D of Table VII we test these three implications, starting with the first. The first two columns estimate a model for the probability that an individual has moved from his region of birth to another region. In the sample, 17.2 percent of the household heads were born in a region different from the one where they currently live. Since the regressions include a full set of dummies for region of birth, local factors affecting the decision to move, such as labor market conditions, wage prospects in the area, etc., are accounted for. Compared to the risk neutral and lovers, the probability of being a mover is lower among the risk-averse, but the latter effect is not statistically significant (first column). The second column reports the estimates for the restricted group of risk-averse individuals. The degree of risk aversion has a negative and highly statistically significant effect on the probability of being a mover; increasing the degree of risk aversion by one standard deviation lowers the probability of being a mover by 2 percentage points, or 12 percent of the sample mean. The third and fourth columns show the results for the propensity to change job. The left-hand side variables is a dummy equal to 1 if the household head has changed more than 2 jobs, and zero otherwise. About 33 percent of the consumers in our sample have changed job more than twice. Being risk averse compared to being risk neutral or risk lover lowers the probability of being a job changer but the coefficient is not precisely estimated. Yet, in the group of risk averse individuals, a higher degree of risk aversion has a negative and statistically significant effect on the probability of changing job; a one standard deviation increase in risk aversion lowers the probability of taking the risks connected to changing job by 1.4 percentage points. The last two columns report probit regressions for the probability of being affected by a chronic disease. When the total sample is used the estimates indicate that the risk-averse are significantly less likely than the risk lovers and the risk-neutral to incur a chronic disease, with an effect equal to 16 percentage points, about 77 percent of the sample share of households with a chronic disease. When the sample is restricted to the risk-averse, the degree of risk aversion has moderate predictive power on health status; one standard deviation increase lowers the probability of a chronic disease by 1 percentage points (5 percent of the sample mean).

Overall, the evidence in Table VII implies that attitudes towards risk have considerable explanatory power for several important consumer decisions. Thus, our evidence suggests that leaving out measures of risk aversion in empirical analysis of households behavior is likely to be a substantial problem.

## 10 Consistency with observed behavior

If our findings on the relation between wealth and risk-aversion do indeed reflect the structure of individual preferences, then this should be reflected in actual behavior; i.e. observed behavior should be consistent with the shape of the measured risk-aversion-wealth relation. In this section we discuss some implications of our empirical characterization of the wealth-risk-aversion relation. First, if relative risk aversion is increasing in wealth, as implied by our findings, the portfolio share of risky assets should decline as wealth increases. Second, if , as our results suggest, absolute risk tolerance is a concave function of the consumer endowment, the portfolio share of risky assets should be an increasing function of age. Third, if our estimates do indeed identify the parameters of the consumers' utility function, it should be possible to recover them from the estimation of Euler equations for consumption.

### 10.1 Wealth-portfolio relation

The first implication is clearly contradicted by the data since portfolio shares are found to be an increasing function of wealth. This is obviously in contrast also with constant relative risk aversion preferences. One strategy that has been pursued in the literature is to maintain the CRRA characterization of the utility of consumption but assume that wealth enters the utility function directly as a luxury good, for instance through a joy-of-giving bequest motive. As Carroll (2000) shows, this implies that a larger proportion of lifetime wealth will be devoted to the risky assets. Clearly, this mechanism can still explain the data even if the utility function of consumption is characterized by IRRA, provided that the joy-of-giving motive is sufficiently strong. Another explanation is that there are portfolio management costs that decline with the size of the investment in risky assets (which is increasing in wealth); if they are sufficiently important, this mechanism can overturn any incentive to lower the portfolio share of risky assets coming from IRRA. Thus, our results, do not in principle conflict with the evidence.

### 10.2 Age-portfolio profile

To check the second implication - i.e. that with concave risk tolerance the age portfolio profile is upward sloping - we run Tobit regressions of the portfolio share of risky assets on wealth (linear and square), age and a set of controls including city size, household size, gender, region of residence, education of household head etc. We exclude households with zero wealth and those with head above age 60 since the elderly may have various incentives to decumulate assets after retirement, particularly the riskier ones.[27]

After these exclusions our sample includes 4,799 households. Table VIII shows the results of the estimates separately when risky assets are divided by total family wealth and by financial wealth, respectively. The first two columns use the whole sample of non-retired consumers, the last two columns check the results on the subsample of consumers who respond to the lottery question and control also for risk aversion. All the estimates show that the share of risky assets is increasing with age with the portfolio share increasing by 2 percentage points (5 when financial wealth is used as a scale variable) for a 10-year increase in age, which is consistent with our empirical characterization of absolute risk aversion.

### 10.3 Euler equation estimates

To further check the consistency of our results with observed behavior we follow a third route. We estimate the value of the parameter $\beta$ from an Euler equation under the assumption that the utility function has the form given by equation (9) in the text. Suppose there is no background risk. Using equation (9) the Euler equation for consumption is

[27] As pointed out by Hurd (2000) the portfolio behaviour of the retired elderly consumers may be quite different from that of the non-retired. First, the retired have a limited ability to return to the labor force and use this possibility as a buffer against financial losses. This limitation should reduce their willingness to hold risky assets. Second, the elderly face substantial mortality risk, which increases sharply at advanced old age and leads to a decline in consumption and wealth. This, in turn, may be reflected in the portfolio composition. Third, retired consumers have large annuity income flows, and the risks associated with those flows are quite different from the risks of earnings. Finally, the elderly face a much a higher risk of health care consumption than the nonelderly which discourages holdings of risky assets. Consistent with this Guiso and Jappelli (2000) find that the portfolio share of risky assets declines with age after retirement.

$$\exp(-k\frac{c_{t+1}^{1-\beta}}{1-\beta}) = \gamma(1+r_{t+1})\exp(-k\frac{c_t^{1-\beta}}{1-\beta}) + \varsigma_{t+1} \qquad (13)$$

where $\gamma$ is the subjective discount factor and $\varsigma_{t+1}$ is an expectational error, orthogonal to all variables in the information sets of the agents at time t. Thus, we can use these orthogonality conditions and estimate the parameters of equation (13) using a generalized method of moment estimator. If we are uncovering true preference parameters we should obtain values of $\beta$ and of the implied degree of risk aversion similar to those estimated in the previous sections.[28] To estimate (13) we rely on the panel component of

the SHIW and pool together the observations for the years 1989, 1991, 1993 and 1995. The SHIW has a rotating panel component, where half of the sample in a given survey is re-interviewed in the subsequent one. Thus, the maximum number of time periods a household can be present is 4. Since our estimator is consistent only for large $T$ these results should be regarded as suggestive. Our sample consists of an unbalanced panel of about 2,500 households, who answered the lottery question in 1995 and turned out to be risk averse. In addition, since the Euler is known not to hold when credit markets are imperfect, we have excluded those households which are at the bottom twenty percent of the distribution of financial wealth and which could therefore be somewhat liquidity constrained. As a measure of consumption we use total, real household expenditure on non-durables goods and services, adjusted for household size.[29] As a measure of the interest rate we use the return on bank deposits and checking accounts, which varies over time and across Italian provinces, and impute to each household in a given

[28] If there is backgroud risk, using the approximate expression for the indirect utility function $v$, we can write the Euler equation for consumption as:

$$u'(c_{t+1}) = \gamma(1+r)u'(c_t) - [u'''(c_{t+1}) - u'''(c_t)]\sigma^2/2 + \eta_{t+1}$$

where it has been assumed that the variance of the background risk is time-invariant. Using (9) and letting $y_{t+1} = \exp(-k\frac{c_{t+1}^{1-\beta}}{1-\beta})$ this condition can be written as:

$$y_{t+1} = \gamma(1+r)y_t - [kc_{t+1}^{-\beta}(\beta c_{t+1}^{-1} + kc_{t+1}^{-\beta})y_{t+1} - kc_t^{-\beta}(\beta c_t^{-1} + kc_t^{-\beta})y_t]\sigma^2/2 + \eta_{t+1}$$

which again can be estimated by a generalized method of moment estimator.

[29] Household per-adult equivalent expenditure is obtained using the following adult equivalence scale: the household head is weighted 1, the other adults in the household are weighted 0.8 and the children are weighted 0.4.

year and living in a given province the average rate prevailing in that year and province. To account for demographics, we let the parameter $k$ be a function of the age and gender of the household head. Year dummies are also included. As instruments in the agents' time t infomation set, we use the interest rate lagged one and two periods, a categorical variable for the size of bank deposits, a dummy for the ownership of saving accounts, the herphindal index of bank concentration in the province, a categorical variable for the size of the town where the household lives and and the population of the province where the town is located. Results, not shown for brevity, imply a point estimate of the parameter $\beta$ of 0.07, which is not far from the range of estimates that we have obtained from the relationship between our measures of absolute risk aversion and the consumer endowment.

Overall, we take the evidence in this Section as suggesting that our estimates of the risk aversion-wealth relation are remarkably consistent with observed behavior. To conclude this discussion, we notice that our empirical characterization of the relation between risk aversion and wealth helps also reconcile some portfolio puzzles that have been noticed in the literature. Simulation models, such as those discussed by Heaton and Lucas (2000), reveal that portfolio shares of risky assets close to those observed in reality, require simultaneously three ingredients: a) background risk must be "large"; b) it must be positively correlated with stock market returns; c) stock holders must have a high degree of relative risk aversion, 8 in Heaton and Lucas (2000) simulations. The first two conditions are met by the rich segment of the population because they own most of the business wealth which is highly volatile (relative to labor income) and co-moves with the stock market. If preferences are well described by our findings, than it is well possible that stockholders have a degree of relative risk aversion close to the one implied by the Heaton and Lucas simulations. In our sample, the relative risk aversion of the bottom 10% of the wealth distribution is 3.7 on average and its consumption is 23.3 million lire ($ 11.500). The consumption of the top 10%, who own 61 percent of the total risky assets, is $31,000. Thus for the latter, the predicted degree of relative risk aversion, holding other characteristics constant (i.e. place of birth, exposure to background risk etc.), would be 8.5 ($= 3.7\times$ ((consumption of the rich/consumption of the poor)$^{0.84}$), close to the value required by the Heaton and Lucas simulations (2000).

## 11 Conclusions

In this paper we construct a direct measure of absolute risk aversion using the 1995 Bank of Italy Survey of Household Income and Wealth. The measure is based on a simple yet powerful question on the maximum price a consumer is willing to pay to enter a lottery. Its main advantage is that it does not rely on any assumption as to the form of individual utility. As a consequence, it applies not only to the risk-averse, but also to risk-neutral and risk-prone individuals, providing a point estimate of the degree of risk aversion for each individual in the sample. This estimate has then been used to gather direct evidence on the nature of the relationship between individual risk predisposition on the one hand and individual endowment, demographic characteristics and measures of uninsurable risk exposure on the other.

So far there is very limited evidence on the sign of the relationship between risk attitude and wealth and no evidence at all on the curvature of this relationship. Our findings suggest that among risk averse consumers the degree of absolute risk aversion is decreasing in individual endowment - thus rejecting CARA preferences - but the elasticity to consumption is far below the unitary value predicted by CRRA utility. Consequently, absolute risk tolerance is a concave function of consumer endowment. How reasonable is this finding? One way to answer the question is to run the following experiment. Suppose that a consumer with annual consumption of 20 million lire ($ 10,000, roughly the 17th percentile) is willing (at most) to pay 0.5 million lire ($ 250) to enter the lottery. Than, using equation (6), the implied value of his absolute risk aversion would be 0.1895 and his degree of relative risk aversion would be 3.7905. Suppose that relative risk aversion is constant and equal to this value. Than, if our consumer had an annual consumption of 100 million lire ($ 50,000, about the 98th percentile of the distribution) he would report a price of 7.2 million lire ($ 3,100) to participate in our hypothetical lottery. This seems an implausibly high figure, very close to the expected value of the lottery. Intuitively, CRRA implies that absolute risk tolerance increases "too fast" with consumption. If instead absolute risk tolerance increases with consumption at the speed implied by our estimates, the price that the richer consumer would be willing to pay to enter the lottery would be 1.5 million lire ($ 750), a figure that seems to us much more reasonable.

As argued, our findings are also consistent with the empirical evidence that young households take on relatively less portfolio risk than more mature households. In fact, according to Gollier and Zeckhauser (1997), the concavity of absolute risk tolerance is a necessary and sufficient condition for such behavior to be optimal.

Individual risk aversion appears also to be characterized by a substantial amount of unexplained heterogeneity. Consumers attributes and demographic characteristics are of little help in predicting the degree of risk aversion. The only exception are age and the region of birth; the latter is likely to capture regional differences in risk predisposition and culture that are transmitted with upbringing within the family.

In a world of incomplete markets, individual attitudes towards risk may vary across households not only because of differences in tastes, but also because of differences in the environment. We address this issue by analyzing the impact that various measures of earnings uncertainty have on the degree of risk aversion. We find unequivocal evidence that employment-related risk shapes consumers attitudes to accept risk. One important implication is that imperfections in financial markets may discourage entrepreneurship and investment not only because they limit access to external finance but, more directly, because they discourage individuals willingness to bear risk.

Finally, we verify the predictive power of our measure of risk attitude with respect to consumer choices, such as occupation, portfolio composition, insurance, health-related conduct and moving and job change decisions. Apart from market insurance, which might be replaced by self-protecting actions, for virtually every type of behavior we investigate, our risk attitude measure makes qualitatively correct predictions: as expected, potentially risky conduct is negatively correlated with risk aversion and effects are economically important. Overall, these results suggest that attitudes towards risk have considerable explanatory power for a number of important consumer decisions. Given the amount of heterogeneity that characterizes risk aversion and its unobservable nature, our evidence suggests that excluding measures of risk aversion from the empirical analysis of household behavior is likely to constitute a serious problem. As a consequence, an effort should be made to elicit indicators of attitudes towards risk of the sort used in this paper.

# A APPENDIX

## A.1 The SHIW

The Bank of Italy Survey of Household Income and Wealth (SHIW) collects detailed data on demographics, households' consumption, income and balance sheet items. The survey was first run in the mid-60s but has been available on tape only since 1984. Over time, it has gone through a number of changes in sample size and design, sampling methodology and questionnaire. However, sampling methodology, sample size and the broad contents of the information collected have been unchanged since 1989. Each wave surveys a representative sample of the Italian resident population and covers about 8,000 households, - although at times specific parts of the questionnaire are asked to only a random sub-sample. Sampling occurs in two stages, first at municipality level and then at household level. Municipalities are divided into 51 strata defined by 17 regions and 3 classes of population size (more than 40,000, 20,000 to 40,000, less than 20,000). Households are randomly selected from registry office records. They are defined as groups of individuals related by blood, marriage or adoption and sharing the same dwelling. The head of the household is conventionally identified with the husband, if present. If instead the person who would usually be considered the head of the household works abroad or was absent at the time of the interview, the head of the household is taken to be the person responsible for managing the household's resources. The net response rate (ratio of responses to households contacted net of ineligible units) was 57 percent in the 1995 wave. Brandolini and Cannari (1994) present a detailed discussion of sample design, attrition, and other measurement issues and compare the SHIW variables with the corresponding aggregate quantities.

## A.2 Definitions of the variables

In the empirical analysis all demographic variables - age, education, gender, number of brothers and sisters, marital status, region of birth, occupation type and sector - refer to the household head.

*Bond, stock and mutual fund ownership and amounts*: Households are asked first to report ownership of the specific financial instrument and then to report in which bracket (out of 14) the amount held falls. Asset amounts are then imputed assuming that the household holds the mid-point of the interval. It is clear from this procedure that while ownership data only suffer from non-reporting, the information on the amounts is affected by imputation errors. For details on how financial assets values are computed in the SHIW see Guiso and Jappelli (1999).

*Consumption, net worth and financial wealth*: Consumption is the sum of the expenditure on food, entertainment, education, clothing, medical expenses, housing repairs and additions, and imputed rents. It also includes expenditures on durable goods (vehicles, furniture and appliances, art objects). Net worth is the total of financial and real assets net of household debt. Financial wealth is given by the sum of cash balances, checking accounts, savings accounts, postal deposits, government paper, corporate bonds, mutual funds and investment in fund units and stocks. Real assets include investment real estate, business wealth, primary residence and the stock of durables.

*Discouraged borrowers and rejected loan applicants*: The following questions have been asked in each wave of the survey since 1989: "During the year did you or a member of the household think of applying for a loan or a mortgage to a bank or other financial intermediary, but then changed your mind on the expectation that the application would be turned down?" Those answering yes to this question are classified as "discouraged borrowers". Those answering yes to the following questions are classified as "rejected" consumers: "During the year did you or a member of the household apply for a loan or a mortgage to a bank or other financial intermediary and have it turned down?" To compute the probability of liquidity constraints we determine the share of consumers in a province that were turned down or discouraged borrowers using all waves since 1989. We than attach this fraction to each household living in the same province.

*Education of the household head's father* : This variable is originally coded as: no education (0); completed elementary school (5 years); completed junior high school (8 years); completed high school (13 years); completed university (18 years); graduate education (more than 20 years). For each of the five categories, we define a dummy variable indicator.

*Education of the household head* : This variable is originally coded as: no education (0); completed elementary school (5 years); completed junior high school (8 years); completed high school (13 years); completed university (18 years); graduate education (more than 20 years). We define three indicators: the first is equal to 1 when education is up through junior high school (zero otherwise); the second is equal to 1 when it is through high school (zero otherwise) and the third is equal to 1 for university or more (zero otherwise).

*Indicators of background risk* : We use two indicators, the variance of expected earnings at the individual level and the variance of shocks to per capita GDP in the province of residence. The first is computed directly from survey questions asking: a) the probability of keeping one's job (if employed) or of finding one (if unemployed) in the twelve months following the interview; b) the minimum and maximum earnings expected conditional on being employed. After making some assumptions on the shape of the on the job probability distribution of earnings and on the value of the unemployment compensation to each individual in the sample, Guiso, Jappelli and Pistaferri (1998) use this information to recover measures of expected earnings and their variance. The second indicator is obtained from time series data on per capita GPD at the province level from 1952 to 1992. For each province we regress the logarithm of per capita GDP on a linear trend and compute the variance of the residuals from this regression. We than impute this variance to all households leaving in the same province.

*Indicator of health* : It consists in a dummy variable based on the answers to the questions on chronic diseases.

*Risk aversion* : The Arrow-Pratt measure of absolute risk aversion and the risk attitude indicators are obtained from a direct question to a survey lottery. Each survey participant is offered a hypothetical lottery and is asked to report the maximum price that he would be willing to pay in order to participate. The wording of the lottery question and the methodology implemented to compute risk aversion are described in the text.

*Year of birth of the household head's father*: This variable is used to define ten-year intervals, starting from 1900. An additional interval is defined for those born in or after 1950. We then construct six indicators: the first is equal to one if the household head's father was born between 1900 and 1909, the second is one if he is born between 1910 and 1919, and so on.

*Windfall gains measures* : Six measures are used. The first is a dummy for home ownership as a result of gift or bequest. The second is the sum of the settlements received related to life (excluding annuities), health and theft and casualty insurance. The third measure is the sum of severance payments, unemployment benefits and redundancy allowance. The fourth is the sum of any additional financial aid from central or local governments, other public institutions

or charities. The fifth consists of gifts/monetary contributions received from friends or family living outside the household dwelling. The last instrument is a measure of windfall gains (or losses) on housing constructed using time series data on house prices at the province level over the years 1965-1994. For homeowners, we compute the house price change since the year when the house was acquired or since 1965 if it was acquired earlier. To non-homeowners, we attach the house price change since the year when they started working or since 1965. This can be justified on the ground that they start saving to buy a home as soon as they start working.

### A.3 Risk aversion of the indirect utility function

Let $v(c) = Eu(c + \widetilde{y})$ denote the indirect utility function. Taking a second order Taylor approximation of the right-hand side around the endowment $c$, we can approximate the indirect utility by

$$v(c) = u(c) + u''(c)\sigma^2/2$$

Using (1) the degree of absolute risk aversion of $v()$ can be expressed as

$$R_v(c) = -\frac{v''(c)}{v'(c)} = R_u(c)\left(\frac{1 + P_u T_u \sigma^2/2}{1 + P_u R_u \sigma^2/2}\right)$$

where $R_u(c) = -\frac{u''}{u'}$, $P_u(c) = -\frac{u'''}{u''}$, $T_u(c) = -\frac{u^{iv}}{u'''}$ denote , respectively, the degree of absolute risk aversion, absolute prudence and absolute tolerance with respect to the utility function $u()$. From (2) it is clear that, for a prudent consumer, a sufficient condition for (a zero mean) background risk to make him more risk averse is that $T_u > R_u$

Let $s$ denote the coefficient of variation of the consumer endowment (i.e. $s = \frac{\sigma}{c}$) and let $r_u$, $p_u$ and $t_u$ denote the degree of relative risk aversion, relative prudence and relative tolerance, respectively (obtained multiplying the absolute degrees by $c$). We can then rewrite (2) as

$$R_v(c) = R_u(c)\left(\frac{1 + p_u t_u s^2/2}{1 + p_u r_u s^2/2}\right)$$

If the utility function is given by (9) in the text, than $R_u = kc^{-\beta}$, $r_u = kc^{1-\beta}$, $p_u = \beta + r_u$, $t_u = \beta + p_u$. Substituting into (3) and taking logs we obtain

$$\log R_v = \log k - \beta \log c + \beta p_u s^2$$

which shows that the parameter $\beta$ of the utility function $u()$ can be recovered even if there is background risk.

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**Table I**

**Descriptive statistics for the total sample, for the sample of respondents and various sub samples**

The figures for consumption, total wealth and financial wealth are the sample medians expressed in million lire. The variable "North" includes the following regions: Piemonte, Valle d'Aosta, Lombardia, Trentino Alto Adige, Veneto, Friuli Venzia Giulia, Liguria and Emilia Romagna; "Center" includes Toscana, Umbria, Marche, Lazio, Abruzzo and Molise and "South" includes all the remaining regions. Low risk averse are those who are willing to bet at least 1 million lire, which is the median of the bet distribution.

| Variable | Sample of respondents | | | | | Total sample |
|---|---|---|---|---|---|---|
| | Risk averse | | | Risk lovers and neutral | Total | |
| | High | Low | Total | | | |
| Age | 49.24 | 47.39 | 48.50 | 49.34 | 48.54 | 54.23 |
| Male % | 77.98 | 81.16 | 79.24 | 93.75 | 79.84 | 74.35 |
| Years of education | 8.76 | 9.98 | 9.25 | 10.81 | 9.31 | 8.03 |
| Married % | 77.88 | 79.64 | 78.58 | 87.50 | 78.95 | 72.50 |
| No. of earners | 1.84 | 1.86 | 1.85 | 1.81 | 1.84 | 1.80 |
| No. of components | 3.23 | 3.15 | 3.20 | 3.00 | 3.19 | 2.94 |
| No. of siblings | 2.55 | 2.33 | 2.46 | 1.90 | 2.44 | 2.50 |
| Area of birth: North | 34.44 | 44.07 | 38.27 | 53.90 | 38.91 | 37.43 |
| Center | 23.09 | 20.18 | 21.94 | 19.86 | 21.85 | 24.75 |
| South | 42.47 | 35.75 | 39.80 | 26.24 | 39.24 | 37.82 |
| Self-employed % | 15.57 | 20.14 | 17.38 | 29.17 | 17.87 | 14.23 |
| Public employee % | 28.33 | 26.37 | 27.55 | 27.08 | 27.53 | 23.26 |
| Value of Z | 0.53 | 3.78 | 1.82 | 11.19 | 2.21 | - |
| Abs. Risk aversion | 0.189 | 0.110 | 0.157 | -0.005 | 0.151 | - |
| Rel. Risk aversion | 6.53 | 4.34 | 5.62 | -0.25 | 5.38 | - |
| Consumption | 30.28 | 34.35 | 32.00 | 41.20 | 32.40 | 28.80 |
| Financial wealth | 9.97 | 18.10 | 12.76 | 49.58 | 13.42 | 10.39 |
| Total wealth | 154.95 | 198.47 | 170.50 | 329.85 | 173.25 | 155.85 |
| N. of observations | 1,998 | 1,316 | 3,314 | 144 | 3,458 | 8,135 |

**Table II**

## Risk aversion, consumption and wealth: OLS estimates

The left-hand-side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. Regressions in column (2) to (4) include 19 dummies for the region of birth of the household head. The number of observations in these regressions is slightly smaller than that in column (1) because for some households some of the right hand side variables are missing. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

| Variable | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log( *c* ) | -0.0902 | -0.0669 | | |
| | (0.0125) | (0.0147) | | |
| Log( *w* ) | | | -0.0187 | |
| | | | (0.0039) | |
| Log( *wf* ) | | | | -0.0412 |
| | | | | (0.0049) |
| Male | | -0.0151 | -0.0121 | -0.0103 |
| | | (0.0171) | (0.0194) | (0.0204) |
| Age | | 0.0010 | 0.0014 | 0.0014 |
| | | (0.0005) | (0.0006) | (0.0006) |
| No. of siblings | | 0.0027 | 0.0016 | 0.0000 |
| | | (0.0031) | (0.0030) | (0.0035) |
| Unemployment experience | | -0.0023 | 0.0107 | -0.0130 |
| | | (0.0210) | (0.0206) | (0.0232) |
| Father self-employed | | -0.0248 | -0.0260 | -0.0217 |
| | | (0.0165) | (0.0165) | (0.0176) |
| Father public sector employee | | -0.0070 | -0.0149 | -0.0153 |
| | | (0.0229) | (0.0207) | (0.0198) |
| Constant | -7.8786 | -8.3698 | -8.8718 | -8.6676 |
| | (0.1295) | (0.1430) | (0.0496) | (0.0620) |
| Region of birth | N0 | YES | YES | YES |
| No. of observations | 3,314 | 3,072 | 2,953 | 2,761 |
| Adjusted $R^2$ | 0.0149 | 0.0497 | 0.0496 | 0.0630 |
| $F$ test for region of birth = 0 | - | 11.01 | 8.38 | 5.82 |
| ($p$-value) | | (0.0000) | (0.0000) | (0.0000) |
| $F$ test for $\beta = -1$ | 5,039.47 | 3,872.65 | 59,286.91 | 36,660.26 |
| ($p$-value) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

**Table III**

## Risk aversion, consumption and wealth: IV estimates

The left-hand side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). The estimates in column (4) are conducted on a restricted sample obtained excluding households with total wealth below 20 million (594 observations), those who reported non-positive financial assets (147 observations), those with head aged less than 21 or above 75 (54 observations). Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

| Variable | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Log( *c* ) | -0.1610 | | | -0.1342 |
| | (0.0402) | | | (0.0554) |
| Log( *w* ) | | -0.0246 | | |
| | | (0.0096) | | |
| Log( *wf* ) | | | -0.0633 | |
| | | | (0.0167) | |
| Male | -0.0173 | -0.0264 | -0.0220 | -0.0195 |
| | (0.0166) | (0.0196) | (0.0159) | (0.0220) |
| Age | 0.0016 | 0.0023 | 0.0025 | 0.0016 |
| | (0.0005) | (0.0006) | (0.0006) | (0.0006) |
| No. of siblings | -0.0009 | -0.0007 | -0.0036 | -0.0038 |
| | (0.0030) | (0.0035) | (0.0038) | (0.0048) |
| Unemployment experience | -0.0121 | 0.0243 | -0.0056 | -0.0101 |
| | (0.0227) | (0.0183) | (0.0217) | (0.0248) |
| Father self-employed | -0.0136 | -0.0202 | -0.0147 | -0.0076 |
| | (0.0155) | (0.0152) | (0.0153) | (0.0206) |
| Father public sector employee | 0.0054 | -0.0114 | -0.0092 | -0.0005 |
| | (0.0228) | (0.0198) | (0.0210) | (0.0240) |
| Constant | -7.3217 | -8.7442 | -8.4069 | -7.6226 |
| | (0.4241) | (0.1185) | (0.1672) | (0.5868) |
| Region of birth | YES | YES | YES | YES |
| No. of observations | 2,923 | 2,808 | 2,621 | 2,158 |
| Adjusted $R^2$ | 0.0359 | 0.0441 | 0.0461 | 0.0304 |
| *F* test for region of birth = 0 | 4.20 | 5.51 | 5.02 | 5.87 |
| (*p*-value) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| *F* test for $\beta = -1$ | 667.73 | 8,038.10 | 3,700.46 | 427.99 |
| (*p*-value) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

**Table IV**

## Risk aversion, consumption and wealth: 2SLAD estimates

The left-hand-side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods; *w* is total household net worth and is equal to the sum of real wealth (housing, land and durable goods) and financial wealth net of debt; *wf* is household financial wealth. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Columns (1) to (3) report 2-stages LAD estimates. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| Log( *c* ) | -0.1686 | | |
| | (0.0599) | | |
| Log( *w* ) | | -0.0305 | |
| | | (0.0147) | |
| Log( *wf* ) | | | -0.0714 |
| | | | (0.0265) |
| Male | 0.0029 | -0.0043 | -0.0013 |
| | (0.0144) | (0.0142) | (0.0140) |
| Age | 0.0009 | 0.0019 | 0 .0020 |
| | (0.0005) | (0.0007) | (0.0007) |
| No. of siblings | -0.0012 | -0.0019 | -0.0036 |
| | (0.0022) | (0.0022) | (0.0027) |
| Unemployment experience | -0.0235 | 0.0077 | -0.0094 |
| | (0.0146) | (0.0143) | (0.0134) |
| Father self-employed | -0.0015 | -0.0130 | -0.0044 |
| | (0.0100) | (0.0141) | (0.0121) |
| Father public sector employee | -0.0038 | -0.0226 | -0.0208 |
| | (0.0191) | (0.0237) | (0.0170) |
| Constant | -7.0656 | -8.5253 | -8.1713 |
| | (0.6130) | (0.1511) | (0.2429) |
| Region of birth | YES | YES | YES |
| No. of observations | 2,923 | 2,808 | 2,621 |
| Pseudo $R^2$ | 0.0356 | 0.0380 | 0.0364 |

**Table V**

## Risk aversion and background risk

The left-hand-side variable is the log of absolute risk aversion; *c* is expenditure on durable and non-durable goods. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings refer to the household head. Unemployment experience is a dummy equal to 1 if the household head has ever undergone periods of unemployment or of temporary layoff. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. In the first and second columns for the variable "earnings variance of the household head", we use the variance of the household head's earnings and replace it with a zero if the household head is not working and the variance of his earnings is missing. A dummy for non-working household head is also included. In the second column, we also include the variance of the earnings of the wife and of an additional earner scaled with household consumption squared. If there is no wife or additional earner or if they do not work (and are not seeking work), the missing variances of their earnings are replaced with a zero. Dummies for non-working head, wife and additional earner are also included in the regression. In the last three columns the measure of background risk is the variance of the shocks to log(GDP) in the province estimated from annual data of provincial GDP over the period 1952-1992. The set of instruments includes dummies for the education of the household head, education dummies interacted with age, dummies for the education of the father of the household head and his year of birth; measures of windfall gains (a dummy for the house being acquired as a result of a bequest or gift, insurance settlements and other transfers, capital gains on the house since the time of acquisition). Bootstrapped standard errors (based on 100 replications) are reported in parentheses.

| Variable | IV | IV | IV | 2SLAD | 2SNLLS |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Log( *c* ) | -0.1597 | -0.1739 | -0.1588 | -0.0982 | |
| | (0.0758) | (0.0945) | (0.0327) | (0.0367) | |
| *c* | | | | | 0.1867 |
| | | | | | (0.0276) |
| Earnings variance | -0.2262 | -0.1933 | - | - | |
| Of household head/$c^2$ | (0.1838) | (0.2058) | | | |
| Earnings variance | - | 0.1057 | - | - | |
| Of spouse/ $c^2$ | | (1.1617) | | | |
| Earnings variance | - | 0.5401 | - | - | |
| Of other earner/ $c^2$ | | (1.0411) | | | |
| Variance of shocks to per capita GDP | - | - | 2.8895 | 1.8085 | |
| | | | (1.0233) | (0.5728) | |
| Male | -0.0419 | -0.0452 | -0.0199 | 0.0056 | -0.0163 |
| | (0.0341) | (0.0298) | (0.0195) | (0.0080) | (0.0181) |
| Age | 0.0043 | 0.0045 | 0.0016 | 0.0009 | 0.0018 |
| | (0.0012) | (0.0015) | (0.0005) | (0.0003) | (0.0005) |
| No. of siblings | 0.0000 | 0.0010 | -0.0007 | -0.0013 | -0.0007 |
| | (0.0060) | (0.0068) | (0.0034) | (0.0014) | (0.0027) |
| Unemployment experience | -0.0186 | -0.0139 | -0.0110 | -0.0094 | -0.014 |
| | (0.0320) | (0.0363) | (0.0214) | (0.0089) | (0.0195) |
| Father self-employed | -0.0023 | -0.0035 | -0.0162 | 0.0014 | -0.0065 |
| | (0.0211) | (0.0237) | (0.0160) | (0.0063) | (0.0172) |
| Father public sector employee | 0.0084 | 0.0044 | 0.0040 | 0.0003 | -0.0065 |
| | (0.0330) | (0.0370) | (0.0209) | (0.0100) | (0.0172) |
| Constant | -7.3622 | -7.1457 | -7.3523 | -7.7853 | -6.9443 |
| | (0.7918) | (1.0335) | (0.3389) | (0.3822) | (0.2962) |
| Region of birth | YES | YES | YES | YES | NO |
| No. of observations | 1,115 | 1,052 | 2,901 | 2,901 | 2,901 |
| Adjusted $R^2$ | 0.0403 | 0.0395 | 0.0391 | 0.0185 | 0.9983 |
| (Pseudo $R^2$ for the 2SLAD) | | | | | |
| *F* test for region of birth = 0 | 2.38 | 3.77 | 6.41 | 9.93 | - |
| (*p*-value) | (0.0010) | (0.0000) | (0.0000) | (0.0000) | |
| *F* test for $\beta = -1$ | 90.55 | 221.19 | 559.87 | 603.02 | - |
| (*p*-value) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | |

**Table VI**

## Regimes of attitudes towards risk

The left-hand-side variable is an indicator that is equal to 1 if the consumer is risk-averse, 0 otherwise. *c* is expenditure on durable and non-durable goods; *w* is household net worth and *wf* financial wealth. The endowment variables are in million lira. All regressions include 19 dummies for the region of birth of the household head. Male is a dummy equal to 1 if the head is a male; age and number of siblings and past unemployment experience refer to the household head. Father self-employed and public sector employee are two dummies equal to 1 if the household head's father was self employed or a public sector employee, respectively. Standard errors are reported in parentheses.

| Variable | (1) | (2) | (3) |
|---|---|---|---|
| $c$ | -0.0070 | | |
| | (0.0043) | | |
| $c^2$ | 1.78e-06 | | |
| | (2.70e-05) | | |
| $w$ | - | -0.0005 | |
| | | (0.0001) | |
| $w^2$ | - | 6.87e-08 | |
| | | (3.72e-08) | |
| $wf$ | | | -0.0029 |
| | | | (0.0006) |
| $wf^2$ | | | 1.35e-06 |
| | | | (4.72e-07) |
| Male | -0.5581 | -0.5550 | -0.5423 |
| | (0.1520) | (0.1521) | (0.1535) |
| Age | -0.0048 | -0.0020 | -0.0012 |
| | (0.0033) | (0.0033) | (0.0033) |
| No. of siblings | 0.0422 | 0.0412 | 0.0392 |
| | (0.0247) | (0.0246) | (0.0247) |
| Unemployment experience | -0.0880 | -0.0883 | -0.0810 |
| | (0.1218) | (0.1212) | (0.1210) |
| Father self-employed | -0.0204 | 0.0190 | 0.0011 |
| | (0.0957) | (0.0972) | (0.0970) |
| Father public sector employee | -0.0408 | -0.0227 | -0.0477 |
| | (0.1210) | (0.1214) | (0.1214) |
| Constant | 2.5425 | 2.3050 | 2.2669 |
| | (0.2958) | (0.2660) | (0.2661) |
| Region of birth | YES | YES | YES |
| No. of observations | 2,988 | 2,988 | 2,988 |
| Pseudo $R^2$ | 0.0809 | 0.0877 | 0.0976 |
| *F* test for region of birth = 0 | 34.81 | 33.79 | 32.86 |
| (*p*-value) | (0.0026) | (0.0036) | (0.0049) |
| *F* test for exogenous characteristics = 0 | 17.83 | 16.21 | 15.14 |
| (*p*-value) | (0.0067) | (0.0127) | (0.0192) |

**Table VII**

## Predicting behavior with risk aversion

In panel A the left-hand-side variable is a dummy equal to 1 if the household head is a self-employed (first two columns) or a public employee (last two columns). In panel B, in the first two columns, it is a dummy equal to 1 if the household holds risky financial assets; in the last two columns it is the portfolio share of risky financial assets. Risky assets include private bonds, stocks and mutual funds. The share of risky assets is relative to total financial assets. In panel C the left-hand-side variable is the value of insurance premiums as a share of current consumption. We consider life (first column), health (second column) and theft and casualty insurance (third column). In panel D, in the first two columns, it is a dummy variable equal to 1 if the consumer lives in a region different from the one where he was born. In the second two columns it is a dummy equal to 1 if the consumer has changed job at least twice over his working life. In the last two columns it is a dummy equal to 1 if the household head is affected by a chronic disease. "Risk-averse" is a dummy variable equal to 1 if the consumer is risk-averse, i.e. if the maximum price he/she is willing to pay for the lottery is lower than its fair value of 10 million lire. "Risk-neutral" is similarly defined. "Absolute risk aversion" is the measure of absolute risk aversion discussed in Section 1. All regressions include as explanatory variables age, number of siblings, household size and number of earners, dummies for gender, marital status, education, region of birth and home ownership. The regressions in panel A also include the two dummies for the occupation of the household's head father; those in panel B include a second order polynomial in financial assets, whereas those in panel C include second order polynomials in wealth and earnings. *t*-statistics are reported in parenthesis.

### A: choice of occupation

| | Self-employed (probit regression) | | Public sector employee (probit regression) | |
|---|---|---|---|---|
| Variable | Whole sample | Sample of risk-averse | Whole sample | Sample or risk-averse |
| Risk averse | -0.3513<br>(0.1234) | - | 0.1704<br>(0.1261) | - |
| Absolute risk aversion | - | -1,459.82<br>(615.1) | - | 1,484.1<br>(580.4) |
| No. of observations | 3,341 | 3,203 | 3,341 | 3,203 |

### B: demand for risky assets

| | Ownership of risky assets (probit regressions) | | Portfolio share of risky assets (tobit regressions) | |
|---|---|---|---|---|
| Variable | Whole sample | Sample or risk-averse | Whole sample | Sample or risk-averse |
| Risk averse | -0.1733<br>(0.1305) | - | -0.1129<br>(0.0760) | - |
| Absolute risk aversion | - | -1,504.4<br>( 678.8) | - | -1,143.4<br>(425.6) |
| No. of observations | 3,401 | 3,260 | 3,034 | 2,901 |

**Table VII : continue**

## C: demand for insurance

| | Insurance premiums as a share of consumption (Tobit regressions; sample or risk-averse) | | |
|---|---|---|---|
| Variable | Life insurance | Health insurance | Theft and casualty insurance |
| Absolute risk aversion | -96.839<br>(48.121) | -55.974<br>(22.878) | -63.783<br>(15.909) |
| No. of observations | 3,264 | 3,264 | 3,249 |

## D: moving decision, job change and health status (chronic disease)

| | Moving to another region (probit regressions) | | Propensity to change job (probit regression) | | Health (probit regression) | |
|---|---|---|---|---|---|---|
| Variable | Whole sample | Sample of risk-averse | Whole sample | Sample of risk-averse | Whole sample | Sample or risk-averse |
| Risk averse | -0.0796<br>(0.1360) | - | -0.0686<br>(0.1068) | | -0.5766<br>( 0.1196) | - |
| Absolute risk aversion | - | -1698.8<br>(595.3) | - | -920.8<br>(531.2) | - | -935.216<br>(621.89) |
| No. of observations | 3,401 | 3,260 | 3,404 | 3,263 | 3,401 | 3,260 |

**Table VIII**

## Age and wealth portfolio profiles

In column 1 the left-hand-side variable is the share of risky assets in total wealth; in the second column it is the portfolio share of risky financial assets. Risky assets include private bonds, stocks and mutual funds. All regressions are run on the sub-sample of households with less than 60 years of age; besides age, wealth and wealth square, they include as explanatory variables household earnings linear and square, household size and number of earners, dummies for gender, marital status, education, region of birth and city size dummies. *t*-statistics are reported in parenthesis.

| | Portfolio share of risky assets (tobit regressions) | | Portfolio share of risky assets (tobit regressions) | |
|---|---|---|---|---|
| Variable | Whole sample of non-retired | | Sample of respondents to the lottery | |
| Age | 0.0021<br>(0.0008) | 0.0052<br>(0.0020) | 0.0016<br>(0.0011) | 0.0055<br>(0.0025) |
| *w* | 1.26e-07<br>(1.69e-08) | - | 1.85e-07<br>(4.68e-08) | - |
| *(w/1000)*^2 | -6.81e-12<br>(1.38e-12) | | -2.82e-11<br>(1.57e-11) | - |
| *wf* | - | 2.96e-06<br>(2.26e-07) | - | 2.95e-06<br>(3.25e-07) |
| *(wf/1000)*^2 | - | -1.23e-09<br>(1.34e-10) | - | -1.14e-09<br>(1.82e-10) |
| Absolute risk aversion | | | -597.8<br>(204.6) | -1,149.5<br>(485.5) |
| No. Of observations | 4,799 | 4,420 | 2,458 | 2,273 |

**Figure 1**
**Cross sectional distribution of relative risk aversion**

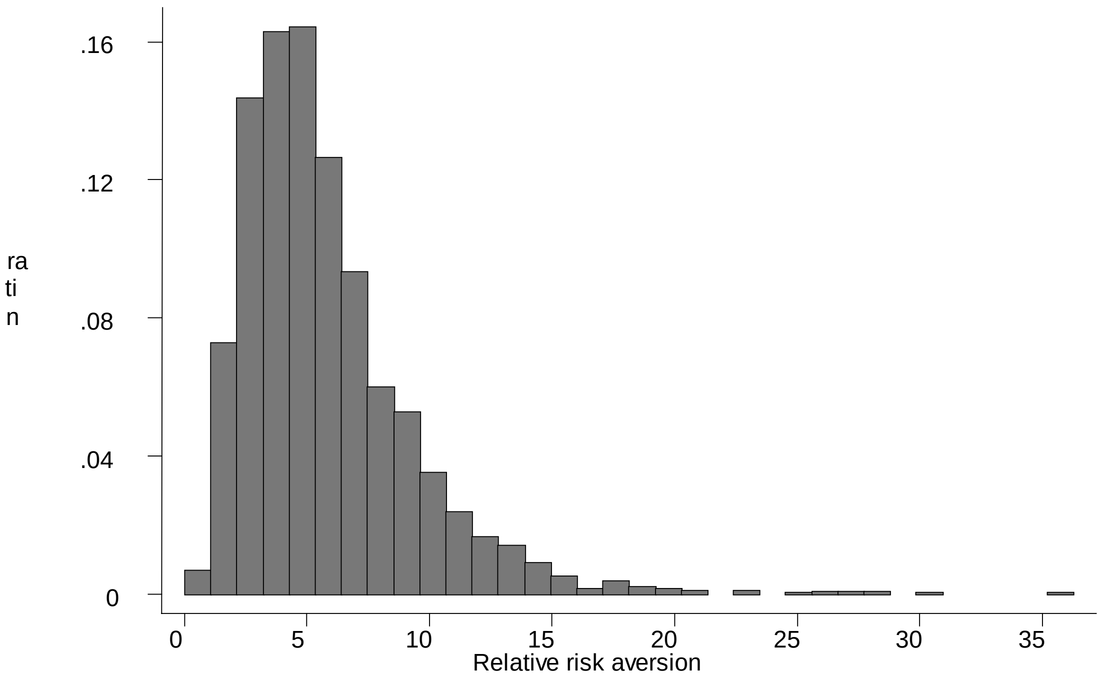

**Figure 2**
**Risk aversion and consumer endowment**