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SUBJECTIVE INCOME RISK AND PRECAUTIONARY SAVING

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Abstract. Econometric studies have produced conflicting results on the relevance of *precautionary saving*. This ambiguity has been often ascribed to *i)* the difficulty of measuring key variables, like households' subjective risk in income and permanent income; *ii)* the occurrence of certain kinds of endogeneity bias associated to the unobservability of individual characteristics, like preferences and trade opportunities. In the present work we investigate these estimation problems exploiting a particular wave of the Italian Survey of Household Income and Wealth which contains both type of information. Our results quantify the average precautionary saving as 4-6 percent of total net wealth. Robustness check are carried out considering two more liquid measures of wealth, and alternative sample definitions. Finally, we use our data set to assess the relevance of the endogeneity bias related to the omission of preference characteristics, like patience and risk-aversion, and of indicators of the households' insurance possibilities, like those signaling the presence of various forms of liquidity and credit constraints.

Keywords: Precautionary saving; wealth accumulation; preferences; liquidity constraints; credit constraints
JEL Classification Numbers: C210; D120; D910

Contents

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1. Introduction

The theory of precautionary saving is grounded on the permanent-income hypothesis of Friedman (1957) and on the life-cycle hypothesis of Brumberg and Modigliani (1954). On the one hand, if preferences exhibit a quadratic felicity (*i.e.* individuals have a linear marginal utility of income), consumption decisions of patient individuals depend on the present value of their permanent income. Any transitory, unexpected income shock is offset by saving decisions and delivers no consumption innovation. Instead, consumption innovations occur as a result of persistent income shocks which produce changes of permanent income. This descriptions conforms to Hall's (1978) certainty equivalence model. On the other hand, if preferences exhibit 'prudence' (*i.e.* individuals have a convex marginal utility of income), consumption decisions do also depend on the perceived consumption risk. A higher expected variance of consumption decreases the current consumption of prudent individuals below their certainty equivalence, for example, in Caballero (1990), Deaton (1991), Weil (1993) and Carroll (1997). This reduction of current consumption goes into 'precautionary saving.' Finally, consumption risk is positive and tied to income risk to the extent to which income shocks are uninsurable; something that ultimately depends on: *a)* the nature of income shocks (*e.g.* idiosyncratic or aggregate, temporary or persistent); *b)* the functioning of markets and institutions (*e.g.* labor and financial markets, social security system); *c)* the ability of the individuals to self-insure (*e.g.* using disposable wealth and transfers from informal networks of friends and relatives). All these three factors are usually captured through the individual budget constraint, for given profiles of prices.

Although it seems natural to try to assess the relevance of precautionary saving by directly testing a model of individual consumption or saving, many empirical studies have focused on wealth accumulation. This is essentially motivated by the fact that one may find no apparent relation between current consumption and perceived income-risk, especially, when the analysis is based on longitudinal data. By converse, it is typically observed that individuals expecting greater uncertainty hold a larger stock of wealth, relative to their 'human wealth' (or permanent income). Such models of wealth accumulation are consistent with the buffer-stock version of a life cycle model (*e.g.* see Deaton, 1991, Carroll 1997, Carroll and Samwick, 1997), in which individuals have an optimal target of wealth corresponding to a certain perceived income-risk.[1] A log-linearized version of this popular, empirical model is,

$$\log \frac{W_j}{Y_j^P} = b_0 + Xb_1 + \frac{\sigma^2_{y_j}}{Y_j^P}\, b_2 + \epsilon_j$$

Individual j's wealth W_j, divided by j's permanent income Y_j^P, is a function of subjective (or perceived) risk in income $\sigma^2_{y_j}$, as well as of personal/household characteristics and economic conditions/opportunities X.

Evaluating the relevance of precautionary saving through the estimation of this model is problematic, as estimates might suffer of (at least) two kinds of bias: one is due to measurement errors of key variables, such as subjective risk and permanent income; the other is an endogeneity bias due to the unobservability of certain fundamental characteristic, like those concerning household preferences and trade/insurance opportunities.

In the present work we investigate these estimation problems exploiting a particularly rich data set, the 2012 Italian Survey of Household Income and Wealth (SHIW), run by the Bank of Italy. This data set is the first one, after those in the nineties (SHIW 1989 and 1991), that contains a question eliciting the respondent's subjective distribution of income. We use this question to derive a measure of subjective

[1] An empirical model of this kind was, first, proposed by King and Dicks-Mireaux (1982). Later it has been used in many studies on precautionary saving; for example, in Guiso, Jappelli and Terlizzese (1992), Lusardi (1997, 1998), Kazarosian (1997), Carroll and Samwick (1998), and more recently in Arrondel (2002) and Fuchs-Schündeln and Schündeln (2005).

risk in income, following the seminal contribution by Guiso, Jappelli and Terlizzese (1992).[2] In addition, SHIW 2012 contains some detailed and precious information that are absent in the nineties surveys; namely, information on: *(i)* the respondents' preferences (*i.e.* on impatience and risk aversion); *(ii)* households' saving/consumption and insurance opportunities (*e.g.* their exposure to liquidity and credit constraints, the soundness of their economic situation).

Theory predicts that preference characteristics affect household decisions on accumulation and precautionary saving in various, important ways. These predictions have been confirmed by a consolidated empirical evidence that, for example, shows the relevance of the rate of time preferences in explaining the cross sectional distribution of wealth and permanent income (*e.g.* see Carroll, Slacalek, Tokuoka, and White, 2017). Other studies documented that precautionary accumulation depends both on risk and personal attitudes toward risk (*e.g.* see Caballero, 1990; Cagetti, 2003; Attanasio, Banks, Meghir and Weber, 1999). It is also well known that substituting preference characteristics with proxies such as occupational status, portfolio composition, and even education achievement, might lead to endogeneity and self-selection bias with regard to most measures of expected risk and of permanent income (*e.g.* see Lusardi, 1997; Fuchs-Schündeln and Schündeln, 2005; Arrondel 2002).

A second important determinant of consumption and accumulation decisions is households' economic opportunities; the individual possibilities to access to trade, both through market institutions and 'informal trade mechanisms (*e.g.* family and friends network).[3] For example, failing to control for trade opportunities in empirical studies of precautionary saving makes impossible to distinguish 'imprudent' individuals from, say, those who are 'prudent' but liquidity constrained. As a consequence, estimates of precautionary saving might be biased.

Finally, it is important to use both information in *(i)* and *(ii)* to account for the fact that preferences interact with economic conditions and trade opportunities. This occurs to the extent to which the latest are, at least partially, the consequence of past accumulation and consumption decisions (*e.g.* see Deaton, 1991).

It is worth pointing out that both types of information, in *(i)* and *(ii)*, are rarely available in official data. 2012 SHIW is the first, and so far the only survey following those in the nineties (SHIW 1989 and 1991), which contains both kinds of information and a question eliciting household heads' perceived risk in income. Furthermore, differently from those waves, this latest question refers to *total income* as opposed to income from *earnings* and *pension*. This has two relevant implications; one quantitative, another qualitative. The first is that our measure of subjective risk displays a sensibly higher cross-sectional variance than the one constructed on labor income from earlier data; and this is expected to help in the identification of precautionary saving.[4,5] Qualitatively, our measure of risk is appropriate to extend the analysis to include business owners, senior citizens and pensioners, whose main source of income is capital (*e.g.* in the form of private equities, financial asses and real estate properties). In doing so we take seriously some potential identification problems. First of all, when including business-owners, we are aware that they are often considered to face a particularly high risk in income and to hold a large stock of wealth to permanent income. Yet, their saving decisions might be driven by motives different from the precautionary one (see Hurst, Lusardi, Kennickell and Torralba, 2010). Similar considerations apply to senior citizens, whose saving

[2]With similar purposes Arrondel (2002) exploits the French 'Patrimoine 97' survey on household wealth which contains very similar questions of those used by Guiso et al. (1992).

[3]The importance of insurance possibilities has been discussed, for example, in Zeldes (1989), Deaton (1991) and, more recently, in Blundell, Pistaferri and Preston (2008); Heatcote, Storesletten and Violante (2009); Blundell, Low and Preston (2013); Carroll et al. (2017, 2021).

[4]According to Browning and Lusardi (1996), an appropriate measure of risk should be observable, exogenous, and vary significantly across the population. This represents a real challenge in empirical studies on precautionary saving.

[5]The higher cross-sectional variance of $\sigma^2_{y_j}$ is also due to the effects of the ongoing global economic and financial crisis, as well as on the Italian sovereign bond crisis.

decisions might increasingly depend on life-cycle considerations (*e.g.* longevity risk, health risk, bequest motives).

Our results show that enriching the model specification with indicators of individual preferences and insurance possibilities, increases considerably its predictive power. However, we find that the effect of precautionary saving is typically small: on average, about 4-6 percent of household's total net wealth, when we restrict the sample to respondents younger than 65. These figures are essentially in line with an average figures found in Guiso et al. (1992) and Lusardi (1997), with respect to earning risk. They do also match the elasticities estimated by in Arrondel (2002) on French data, which refer to a similar measure of perceived risk in total income. Further, we find that, excluding 'illiquid' assets delivers an average elasticity of about 6 percent. Because this suggests that households tend to react to income risk by simply re-scaling their asset position, we complement the analysis with one that tests the hypothesis that households' wealth composition is not sensitive to subjective income risk. Finally, we complete our analysis with some extensions and robustness check. In particular, we estimate our model on a larger sample, including respondents as old as 80 years, and find that the average precautionary saving diminishes by about one percentage point on the measures of net wealth and by about two on financial wealth. In addition, we evaluate the effects of including self-employed individuals and find that it does significatively increase precautionary saving only with respect to the measures of liquid wealth.

Although, the introduction of preference characteristics and indicators on households' consumption/saving opportunities seems to have contributed little to the improvement of the quantitative evaluation of precautionary saving, if compared to earlier studies, such a conclusion is incorrect for at least two reasons. The first one is a marked improvement of the explanatory power of both models on wealth accumulation and permanent income. The second contribution is in the possibility to empirically assess the relevance of different kinds of bias, which have been often debated in the literature. In particular, our analysis highlights that the omission of preference characteristics and indicators on households' insurance opportunities from our baseline model, potentially biases estimates in opposite directions and that the intensity of precautionary saving depends on how these effects compose. Moreover, it also highlights that these effects may have very different empirical relevance; some, like liquidity constraints and other indicators of economic opportunities are stronger than others, like the degree of patience and risk-aversion. Finally, we use indicators of preferences and insurance possibilities to analyze group-behavior; namely to study if and why some particular group has a precautionary saving that significatively differs from the sample mean.

The paper is organized as follows. **Section 2** briefly describes our data source and the definition and measurement of the main variables used in our analysis. **Section 3** presents estimation results on precautionary saving as a fraction of alternative measures of wealth, and discusses some possible sources of bias. **Section 4** discusses the robustness of these results to alternative sample truncation by age (including or excluding respondents of age 66-80) and occupation (including or excluding business owners). Some final considerations are presented in **Section 5**. Three appendices collect useful additional information and analysis.[6]

2. Data and measurement

2.1. **Data.** We use data from the 2012 Italian Surveys of Household Income and Wealth (SHIW) run by the Bank of Italy. The survey was conducted on a sample of 8151 Italian households with interviews carried out between January and August 2013. From this original sample (sample A), we have excluded households whose family head was older than 80, who registered a null or negative net income or total net wealth, or revealed an implausibly high degree of risk aversion. We have also dropped from sample A those households who did not provide relevant information to the interviewer. The remaining sample of 2066 individuals is our

[6] `Stata` codes are available from the authors on request.

sample B. For reasons we explain later, we also define a third sample C (1332 households), that is obtained removing from sample B the respondents older than 65. For a more detailed description of the samples and for sample statistics see Appendix A.

2.2. **Measurement.** In this section we focus on the key variables of our model; for expositional reasons, the exact definition of the indicators, with an exact reference to survey questions, is made available in a separate file.[7]

2.2.1. *Wealth.* Households' wealth is composed of a wide variety of assets, with possibly very different degrees of liquidity. Which assets better capture precautionary saving is unclear, both theoretically and empirically. Illiquid assets, such as real estate and pension funds, may be less useful to prevent the effects of income shocks, because of the extra time or cost required for cashing them out. Thus, in this respect, it would not be surprising to find that holdings of more liquid assets is associated to higher uncertainty. However, we cannot ignore that for Italian households home ownership, and more generally real estates, are typically the largest component of their portfolios; likewise mortgages are their most relevant liabilities. Analogously, we should keep in mind that for households whose head are entrepreneurs (business owners), business equities and some business credit/liabilities are also important components of their net wealth.

Based on these considerations, we focus on a measure of 'Total Net Wealth' and perform robustness checks using two more liquid measures: 'Adjusted Wealth' and 'Financial Wealth.'[8] Basic sample statistics of these three measures are presented in Table 1. These confirm the fact that the average (and median) composition of wealth is largely skewed in favor of real assets. In addition, Figure 1 illustrates the composition of the total

	Sample B				Sample C			
	Count	Mean	Median	SD	Count	Mean	Median	SD
Total Net W.	2066	371.899	248.106	605.191	1332	354.866	255.176	501.140
Adjusted W.	2066	130.576	32.025	393.838	1332	107.379	29.904	259.412
Financial W.	2066	46.832	15.327	153.997	1332	41.315	15.000	94.122

TABLE 1. Three measures of wealth.

(gross) wealth, divided in four main components: Bank deposits, Government bonds, other riskier securities and real estate. Notice that for households below the 20th percentile of this indicator, deposits are the most relevant component of (gross) wealth (above 50%); while, for individuals above the 20th percentile, this role is played by real assets (80-90% of gross wealth); something that, for most households, coincides with their primary house. Instead, bonds play a minor role throughout the wealth distribution.

2.2.2. *Permanent income.* Permanent income is obtained from total net income Y_t, which is the sum of payroll income, transfers, self-employed income, and property income (real and financial). This is accomplished following a decomposition procedure suggested in King and Dicks-Mirraux (1982) and later exploited in a vast literature (*e.g.* Guiso et al. 1992; Lusardi, 1997; Lusardi 1998; and Arrondel, 2002). In this decomposition, permanent component Y_t^P is thought to depend on fundamental, demographic and economic characteristics of every household. It is computed using the predictions of a regression model that uses Y_t as dependent variable and a set of indicators of the households' characteristics as controls. The transitory component is computed residually, $Y_t^T = Y_t - Y_t^P$. We depart from the usual specification of this model, by including

[7]See Complementary material in our repository.

[8]'Total Net wealth' is real assets (real estate, business equity, valuables) + financial assets (deposits, government securities, other securities) - financial liabilities (to banks, financial companies, other households). 'Adjusted wealth' is Tot. Net wealth excluding the main home (or primary house) and business equities. 'Financial wealth' is exclusively composed of financial assets.

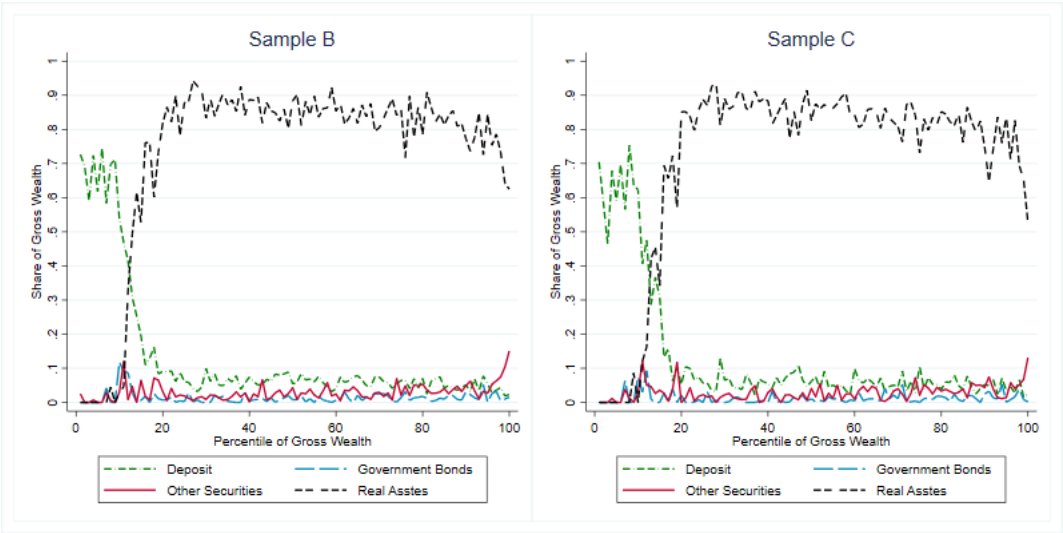

FIGURE 1. The composition of gross wealth by the percentiles of its distribution.

among these indicators some unique ones on households' trade opportunities and preference/attitudes, which are made available in SHIW 2012.[9]

Table 2 contains summary statistics of our income decomposition for both sample B and C. We notice that the average and median net-income is below its permanent component, and that the transitory component is negative. This result is reasonable considering that the survey refers to a year in which the Italian economy was still experiencing a severe economic and financial crisis.[10]

	Sample B				Sample C			
	Count	Mean	Median	SD	Count	Mean	Median	SD
Total Net Income	2066	41.352	35.995	27.248	1332	43.668	39.010	25.476
Permanent Income	2066	45.773	44.782	20.161	1332	50.330	49.213	19.633
Transitory Income	2066	-4.421	-5.266	19.460	1332	-6.662	-7.362	18.374

TABLE 2. Income decomposition. Values in 2012 Euros.

2.2.3. *Subjective risk in income.* Subjective risk in income is computed following the procedure in Guiso et al. (1992), with the major difference that we consider total income, as opposed to labor earnings. To summarize, each sample individual is asked to reveal her/his beliefs on the growth rate of nominal income one year ahead (z). This is achieved by inviting the respondent to place a probability weight on each indicated (intervals of percentage) income change. A similar question is used to measure the expected growth rate of a price index (π). These data are then used to compute the sample standard deviation of the growth rate of real income (x) one year ahead: $\sigma_y = \sqrt{\sigma_z^2 + \sigma_\pi^2 - 2\sigma_{(z,\pi)}}$. Then, the expected volatility of real income is measured as $\sigma_{y,t+1} = \sigma_y Y_t$.[11]

Two major problems emerged with this measure of risk computed on 1989 data, in Guiso et al. (1992): the high number of respondents declaring zero risk and the low variance of the indicator. For a rough comparison with the evidence based on 1989 data, we consider our sample C, excluding respondents older

[9]Appendix A.2 explains in greater details the income decomposition and the estimation of permanent income.
[10]The Italian sovereign debt crisis had its worst time in the first half of the 2012.
[11]For further details and summary statistics, respectively, see Appendix A.3 and A.4.

than 65.[12] Our findings reveal an even higher frequency of observations with a zero value; 43 percent of the

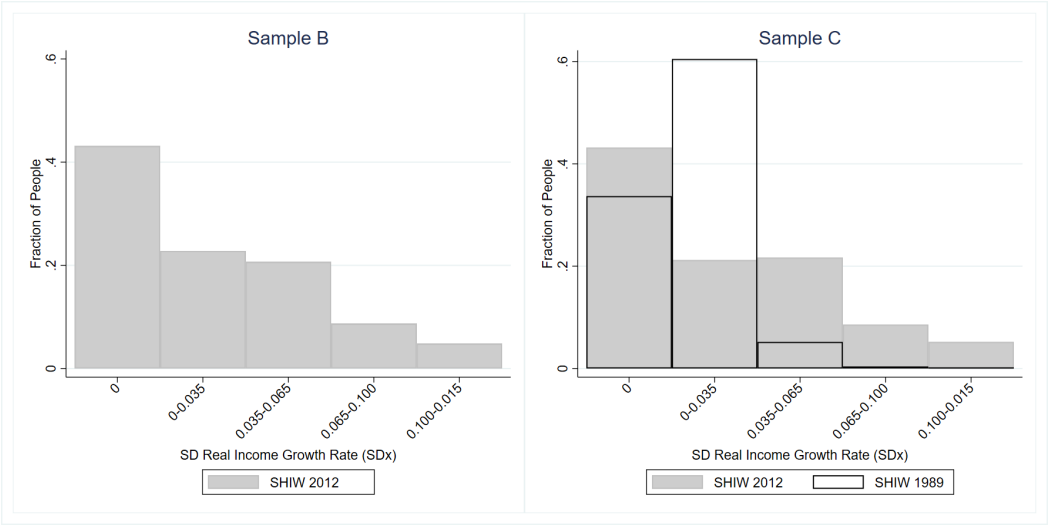

FIGURE 2. Empirical distributions of the standard deviation of the subjective growth of real income σ_y.

sample instead of 33.7 in SHIW 1989. However, they also document a much higher variance in the group of respondents declaring a positive risk. This is shown in Figure 2 detailing the empirical distributions of σ_{y_j} over individuals j, who are grouped by different classes of risk. In the 1989 survey, only around 6 percent of people had an uncertainty higher than 3.5 percent and less than 1 percent of them perceive a significantly high income-risk, higher than 6.5 percent; the corresponding figures in the 2012 survey, respectively, are about 35 and 13 percent.[13] This greater variability is particularly important as it reduces the threat of being unable to consistently identifying precautionary saving.

Finally, recall that our reference model of precautionary saving considers as a dependent variable the ratio of wealth to permanent income (see the Introduction). This implies that, in the rest of our analysis, we shall define 'subjective income risk' as $\sigma^2_{y,t+1}/Y^P_t$, the ratio of the expected income-variance over permanent income.

2.2.4. *Individual preferences: impatience and risk aversion.* One of the major advantages of the 2012 survey with respect to the 1989, is that it contains some questions which can be used to elicit individuals' patience and risk attitudes. In one of them the respondent is asked about his/her willingness-to-pay to anticipate (*i.e.* immediately obtain) the amount of a hypothetical inheritance which is due one year ahead. The price proposed to respondent j is a percentage θ_j of the inheritance, which we interpret as j's subjective, yearly *discount rate*. Coherently, we let this individual's subjective *discount factor* be, $\beta_j = 1 - \theta_j/100$.[14]

Risk attitudes are obtained through a survey question that offers every respondent j to participate in a risky gamble. More precisely, the individual is asked to indicate the fraction d_j of his/her financial assets L_j that he/she would be willing to liquidate in order to purchase a security that either duplicates its value or looses half of it every month, with equal probabilities. Then, every month, j can cash the reimbursement

[12]Even restricting to sample C, the comparison is rough because the questions in the two surveys differ. In SHIW 1989 beliefs on income variation are collected based on a 12 interval grid of positive increments and an alternative of some negative increment. Instead, the 2012 is based on 4 symmetric intervals placed around the central one $[-2, +2]\%$. Moreover, the question on prices is posed with respect to a generic index of 'inflation' in the 1989 survey and on an index of (local) housing prices in the 2012.
[13]Some additional analysis on risk in income is presented in appendix A.3.
[14]For further details and summary statistics, respectively, see Appendix A.3.1 and A.4. For an analogous measure see Guiso, Jappelli and Pistaferri (2002), Guiso and Paiella (2004).

of the security or use it to gamble again. We derive an (approximate) measure of Arrow-Pratt *coefficient of relative risk aversion* (RRA) by interpreting d_j as the maximal willingness-to-pay for this security by j, out of L_j. Assuming that individuals have expected utilities, we obtain the *coefficient of absolute risk aversion* (ARA) as,

$$ARA_j \approx \frac{4}{5}(d_j L_j)^{-1}$$

and the coefficient of relative risk aversion (RRA) as, $ARA_j L_j = (4/5)d_j^{-1}$.[15]

According to the theory, individuals with a high discount factor β have a high propensity to save and accumulate wealth. By converse, the overall effect of risk aversion on saving decisions is, in general, ambiguous. More precisely, in standard expected utility models, the coefficient of relative risk aversion has offsetting effects: accumulation is decreasing in RRA if consumers are 'impatient' and increasing if they are 'patient'. This is the consequence of the fact that RRA is in inverse relationship with the elasticity of intertemporal substitution (EIS).[16] Therefore, to appropriately detect these opposite effects, we define two variables:

$$EIS_j^P = I_p \cdot EIS_j, \quad EIS_j^I = (1 - I_p) \cdot EIS_j$$

where $EIS_j \equiv 1/ARA_j$, and I_p is a binary indicator that splits the sample in patient/impatient individuals. We define as 'patient' ($I_p = 1$) those individuals with a subjective discount rate θ_j ($= \beta_j^{-1} - 1$) that is below the economy real interest rate i; and as 'impatient' all the others (see also footnote 21 below for a discussion of this definition). Data indicate that i is approximately 3 percent in the reference period.[17] Therefore, we let $I_p = 1$ for all respondents j with $\beta_j > .97$. 'Impatient' ($I_p = 0$) is the complementary group.

Table 3 contains sample statics for the four measures of preference characteristics we have described.

	Sample B				Sample C			
	Count	Mean	Median	SD	Count	Mean	Median	SD
β	2066	0.936	0.971	0.069	1332	0.939	0.971	0.066
ARA	2066	0.025	0.005	0.072	1332	0.025	0.005	0.061
EIS^P	2066	1359.9	19.02	8919.5	1332	1302.0	24.27	7542.0
EIS^I	2066	-950.1	0.000	5337.4	1332	-1042.4	0.000	6188.6

TABLE 3. Patience, risk aversion, elasticity of intertemporal substitution.

2.2.5. *Liquidity and credit constraints.* SHIW 2012 contains very detailed information on the occurrence of liquidity constraints, both actual and expected, and credit constraints. There are important theoretical reasons to exploit this level of detail, on which we shall return later.

We define three binary indicators for *liquidity constrained* households, two 'actual' (or 'effective') and one 'expected.' The first is a subjective indicator (*SubjLiqCon*) and identifies households who declare to have a total disposable income that is insufficient to allow the household 'to live reasonably comfortably but not in luxury.' The second indicator is 'objective' (*ObjLiqCon*) and identifies liquidity constrained households as those who were more than three months late in the payment of their ordinary living expenses (rent, utility bills or loans), during the 2012. A third indicator on the occurrence of expected liquidity constraints

[15]See Appendix A.3.1 for further details.

[16]If preferences are standard additively separable vNM, with CRRA felicity, the two coefficient are exactly one the reciprocal of the other. A more general class of utilities, preserving recursivity and stationarity, is Kreps and Porteus' (1978). Epstein and Zin (1989) showed that this class of preferences allows a separation of RRA from EIS, and that the relationship between these two is still of inverse proportionality in some of the most popular homogeneous utility representations.

[17]The interviews of the sample survey on the income and wealth of Italian households in 2012 were conducted between January and August 2013. The inflation rate equals 1.45%, when measured as the average rate of change of the consumer price index in the period of the interviews. In the same period, 4.35 is the nominal average interest rate of 10-year government bond (BTP).

($ExpLiqCon$), looks at households who think they are unable to save enough money to face future unexpected disbursements.

To identify situations of binding credit constraints, first, we consider households who have been 'credit rejected;' namely, families who applied for a loan or a mortgage during the 2012 or in one of the previous two years was, and received (even if only partially) a denial. Second, we consider households that are 'credit discouraged;' that is, with any of its members who had considered to apply to a loan or a mortgage in 2012, but then did not because thought their request would be declined.[18] These two groups are formed by very few households; 20 are credit rejected and 50 are discouraged (respectively, about 1% and 2.4% of sample B). Moreover, only three households are simultaneously members of the two groups. Thus, we decided to address as of 'credit constrained' ($CreditCons = 1$) the households who belong to either one of those groups.

We summarize how these liquidity- and credit-constrain indicators interact with each other in Table 4. This illustrates how households sort into different groups based on the different constrain indicators c listed

c	$Pr(c\|c_1)$	$Pr(c\|c_2)$	$Pr(c\|c_3)$	$Pr(c\|c_4)$	$Pr(c)$	Count
c_1	1	.55	.1	.15	.039	80
c_2	.084	1	.189	.063	.253	523
c_3	.011	.133	1	.019	.359	742
c_4	.179	.493	.209	1	.032	67

TABLE 4. Liquidity constrain indicators, sample conditional probabilities. $c_1 = ObjLiqCon$, $c_2 = SubjLiqCon$, $c_3 = ExpLiqCon$, $c_4 = CreditCon$. Sample B.

in the first column. Sorting can be seen in columns 2-4, each of which reports the sample conditional probabilities that a household faces a particular constrain c_j ($c_j = 1$) when it is subject to a constrain c_k ($c_k = 1$). Instead, the last column presents the unconditional sample probabilities of the different indicators c.

From the penultimate column of the Table 4, it is immediately evident that, while only 3.9 percent of households is objectively liquidity constrained in 2012 ($c_1 \equiv ObjLiqCon = 1$), a much larger fraction declares either to be constrained ($c_2 \equiv SubjLiqCon = 1$) or to expect to be so in the next future ($c_3 \equiv ExpLiqCon = 1$) (respectively, about 25% and 36%). However, not all those falling in the group of objectively constrained are also part of the last two categories; only about 55 and 10 percent of the 'objectively' liquidity constrained, respectively, declared that the household's income is insufficient to 'live reasonably comfortably' ($SubjLiqCon = 1$) or to avoid liquidity constrains in the next future ($ExpLiqCon = 1$). To confirm that the three indicators capture sufficiently independent phenomena, we notice that there are only 8 households (0.4 % of sample B) who are liquidity constrained according to all three indicators. It is clear that credit ($c_4 \equiv CreditCon = 1$) and liquidity constrains interact significantly with each other. Although only 3.2 percent of the sample appears to be tied to credit, almost 18 percent is (objectively) is liquidity constrained (almost 50% is subjectively tied) and about 21 percent expects to be so in the future.

For further details and summary statistics, respectively, see Appendix A.3.2 and A.4.

3. Main results

To help comparisons with earlier studies, we start by estimating a model of total net wealth over a subsample of individuals younger than 65 (our sample C). We shall later comment how these results extend to the two other measures of wealth considered. Further extensions and robustness test are postponed to

[18]The distinction between 'credit constrained' and 'credit discouraged' has been first proposed in Jappelli (1990), who considered data from 1983 U.S. Survey of Consumer Finance.

section 4, where we run our analysis on the whole sample of individuals, up to age 80 (sample B), and explicitly address the effects of excluding business-owners from our samples.

3.1. **A model of total net wealth.** As for the general model presented in the Introduction, we regress the log-ratio of wealth to permanent income $\ln(W/Y^P)$ on our measure of subjective risk in income σ_y^2/Y^P, and on three types of household characteristics (see Table 5). Of these characteristics, we focus on just two: **preferences**, captured by the respondent's subjective discount factor β, and by the indicators of risk aversion EIS^P and EIS^I; **trade opportunities**, represented by the household's exposition to liquidity constraints (*ObjLiqCon*, *SubjLiqCon*, *ExpLiqCon*), credit constraints *CreditCon*, and by its status of real estate owner (*HomeOwner*, *OtherHouses*, *NewHomeOwner*).

	(1) $\ln(W/Y^P)$		(2) $\ln(W/Y^P)$		(3) $\ln(W/Y^P)$		(4) $\ln(W/Y^P)$	
	b	se	b	se	b	se	b	se
Subj. Income Risk								
$\sigma_y^2/Y^P \times .01$	0.077***	0.009	0.080***	0.009	0.068***	0.009	0.060***	0.007
Preferences								
EIS^P			0.073	0.375	0.149	0.367	0.364*	0.209
EIS^I			-0.351*	0.200	-0.195	0.186	-0.328**	0.157
$\beta \times 100$			0.012**	0.006	0.003	0.005	0.001	0.004
Econ. Cond.								
CreditCon					-0.263	0.171	-0.041	0.127
ObjLiqCon					-0.524**	0.226	-0.249	0.158
SubjLiqCon					-0.785***	0.088	-0.394***	0.061
ExpLiqCon					0.255***	0.061	0.156***	0.045
HomeOwner							1.953***	0.083
OtherHouses							0.539***	0.051
NewHomeOwner							-0.225***	0.084
Constant	-0.264	0.272	-1.447**	0.598	0.120	0.580	-0.257	0.454
Demographic	Yes		Yes		Yes		Yes	
Geographic	Yes		Yes		Yes		Yes	
Occupation	Yes		Yes		Yes		Yes	
N	1332		1332		1332		1332	
R^2_{adj}	0.132		0.134		0.229		0.592	
aic	4305.3		4304.8		4154.5		3310.2	

$* \; p < 0.10, \; ** \; p < 0.05, \; *** \; p < 0.01$

TABLE 5. Regression outcome. Dependent variable: log of Total Net Wealth over permanent income. OLS with std errors robust to heteroscedasticity. Sample C.

Estimation results in Table 5 are presented for four model specifications. These, enumerated from (1) to (4), contain the indicator of subjective risk in income and progressively richer specifications of households characteristics. In particular, (1) only includes some basic demographic and socio-economic characteristics that we omitted for brevity, (2) introduces preferences, (3) adds liquidity and credit constraints, (4) includes three binary variables on the households' real estate properties.

Model (1) indicates that the level of accumulated net wealth, relative to its 'target' Y^P, increases in the subjective risk in income. The coefficient associated to this variable is positive and significative; although, the magnitude of precautionary saving is more easily interpreted in terms of the elasticity with respect to total net wealth $\varepsilon(1)$ in Table 6. Elasticities are measured as the change of W due to a marginal change in σ_y^2.[19]

[19]Their computation results from, $(\partial W/\partial \sigma_y^2) \cdot (\sigma_y^2/W) = \widehat{b}_2 \cdot (\sigma_y^2/Y^P)$, where $\widehat{b}_2$ is the estimated coefficient associated to the risk variable σ_y^2/Y^P in our regression model. To help comparisons with the elasticities in Guiso et al. (1992) and Lusardi

		$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$
σ_y^2/Y^P	mean	.0622	.0639	.0545	.0479
	sd	.1775	.1824	.1556	.1365

TABLE 6. Precautionary saving: Estimated elasticities with respect to Tot Net Wealth; mean and standard deviation; models (1)-(4). Sample C.

In specification (2) preference characteristics are introduced. According to the theory, individuals with a higher discount factor β have a higher propensity to accumulate wealth. Further, as noted in Carroll et al. (2017), a substantial sample dispersion of β may help to explain the large cross-sectional variance characterizing households' wealth (see our discussion in Appendix A.3.1). By converse, the overall effect of risk aversion on saving and accumulation is, in general, ambiguous. As we argued in section 2.2.4 above, common expected utility models have the property that the relative risk-aversion coefficient (RRA) is in a reciprocal relationship with the elasticity of intertemporal substitution (EIS). Therefore, by regressing a measure of wealth accumulation on an index of risk aversion, the estimated coefficient may take either signs, depending on whether the individual is 'patient' or 'impatient,' or may be non-significative. This is what we recurrently found in our preliminary analysis.[20] It is also what actually motivated us to split the EIS in the two separate indicators, EIS^P and EIS^I, based on the individuals' degree of patience (see section 2.2.4 above).[21] As expected, we found that accumulation increases in the 'patience' indicator and decreases in the 'impatience,' both in model (2) and, more generally, in the rest of the analysis.

Model (3) introduces various indicators of liquidity and credit constraints, discussed in section 2 above. Liquidity constrains have diverse and potentially strong effects on households' saving decisions. In particular, following Deaton (1991), we differentiated 'actual' from 'expected' liquidity constraints. The underline idea is that liquidity constrained households tend to hold a level of net wealth below its target, in the attempt to sustain consumption; while expected liquidity constrained tend to increase current asset accumulation to finance future consumption. Our results confirm this interpretation for all measures; the two 'actual' ones, based on a subjective and an objective indicator, show that a constrained individual reduces accumulation with respect to its target, respectively, by 78.5 and 52.4 percent; the 'expected' one reveals that a constrained individual raises accumulation by 25.5 percent. Moreover, the overall contribution of these indicators in explaining the cross sectional variance of the wealth accumulation is substantial and seems to absorb most of the effect of preference indicators. This is especially true for β and can be seen more clearly looking at model (4). We interpret this effect mostly as the result of the fact that situations of financial distress are, at least partially, related to past decisions (*e.g.* concerning education, employment and saving).[22]

(1997), we have reported the values obtained using their definition in Appendix B. In general, these alternative definitions give elasticities of the same order of magnitude.

[20]Our empirical finding are consistent with Arrondel's (2002), who used a very similar measure of ours RRA. In Arrondel's, the estimated coefficients associated to a categorial variable built for different classes of RRA values, alternate in sign and, in general, are non-significative.

[21] This can also be seen considering a standard Euler equation model,

$$\mathbb{E}_t\left[\Delta\log(c_{t+1})\right] = \frac{1}{c_t r(c_t)}\left(\frac{i_{t+1}-\theta}{1+i_{t+1}}\right) + \frac{1}{2}p(c_t)\mathbb{E}_t\left[(\Delta\log(c_{t+1}))^2\right]$$

where θ is the subjective discount rate; $p(c_t) \equiv -c_t u'''(c_t)/u''(c_t)$ is Kimball's coefficient of relative prudence; $r(c_t)$ is the RRA_t, and $1/r(c_t)$ is the EIS_t. Whether the individual is 'patient' or 'impatient' depends on how large is the interest rate with respect to θ, $i_{t+1} - \theta \gtrless 0$. Clearly, an increase in RRA raises (reduces) savings/consumption-growth for patient (impatient) individuals. See, for example, Carroll (1997) for a discussion on this point.

[22]Statistically, we found that households' permanent income is increasing in patience and decreasing in risk aversion, after controlling for their current and past employment status. Moreover, households' problems of liquidity and access to credit are more evident among respondents with a lower permanent income.

Finally, in (3) we also keep distinct situations in which households run into 'liquidity constrains' from 'credit constraints.' In reality, liquidity constraints are typically associated to circumstances in which an individual is short of cash or liquid assets. Thus, perhaps excluding individuals who run a personal business, most Italians find costly to finance daily payments (*e.g.* utility bills, house rent etc.) in debt, even in the form of overdraft facilities and credit card debt. By contrast, for these households the most important component of credit is mortgages acquired to purchase or renovate their home (see data and discussion in section 2.2). Moreover, the relatively low fraction of credit-constrained suggests that households tend to apply for mortgages only when they believe they are eligible; something that, among other things, requires their ability to meet the required down-payment. Such an interpretation is coherent with the empirical evidence showing that those who have recently purchased their main house experience a drop of their ratio of net-wealth to permanent income.[23] In model (4) the effect of acquiring the house of residence is captured by the binary variable NewHomeOwner.[24] The estimated coefficient is negative and significative, signaling that the negative effect of this decision on the holding of other assets and the positive effect on liabilities. A simple graphical illustration shows that these effects are especially evident for adjusted net wealth, which does not comprise home ownership (but include mortgages), in Figure 3. Moreover, we found that adjusted wealth of 'new home owners' becomes negative if we exclude from the group of new homeowners those families who own other houses.

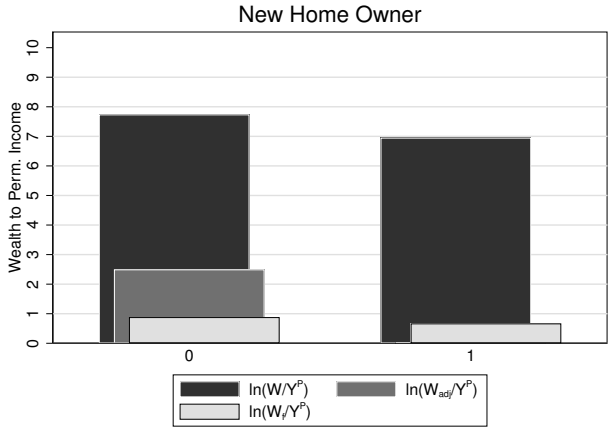

FIGURE 3. Ratios of wealth to permanent income for our three measures of wealth. Sample C.

To summarize, estimation results indicate that the average contribution of precautionary saving is significative, but 'small;' around 4-6 percent of total net wealth, not much higher than the one resulting from the OLS estimates on earning risk in Guiso et al. (1992) and in Lusardi (1997), based on SHIW 1989 (see Table 6). However, the inclusion of covariates representing households' preferences and economic conditions has considerably improved the explanatory power of the model and, as we further discuss in the next section, it also significantly affects the estimated elasticity of the precautionary component. Moreover, with respect to traditional, more parsimonious specifications, our does not include among the regressors, variables such as

[23]For an in deep, empirical analysis of the relevance of down payments on home ownership see Chiuri and Jappelli (2003).

[24]This variable which takes value 1 for those households who have purchased or built their primary residence in the last five years prior the interview, and 0 otherwise. The choice of including households who have purchased their home in the years prior 2012 is motivated by the sample size/characteristics. In fact, first, we noticed that very few people in the sample have become home owners in 2012; second, the decision to purchase (or build) a house seems to have persistent effects on wealth, especially, excluding the home value (our measure of adjusted total net wealth). This is shown in Figure 3 below.

the log of permanent income, normally used as a proxy of the respondent preferences; or a higher-order polynomial function of the respondent's age, typically used to capture life-cycle properties of the cross-sectional distribution of wealth that were otherwise unexplained.[25]

3.2. **Omission variable bias and precautionary saving.** We now ask to what extent the use of information on household preferences and trade opportunities might actually prevent the occurrence of bias in the estimation of the average magnitude of precautionary saving, given our baseline model and data. To answer this question we test whether the inclusion of specific covariates, from model (1) to (4), produces significative changes in the estimated elasticities of precautionary saving. Moreover, given the empirical relevance of liquidity constraints and home ownership, we try to better understand how these indicators interact with each other and with preferences.

Before proceeding to formal testing, it is useful to start by summarizing what is the expected sign of each kind of bias. The direction of an omission variable bias on the elasticities ε, depends on two factors: the sign of the coefficient associated to the variable that could be omitted, and the sign of the covariance between that variable and the subjective risk in income (σ_y^2/Y^P). On the first sign we have conjectures, based on economic theory, which we have discussed above; while on the second sign, providing a theoretical explanation is more difficult, and we begin by letting the data speak. Table 7 summarizes these signs and the resulting directions of the bias.

	Correlation	Coefficient	Bias
β	$-$	$+$	$-$
EIS^P	$-$	$+$	$-$
EIS^I	$-$	$-$	$+$
CreditCon	$+$	$-$	$-$
SubjLiqCon	$-$	$-$	$+$
ObjLiqCon	$-$	$-$	$+$
ExpLiqCon	$+$	$+$	$+$
HomeOwner	$+$	$+$	$+$
OtherHouses	$+$	$+$	$+$
NewHomeOwner	$-$	$-$	$+$

TABLE 7. Correlations are wrt σ_y^2/Y^P. Coefficient signs are estimated from our model. Bias results as the product of the former signs. Sample C.

Turning to our estimation results in Table 6 above, we notice that the introduction of preferences in (2) tends to rise the elasticity of precautionary saving. Qualitatively, this is coherent with the commonly shared opinion of the existence of a (potentially serious) problem of selection bias associated to the measure of risk in income. However, quantitatively, this hypothesis is rejected by data, as the change of the estimated elasticity is statistically non-significative. Indeed, the estimated standard deviations associated to ε are quite large, indicating a sensible cross-sectional variance of the precautionary component. We illustrate this in Figure 4, where we have graphed the confidence intervals of the average elasticities $\varepsilon(\cdot)$ associated to models (1) to (4).

In particular, comparing (1) and (2) does not reveal a significative bias associated to preferences. However, in general, one has to be careful on the fact that the sign of the potential bias associated to omitting β may

[25]The inclusion of permanent income has been justified to account for the possibility that preferences are non-homothetic. However, we notices that this variable tends to completely loose its statistical significance once we control for both preference characteristics and liquidity constraints in models (3) and (4); something that makes us suspicious of the effective role played in traditional specifications. Second-degree or higher-order polynomials of Age have been used since King and Dicks-Mireaux (1982) by all authors. We tested different polynomial structures of the second order, but could not reject the linear specification in Age.

differ from the one associated to indicators of risk aversion. In our context, this is the case of EIS^I; in Table 7 the sign of the bias of omitting this variable is different from the corresponding signs of β and of EIS^P. Something can also be said on the covariance signs. For example, individuals who are more patient might achieve higher educational levels and this tends to reduce their exposure to unemployment risk. This would explain why the covariance between β and income-risk is negative. A positive (resp. negative) covariance between RRA (resp. EIS) and income-risk is typically explained by noticing that risk-averse individuals sort to 'safer' occupations (*e.g.* in the public administration), and prefer safer investments. Instead, the

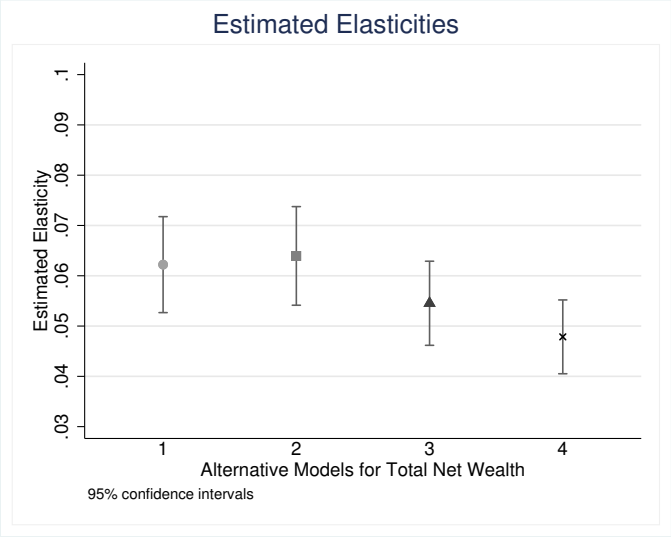

FIGURE 4. Confidence intervals for the sample means of $\varepsilon(1) - \varepsilon(4)$. Sample C.

introduction of liquidity constraints and of indicators on real estate ownership, have a significative impact on the estimated mean elasticity in models (3) and (4), respectively. In both cases the final effect is to reduce the ε's. Moreover, as Table 7 highlights, the sign of the bias associated to omitting any of these indicators is unambiguously positive. Given the empirical relevance of these indicators, it is worth trying to further explain their effects on precautionary saving.

We have said above why theory predicts that 'effective'- (*i.e.* subjective or objective) and 'expected'- liquidity constrains have opposite signs on wealth accumulation. In traditional buffer stock models, individuals respond to the foreseen liquidity/credit constraints by displaying an increasing level of prudence.[26] Mapping this into our setting, people who are expected to be liquidity constrained, have an higher subjective risk in income and decide to increase accumulation (*i.e.* increase precautionary saving). This essentially explains the two positive signs in the row associated to *ExpLiqCon* in Table 7. Instead, coherently with consumption smoothing, households who are 'effectively' liquidity constrained tend to accumulate relatively less wealth; and this is particularly true for those who are not expecting to find themselves short of cash in the future, as it is for almost all households in our sample.[27] In addition, for households who are constrained at present but do not expect to be so in the future, it is plausible to find a more 'optimistic attitude' toward income

[26]Prudence is higher in consumption functions which are more concave; and since consumption concavity enhances the concavity/prudence of the value function, precautionary saving is reinforced in the presence of binding constraints. A similar effect is obtained by an increase in expected income risk. See, for example, Carroll, Holm and Kimball (2021).

[27]It is important to recall that, by definition, the set of households who are expected-liquidity constrained and those who are 'effectively' liquidity constrained have a negligible intersection (only very few respondents are in the two groups). Thus, when considering the behavior of people in the first group, we have to keep in mind that these households believe they will not be constrained in the future.

risk in the future. This, if true, would explain the negative correlation recorded in the Table between σ_y^2/Y_P and the indicators of 'effective' liquidity constrains. Overall, omitting the indicators of 'effective' liquidity constraints bias upwards the estimated elasticity of precautionary saving; and this indicates that this group of households tend to have a lower precautionary motive for saving.

A further consideration concerns the effect of becoming a homeowner. From the results in the previous section, it seems clear that acquiring the primary house of residence is a major plan for most households (at least for its size). Around the time in which this plan is realized, households experience a reduction of their net wealth (these are the New Home Owners). Later on, becoming a homeowner is associated to a higher ratio of wealth-to-permanent income. This evidence is reinforced for those households who decide to purchase other real estate properties (OtherHouses). But the question we wish to answer here is if and how the acquisition of real estates alters the households' attitude toward precautionary saving. A first qualitative answer is offered in Table 7, which points to the fact that omitting any of the housing indicators tends to bias the estimated elasticity of precautionary saving upwards. Quantitatively, an evidence of a significative bias is offered observing that the drop in the average elasticity, from $\varepsilon(3)$ to $\varepsilon(4)$ in Table 6, is statistically significative at the 95%. All this indicates that home ownership is associated to a lower estimated elasticity of precautionary saving. Such an evidence may be the consequence of the fact that for Italian households real estate properties tend to be associated to sounder patrimonial conditions, which may be thought to convey a grater sense of security and a lower attitude toward precautionary saving.

Finally, we verify if different groups of households, defined based of our three indicators of home ownership, have an elasticity of precautionary saving that is significatively different from the mean. The hypothesis that homeowners have a lower elasticity of precautionary saving was tested and accepted by Lusardi (1997), who excluded this group from her sample. Differently from Lusardi, we run our tests keeping all the individuals in the sample and introducing interaction terms. In particular, to test the presence of significative group-differences in precautionary saving, we add to the covariates of model (4) as many interaction terms as the dummy variables in Table 7.[28] Each interaction term is the product of a particular indicator with the variable of perceived income risk, σ_y^2/Y^P.[29] Results show that the only group whose precautionary motive is significatively different from the sample mean is the one of credit constrained households. This group has an estimated elasticity of precautionary saving of 24.2 percent, five times higher than the sample mean (4.8%); while the group of unconstrained households have an elasticity of 2.4 percent.

3.3. **More liquid measures of wealth.** Recall that our 'more liquid measures of wealth' are Adjusted Wealth (W_a) and Financial Wealth (W_f). The first is obtained from total net wealth, by dropping business equities and home ownership; while the second consists of financial assets. A part from the definition of the dependent variable, regression models (5) and (6) have the same exact specification of (4) above (see Table 5). Estimates are presented in Table 8, and the corresponding average elasticities of precautionary saving are compared with $\varepsilon(4)$ in Table 9.

Table 9 and Figure 5 show that eliminating the most illiquid components of wealth (the primary house of residence and business equities) produces a small but significative increase of the estimated elasticity of precautionary saving.[30] Yet, contrary to what we expected, estimates show that the precautionary saving component does not significantly vary across the two more liquid definitions of wealth. In general, the small variability of precautionary saving across different measures of wealth is positive, if interpreted as a

[28]We have also considered more parsimonious specifications, combining similar indicators (*e.g.* SubJLiqCon and ObjLiqCon), and nested models.

[29]It is a dummy variable that takes value σ_y^2/Y^P only for those individuals who are part of a selected group and zero otherwise. This is included in the regression model in addition to the original variable σ_y^2/Y^P. Then, elasticities are computed based on a their estimated coefficients.

[30]See Table 20 in Appendix B for a closer comparison with Guiso et al. (1992).

	(5) $\ln(W_a/Y_P)$		(6) $\ln(W_f/Y_P)$	
	b	se	b	se
Subj. Income Risk				
$\sigma_y^2/Y^P \times .01$	0.073***	0.014	0.074***	0.012
Preferences				
EIS^P	0.641*	0.359	0.509*	0.282
EIS^I	0.065	0.372	-0.137	0.246
$\beta \times 100$	0.009*	0.005	0.019***	0.005
Econ. Cond.				
CreditCon	0.197	0.156	-0.276	0.173
ObjLiqCon	-0.428**	0.186	-0.761***	0.173
SubjLiqCon	-0.528***	0.083	-0.432***	0.085
ExpLiqCon	0.440***	0.067	0.741***	0.070
HomeOwner	0.023	0.083	0.030	0.087
OtherHouses	1.591***	0.069	0.180**	0.077
NewHomeOwner	-0.174	0.158	-0.264**	0.125
Constant	-1.595***	0.569	-3.388***	0.567
Demographic	Yes		Yes	
Geographic	Yes		Yes	
Occupation	Yes		Yes	
N	1160		1332	
R^2_{adj}	0.441		0.261	
aic	3517.9		4253.4	

$* \; p < 0.10, \; ** \; p < 0.05, \; *** \; p < 0.01$

TABLE 8. Regression outcome. Adjusted Wealth and Financial Wealth. Sample C.

		$\varepsilon(4)$	$\varepsilon(5)$	$\varepsilon(6)$
σ_y^2/Y^P	mean	.0479	.0620	.0592
	sd	.1365	.1784	.1690

TABLE 9. Precautionary saving: Estimated elasticities with respect to the three measures of wealth; models (4),(5),(6). Sample C.

robustness check of our results. Thus, for example, it may be used to reject the hypothesis that there may be a measurement error of precautionary saving due to the choice of any of the two more liquid measures of wealth W_a and W_f. However, in an economic perspective, this result is puzzling, as it suggests that households react to a change of income risk by simply re-scaling their 'liquid' portfolios.

The hypothesis that more risk leads to a simple re-scaling of assets may be plausible if the main motivation for holding precautionary assets is to self-insure against rare but large shocks to income, such as severe health problems or long spells of unemployment. In fact, in this case, liquidation costs would probably not be a major concern for prudent individuals, and any change of risk would essentially lead households to adjust all their 'liquid' assets proportionally. To verify the soundness of this argument, we exploit disaggregate data on wealth and check whether the proportions of different asset holding, relative to total wealth, are sensitive to income risk. Precisely, we divide assets in four aggregates: *deposits*, including both bank and postal accounts; *government bonds*, including all types of bonds issued by the Italian government on the market; *non-government bonds and equities*; *real assets*, mostly consisting in real estate properties. Then, we define portfolio shares as the ratio of each of these aggregates with respect to household's total wealth. Finally, we test the hypothesis that any of these portfolio shares is sensitive to income risk, based on a Tobit model with

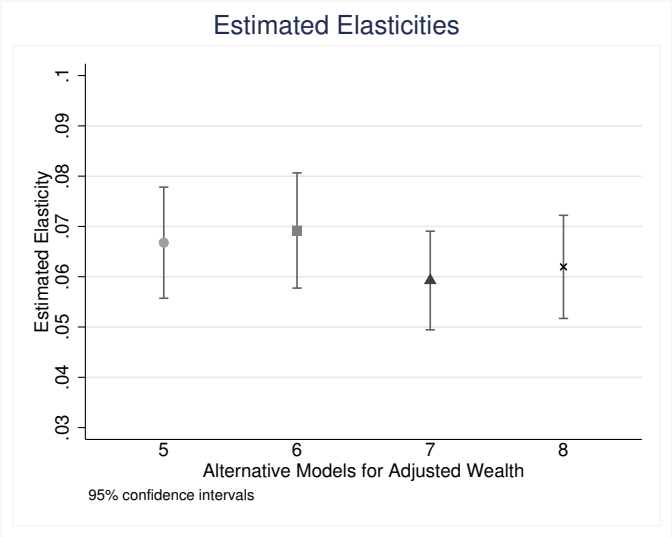

FIGURE 5. Confidence intervals for the sample means of $\varepsilon(4), \varepsilon(5), \varepsilon(6)$. Sample C.

a specification similar to models (4)-(6) above. Results, which are detailed in Appendix C, robustly reject this hypothesis, supporting the simple re-scaling argument.[31]

4. Extensions: The relevance of senior citizens and business owners

In the previous section we estimated the relevance of precautionary saving over a sample of households whose head is younger than 65 (sample C), and found that it amounts to an average of 4-6 percent of total net-wealth. In this section, we analyze if these results are sensitive to a sample revision that includes respondents who are as old as 80 years (sample B) and to one that exclude business owners.

4.1. **Senior citizens.** Qualitatively, the analysis conducted on sample B confirms all the results obtained above. Instead, quantitatively, we found that including senior citizens reduces the estimated elasticity of precautionary saving by about one percentage point for the two measures of net wealth and by about two percentage points for financial assets (see Table 10).[32] All these differences are statistically significative.

		$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$	$\varepsilon(5)$	$\varepsilon(6)$
σ_y^2/Y^P	mean	.052	.053	.046	.038	.047	.030
	sd	.171	.175	.153	.127	.155	.100

TABLE 10. Precautionary saving: Estimated elasticities models (1)-(6). Sample B

One possible interpretation of this phenomenon is that, as people become older and approach, or enter, the retirement age, the relative importance of income-risk diminishes with respect to other risks, such as longevity- and health-risk. Moreover, it is possible that perceived income risk itself drops, especially, for those households whose main source of income are pension transfers, which can be regarded as riskless. Although we are unable to test the first conjecture on our data, we found evidence that essentially rejects the second one. In fact, data show that the income risk perceived by retired workers depends more on the level of household's wealth than on the relative importance of pension transfers with respect to capital

[31] A somewhat different conclusion is reached in Guiso, Jappelli and Terlizzese (1996) who regress a similar Tobit model on data from SHIW 1989. This difference is even more striking if one considers that the measure of risk in income we consider is based on 'total income,' as opposed to theirs that was based on labor-earnings and pensions only.

[32] See Table 21 in Appendix B for a closer comparison with Guiso et al. (1992).

income (*i.e.* income from financial and real assets). To illustrate this point, we divide pensioners into three groups, based on the fraction f of their capital income with respect to total. Then, we notice that the group with the smallest f has an average perceived risk in income higher than the one with the highest f. This is shown in the left panel of Figure 6, where the three groups are labelled "Low", "Mid" and "High," for increasingly higher fractions f.[33] The right panel in the figure shows that perceived income risk is decreasing in total net wealth. Both patterns in the figure hold irrespectively of the sample considered.

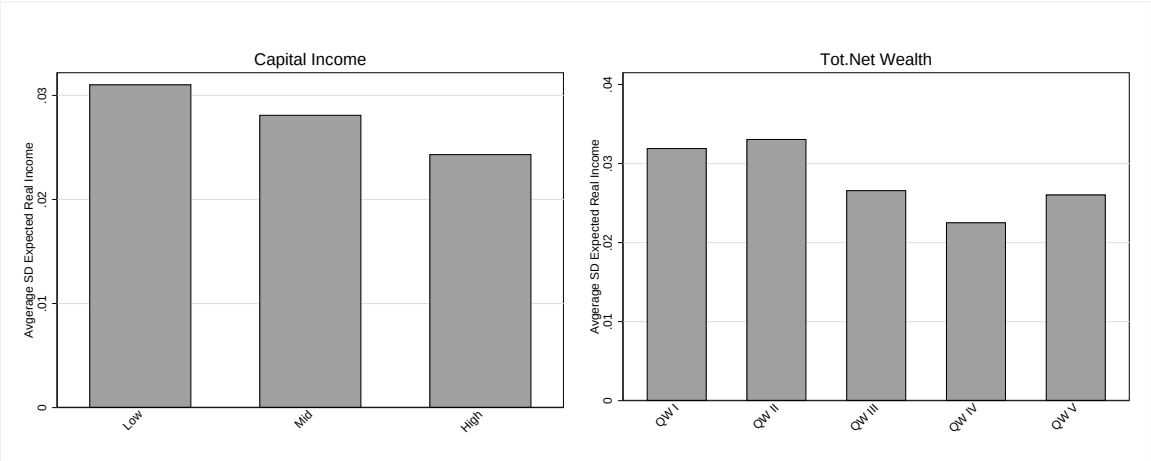

FIGURE 6. Pensioners' perceived risk in income by the fraction of capital income (first panel) and by the distribution of total net wealth (second panel). Sample B.

As a final remark we notice that the lower average sensitivity of the elderlies to total income risk need not be in contrast with the 'wealth decumulation puzzle' emerged also for Italian households. In fact, a reduction of precautionary saving defined with respect to total income risk may be accompanied with a higher propensity to save for other risks (*e.g.* health and longevity risks) and motives (*e.g.* the desire for bequests and intergenerational transfers).[34] Along these line, elderly households may become less sensitive to their income risk, and still remain concerned with keeping a certain level of wealth to ensure their welfare as well as the welfare of their progeny.

4.2. **Business owners.** A potentially relevant source of bias relates to disparities in saving motives, not immediately imputable to preferences or to economic possibilities. In particular, Hurst et al. (2010) presented some empirical evidence in support of the hypothesis that failing to properly accounting for differences between entrepreneurs and non-business owners, can lead to an upward bias in the estimates of precautionary saving in studies on household wealth. More precisely, the fact that business owners tend to hold a relatively larger stock of wealth and face high income risk, gives rise to a correlation between risk in income and wealth that has little to do with precautionary motives. By contrast, this correlation is imputable to the specific nature of risk and, perhaps, to the absence of specific insurance mechanisms (*e.g.* 'business risk' may be more difficult to diversify). To account for this, in our previous analysis we have considered Adjusted Wealth and Financial Wealth, as alternative measures of saving accumulation, but kept business owners. Instead, in

[33]The group thresholds of f are defined as follows. Given the average fraction of capital income $\mu = .253$ and a standard deviation $s = .138$ for the labor pensioner, the "High" group is the one with $f > \mu + s$, and the "Low" is the one with $f \leq \mu - s$. These are respectively formed by 133 and 106 individuals. The remaining 667 form the "Mid" group.

[34]Up to date references on the large literature on saving after retirement can be found in De Nardi et al. (2016). A recent article by Ventura and Horioka (2020) uses data from SHIW to analyze the role of bequest and precautionary saving of elderly Italian households.

this section, we drop business owners (*i.e.* 'self-employed') from sample B and C, and consider all measures of wealth.

The estimated average elasticities from our six models, are reported in Table 11, both with regard to sample B and C, without business owners.[35] Next, we compare the results obtained regressing models of different measures of wealth, (4)-(6), with those found for sample C in Table 9 and B in Table 10.[36] This comparison reveals that the change of coefficients is noticeable; though, it is statistically significative only for the measures of Total Net Wealth and Financial Wealth. Instead, when Adjusted Wealth is considered (*i.e.* business equities are dropped from the measure of wealth), including or excluding business owners does not change the average magnitude of precautionary saving.

σ_y^2/Y^P		$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$	$\varepsilon(5)$	$\varepsilon(6)$
Sample B	mean	.049	.051	.047	.035	.037	.010
	sd	.146	.151	.140	.105	.113	.029
Sample C	mean	.059	.063	.058	.043	.045	.034
	sd	.124	.131	.121	.089	.094	.071

TABLE 11. Precautionary saving: Estimated elasticities models (1)-(6), sample B and C, without self-employed individuals ($N_B = 1773$, $N_C = 1069$).

We think that financial wealth is not a good measure to use in the estimate of precautionary saving, based on the fact that entrepreneurs tend to privilege real wealth to financial wealth in their accumulation decisions. Indeed, we found that entrepreneurs tend to have a ratio of Adjusted Wealth to permanent income that is (at least) 4 times higher than the average one of any other category of employed individuals; for craftsmen it is about 2.8, slightly above the third highest one, corresponding to the managers of the private sector. Instead, the ratio of financial wealth to permanent income does not reveal such differences. Moreover, if compared to total wealth, the amount of financial assets held by entrepreneurs and craftsmen is small: about 14 percent of total wealth for the entrepreneurs and 10 for the craftsmen; as opposed to 20 percent of the employed and 19 of the pensioner. By contrast, the fraction of total real assets is in line with the one found for respondents with other working positions.

5. Conclusions

Empirical studies of precautionary saving have produced somewhat mixed conclusions, with a large variety of econometric estimates ranging from about 50 to 1 percent of total wealth.[37] Differences persist even if one restricts the attention to studies using a similar methodology and data source. In particular, in studies of wealth accumulation exploiting longitudinal data, this ambiguity has often been attributed to two main sources of *bias*: a measurement bias and an endogeneity bias. The first is mainly associated to the unobservability of two key variables: (subjective) risk in income and permanent income. The endogeneity bias is mostly the consequence of the unavailability of data on individual preference characteristics and on information of households' saving/consumption and insurance opportunities.

In the present work we addressed these estimation problems exploiting a unique data set from SHIW 2012. The peculiarity of this survey is to simultaneously contain a particular question which elicits the respondent subjective risk in total income, and some detailed information on individual preferences and on households' insurance possibilities.

[35]Model specifications are identical to those detailed above, (1) to (4), except that we dropped from correlates some controls for Entrepreneurs and Craftsmen.
[36]See Table 21 in Appendix B for a closer comparison with Guiso et al. (1992).
[37]See, for example, Browning and Lusardi (1996) and Carroll and Samwick (1997) for early references. For more recent results, see Hurst et al (2010).

The results presented quantify precautionary saving as 4-6 percent of total net wealth. Since our measure of risk is based on total income, as opposed to just earning risk, these figures are roughly in line with those found in Guiso, Jappelli e Terlizzese (1992) and in Lusardi (1997), based on SHIW 1989. However, the introduction of preference characteristics and indicators of the households' trade opportunities, highlighted two relevant aspects. The first one is a marked improvement of the explanatory power of both models of wealth accumulation and permanent income. This improvement is achieved directly, in the most obvious way, by adding a larger set of explanatory variables; and, indirectly, to the extent to which controlling for preferences and consumption/saliving opportunities allows to account for various kinds of endogeneity bias, affecting precautionary saving. The possibility to avoid endogeneity bias, in turn, is also relevant for the choice of the estimation method; namely, it legitimates the use of OLS as opposes to hit the slippery road of Instrumental Variables.[38]

The second improvement from considering data on individual preference characteristics and trade opportunities is to be able to actually assess the relevance of some potential sources of bias. We argue in the paper that the omission of these variables might bias estimates in opposite directions and that the intensity of precautionary saving depends on how these effects compose. If the omission of the subjective discount rate and risk aversion have opposite effects on precautionary saving, failing to control for liquidity constraints might unambiguously bias its estimates upwards. Interestingly, the latest is true also when we both include indicators of current- and expected-liquidity constraints, which are known to have opposite effects on aggregate wealth accumulation. Another potentially relevant source of bias comes from the inability to control for home ownership and for the timing of its acquisition. Home ownership has two effects on precautionary saving. Around the time in which the property is purchased, it becomes a priority over other saving motives, the precautionary one included. Later on, it reduces households' risk perceptions and their attitude to save for 'rainy days.'

Of all these potential sources of bias, data reveal that the only significative ones are those associated to the omission of indicators of the household trade opportunities; in particular, those capturing liquidity and credit constraints, as well as those representing financial consistency (*e.g.* the ownership of the primary house and other real estates). Instead, we rejected the hypothesis that omitting any of the preference indicators would significatively bias precautionary saving.

Moreover, dividing the sample in groups, based on all our indicators of preferences and trade opportunities, allowed us to conclude that the only group whose behavior is significatively different from the average is that of credit constrained, which displays a precautionary saving about five times higher than the sample mean. To the extent to which perceived income risk and credit constraints are both countercyclical, this particular result supports the idea that precautionary saving is also countercyclical (*e.g.* in Parker and Preston, 2005).

Our estimation results are robust to the use of alternative measures of wealth, with some caveats. If we consider the sample of people younger than 65, we found that precautionary saving varies little, provided we exclude from total wealth the most 'illiquid' assets; namely, the primary house of residence and business equities. As a matter of fact, we documented that households tend to react to income risk by simply re-scaling their asset position, and that their portfolio composition is insensitive to subjective income risk. Moreover, the estimates obtained with adjusted wealth and financial wealth are also robust to the inclusion of business owners, who have a tendency to accumulate their non-business wealth in real asset, as opposed to financial assets. Instead, including respondents as old as 80, has the effect to reduce the average precautionary saving by about one percentage point on the two measures of net wealth and by up to 2 pp. on financial wealth.

[38]Lusardi (1997) estimated precautionary saving using instrumental variables and found elasticities that are up to five times higher than those obtained using OLS. However, she questioned the reliability these results, based on the difficulty to find an adequate set of instruments. Using French data Arrondel (2002) had a similar experience and opted to present OLS estimates only.

The evidence found shows lower average sensitivity to total income risk. We commented how this finding need not be in contrast with the 'wealth decumulation puzzle' documented for Italian households.

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Appendix A. Data and Measurements

A.1. **Data.** The 2012 Italian Surveys of Household Income and Wealth (SHIW) collected information on a sample of $8,151$ Italian households, approximately twenty thousand individuals, with interviews carried out between January and August 2013.[39] We denote the complete data set as sample A.

We define sample B, excluding from A the households with the following characteristics: a family head older than 80; a null or negative net income or total net wealth; an implausibly high degree of risk aversion; did not provide relevant information to the interviewer (*e.g.* with missing values on the questions used to elicit preference characteristics or subjective risk in income). Instead, we kept in the sample entrepreneurs and retired citizens, which were instead removed in some earlier studies.[40] Sample B is formed by 2,066 respondents. In Table 12 we compare samples A and B with a third one, sample C, that excludes from B respondents older than 65. This comparison is by individual characteristics. The definition of the filters used to obtain our samples B and C, explains why their respondents are slightly younger, better educated and with a relatively higher income and net wealth than those in A. Also, with respect to A and B, sample C has a moderately higher fraction of males who are self-employed. Instead, it is balanced in terms of family characteristics (marital status, family size, number of children).

	Sample A		Sample B		Sample C	
	Mean	SD	Mean	SD	Mean	SD
Male	0.547	0.498	0.664	0.472	0.640	0.480
Age	59.283	15.710	58.209	13.204	50.498	9.575
Diploma	0.383	0.486	0.514	0.500	0.618	0.486
Degree	0.119	0.323	0.180	0.384	0.220	0.414
Married	0.611	0.488	0.680	0.467	0.694	0.461
Divorced	0.080	0.272	0.084	0.277	0.110	0.313
Widowed	0.182	0.386	0.099	0.299	0.035	0.183
Employed	0.317	0.465	0.396	0.489	0.604	0.489
SelfEmployed	0.090	0.287	0.142	0.349	0.197	0.398
Pensioner	0.452	0.498	0.462	0.499	0.198	0.399
Outofwork	0.141	0.349	0.000	0.000	0.000	0.000
FamilySize	2.456	1.266	2.497	1.175	2.815	1.236
NChildren	0.718	0.946	0.702	0.906	0.972	0.968
Total Net Wealth	261.190	441.565	371.899	605.191	354.866	501.140
Total Net Income	31.768	23.795	41.352	27.248	43.668	25.476
Total Consumption	25.402	14.908	29.379	15.622	30.961	15.593
N	8151		2066		1332	

Table 12. Sample statistics (Mean and Std. Deviation). Sample A,B,C.

A.2. **Permanent income.** We decompose total net (or disposable) income (Y) in a 'permanent' (Y^P) and a 'transitory' (Y^T) component: for a typical respondent j of age t, $Y_{j,t} \equiv Y^P_{j,t} + Y^T_{j,t}$. The procedure assumes that the total net income of a respondent of age t behaves according to the model,

$$(*) \qquad Y_t = Z\ b + f_t$$

[39]The survey is conducted every two years. Details on the 2012 wave, regarding the questionnaire, the sample design and the responses can be found in Bank of Italy (2014).

[40]*E.g.* see Guiso et al. (1992); Lusardi (1997); and a more specific study due to Hurst et al., 2010. Instead, Arrondel (2002) followed our same choice.

where Z is a vector of observable household's characteristics, b are coefficients, f_t is polynomial function of the age.[41] Using our cross sectional data on households' income and characteristics, we obtain estimated coefficients $\widehat{b}$ and $\widehat{f_t}$, for each and every respondent of age t. Then, assuming that each respondent j born in t has a sure life span of $80 - t$ years, we compute his/her *permanent income* as,

$$\widehat{Y}^P_{j,t} = Z_{j,t}\ \widehat{b} + \frac{1}{80 - t + 1} \sum_{s=0}^{80-t} \widehat{f}_{t+s}$$

The corresponding *Transitory income* is obtained residually, $\widehat{Y}^T_{j,t} = Y_{j,t} - \widehat{Y}^P_{j,t}$.

We estimate model $(*)$ on our sample B using OLS (see Table 13). The set of covariates in Z includes observable attributes of the respondent (*e.g.* preference characteristics, gender, education, martial status), household's characteristics (*e.g.* family size, number of children, number of income earners in the household), the respondent's working condition (e.g. employment status and current occupation), her/his employment history (e.g. having ever been unemployed) and asset position (e.g. being a homeowner, having invested in Government bonds or other financial assets). It also includes indicators of the household ability to access to insurance schemes (e.g. having a life, pension and/or health insurances). The overall goodness of fit is satisfactory with an adjusted R^2 equal to 50%. The preference parameters have opposite effects on the dependent variable: The higher the degree of patience β, the greater the income; while the higher the ARA coefficient, the lower the income. For a 1 pp increase in β, total net income increases by about 131 Euro; instead, the same change of ARA makes Y fall by about 12 thousand Euro. The third-order polynomial in the age captures the hump-shaped age-income relationship, and all its terms are highly significant. Every thing else equal, an additional year in the respondent age makes its income vary by 322 Euros. A married couple (or a widow) earns approximately 3.5 (5) thousand Euros more than a single. The number of income earners in the household (NRecipiens) significatively affects total net income, while the number of children (NChildren) does not. The area of residence is another source of heterogeneity (Central Italy is the omitted, reference category). People living in the southern report a negative but not significant coefficient. On the contrary, families who live in the North earn approximately 2.5 thousand Euro more than those in the central regions.

Total net income is essentially increasing in the level of education. People with a middle school diploma have an income higher by 4.6 thousand Euro than the average illiterate and the wage-premium progressively increases for people with a high school diploma, a master, a PhD (respectively, equal to 11, 20 and 25). Yet, there is some evidence that getting a college degree does not improve income above those who finished high-school. As a proxy for ability, we use a binary indicator that highlights individuals who achieved their highest level of education with honor (Praise). This has a strong impact on income: 'high ability' have a wage premium of about 9.3 thousand Euro.

The type of employment and the sector of occupation capture the labour income heterogeneity. Workers are the (omitted) category with the lowest income. The difference is particularly significant with respect to managers and entrepreneurs, who respectively earn almost 7.9 and 16.7 thousand Euro more than blue collars. Pensioners have an income lower than workers by 8.6-9.5, respectively for labour pensioner (LPensioner) and survivors ones (NLPensioner). All else equal, people working in the public administration (PA) have 5.9 thousand Euro less than those employed in the private sector. Having experienced periods of unemployment (WasUnemployed) significantly affects the dependent variable, decreasing it by 4 thousand Euro.

[41] A non-linear polynomial is traditionally used to capture the typical hump shaped age-income profile observed in a life-cycle model. The empirical literature often assumes polynomials to be piece-wise linear or of order $n \geq 2$ (*e.g.* a mixed of linear and quadratic King and Dicks-Mirraux, 1984 and in Arrondel, 2002; quadratic in Guiso et al., 1992; of the third order in Lusardi, 1997).

	Coeff.	SE
$\beta \times 100$	131.3**	(2.49)
ARA	-12019.1***	(-3.99)
Age	-5667.5***	(-3.32)
Age^2	113.4***	(3.54)
Age^3	-0.675***	(-3.60)
Male	984.5	(1.02)
Married	3541.3**	(2.45)
Divorced	404.3	(0.26)
Widowed	5048.2***	(3.28)
Middle	5162.6***	(5.13)
HighSchool	11812.3***	(9.96)
Bachelor	11076.5***	(4.11)
Master	20778.3***	(10.27)
PhD	25050.3***	(5.65)
Praise	9356.9**	(2.27)
NRecipients	13131.0***	(13.50)
NChildren	778.0	(1.20)
Northern	2569.9***	(2.71)
Southern	-736.3	(-0.65)
Employee	1917.2	(1.62)
Manager	7898.9***	(4.19)
Entrepreneur	16695.8***	(5.11)
Craftsman	3370.5	(1.49)
LPensioner	-8659.6***	(-3.51)
NLPensioner	-9534.7***	(-3.65)
PA	-5912.6***	(-4.58)
WasUnemployed	-4013.3***	(-4.47)
HomeOwner	4204.5***	(3.49)
OtherHouses	10343.9***	(9.33)
GovBonds	5022.8***	(2.94)
OtherBonds	7070.6***	(7.00)
Life Insurance	3861.1**	(2.27)
Pension Insurance	1706.4	(1.41)
Health Insurance	2455.4**	(2.09)
Constant	63118.5**	(2.25)
N	2068	
R^2	0.509	
R^2_{Adj}	0.501	

TABLE 13. Estimating Permanent Income. Estimation: OLS with standard errors robust to heteroskedasticity. Dependent variable: Total Net Income. The reference categories are: non-Married, resident in the Centre of Italy, Illiterate and Workers.

To represent the household's economic condition and capture the relevance of capital as a source of income, we include binary indicators on the ownership of real and financial assets. Being the owner of the main residence (HomeOwner) increases the income by 4 thousand and other housing (OtherHouses) has an even more pronounced effect. Investing in (short term or long term) Government bonds (GovBonds) or in other bonds and equities (OtherBonds) makes the outcome vary by about 5 and 7 thousands Euro respectively.

Indicators on insurance opportunities are also significant. Having a life insurance (Life Insurance) and/or a health policy (Health Insurance) positively affects income by 3.8 and 2.4 thousand Euro respectively.

Turning to the results of our income-decomposition, Figure 7 shows that data differ considerably across respondents' occupations (by individuals in the labor force and pensioners) and employment sectors (by

employed in the private sector PS and public administration PA). Entrepreneurs and managers report the highest average permanent income, respectively around 74.4 and 63.7 thousands Euros and a relatively lower standard deviation. Employees, craftsmen and workers (operative and laborers), in the order, have

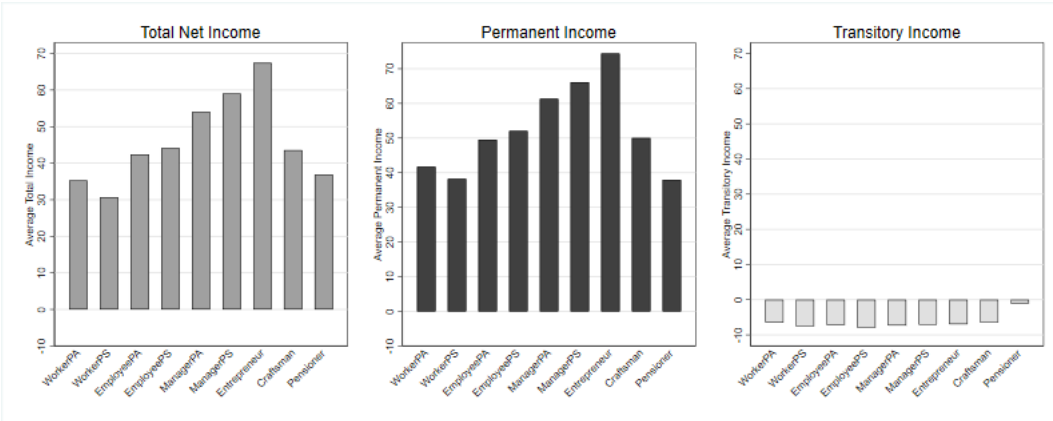

FIGURE 7. Income decomposition across occupations. Sample B.

progressively lower figure, about 50.9, 50.4 and 38.6 thousands Euros, but a higher dispersion. Transitory income is negative on average, but its dispersion is high. The lowest values are for workers, employees, and more generally for households in the low percentiles of the wealth distribution. However, entrepreneurs and craftsmen, who have a more favorable mean transitory income, have the greatest standard deviation.

A.3. **Subjective risk in income.** Subjective income risk is computed following the procedure in Guiso et al. (1992), with the major difference that we consider total income, as opposed to labor earnings. Each individual in the sample is asked to assign a probability weight (ω) to each of the intervals of possible growth rate in nominal income (z) and to those of an inflation index (π) one year ahead. The proposed scenarios of income are: *i) More than 10%; ii) Between 2% and 10%; iii) Between -2% and 2%; iv) Between -10% and -2% and v) Less than -10%*. Those for prices instead are: *i) More than 10%; ii) Between 2% and 10%; iii) Between -2% and 2%; iv) Between -10% and -2% and v) Less than -10%* For each interval we consider the central value as reference point and we compute weighted averages, variances and covariances as follows:

$$E(z) = \sum_{i=1}^{5}[w_i^z z_i]; \qquad E(\pi) = \sum_{j=1}^{5}[w_j^\pi \pi_j]$$

$$\sigma_z^2 = \sum_{i=1}^{5}[w_i^z (z_i - E(z))^2]; \qquad \sigma_\pi^2 = \sum_{j=1}^{5}[w_j^\pi (\pi_j - E(\pi))^2]$$

$$\sigma_{(z,\pi)} = \frac{\sum_{i=1}^{5}\sum_{j=1}^{5}[w_{ij}^{z\pi}(z_i - E(z))(\pi_j - E(\pi))]}{\sum_{i=1}^{5}\sum_{j=1}^{5} w_{ij}^{z\pi}}$$

From these computations we measure the variance of the expected real income simply considering that the growth rate of real income (y) is $y = z - \pi$. The rest of the computation of the expected variance of the real income is explained in the main text (see section 2.2.3).

It is interesting to complement this analysis with one on perceived risk by sample characteristics; we do so referring to our larger sample B.[42] First we divide this in Low- and High-risk, based on a 3.5 percent

[42]See also section A.4 below for summary statistics of perceived risk, by groups, computed on sample C.

threshold.[43]

Variables X	Sample B	σ_y^2 Low	High	b	t-stat
Preferences					
Beta	0.936	0.943	0.922	-0.0691	-5.784
ARA	0.025	0.025	0.026	-0.0018	-0.178
Demographic					
Male	0.664	0.665	0.661	0.0016	0.970
Age	58.209	58.729	57.201	-0.0001	-0.944
None	0.015	0.015	0.016		
Married	0.680	0.688	0.663	0.0014	0.571
Single	0.137	0.133	0.147		
Divorced	0.084	0.079	0.092	0.0014	0.465
Widowed	0.099	0.100	0.098	0.0029	0.860
NChildren	0.702	0.698	0.711	-0.0006	-0.602
NRecipients	1.758	1.777	1.721	-0.0008	-0.673
Geographic					
Northern	0.510	0.519	0.492	0.0062	3.646
Centre	0.232	0.261	0.175		
Southern	0.258	0.219	0.333	0.0113	5.128
Education					
Elementary	0.148	0.147	0.149	0.0028	0.407
Middle	0.323	0.327	0.314	0.0011	0.159
HighSchool	0.334	0.331	0.340	0.0017	0.248
Bachelor	0.013	0.011	0.016	0.0106	0.993
Master	0.154	0.158	0.147	0.0007	0.096
PhD	0.013	0.010	0.018	0.0142	1.310
Praise	0.031	0.030	0.034	-0.0010	-0.237
Occupation					
Worker	0.133	0.134	0.132		
Employee	0.198	0.193	0.208	0.0017	0.580
Manager	0.065	0.065	0.064	0.0004	0.093
Entrepreneur	0.072	0.070	0.077	0.0063	1.782
Craftsman	0.070	0.066	0.077	0.0041	1.285
Pensioner	0.462	0.472	0.442	0.0045	1.455
PA	0.149	0.145	0.156	0.0024	0.918
Was Unemployed	0.139	0.117	0.182	0.0061	2.787
Econ. Res.					
HomeOwner	0.798	0.798	0.798	0.0019	1.062
OtherHouses	0.264	0.289	0.216	-0.0049	-3.157
GovBonds	0.130	0.133	0.125	0.0025	1.215
OtherBonds	0.297	0.311	0.270	-0.0034	-2.115
Insur. Opportun.					
LifeIns	0.145	0.146	0.144	0.0015	0.760
PensIns	0.207	0.191	0.238	0.0064	3.173
HealthIns	0.348	0.360	0.326	-0.0015	-0.922
Tot. Net Wealth$_{(1)}$	371.899	376.038	363.874		
Tot. Net Income$_{(1)}$	41.352	42.348	39.420		
Permanent Income $_{(1)}$	45.776	46.604	44.170		
ND Consumption$_{(1)}$	27.940	28.630	26.600		
APC	0.826	0.765	0.946		

TABLE 14. Selected characteristics X for sample B and for the subsamples of High- and Low-risk. Estimated coefficients b of $\sigma_y^2 = Xb + u$ in the penultimate column. (1) thousands of Euro.

Table 14 is structured similarly to Table 2 in Guiso et al. (1992). These groups were essentially homogeneous in terms of demographic characteristics, with a slight tendency of the high risk to be more numerous among

[43]A simple analysis on the extreme values of risk in income reveals that there are 5 observations with values above 900. Of these, 4 are self-employed and one is a pensioner. All are wealthy individuals (belonging to the highest quintile of the wealth distribution) with a high education achievement.

single and divorced respondents. The high-risk group had a predominantly larger component of people with a high educational achievement (college graduate or more) or a very low one (elementary or none), who are self-employed, especially craftsman, who had experienced a period of unemployment in the past, and live in the South.[44] In terms of asset position, Low-risk had a tendency to invest relatively less in real estates (*OtherHouses*) and in securities different from government bonds (*OtherBonds*), and relatively more in government bonds (*GovBonds*), life insurances (*LifeIns*) and retirement plans (*PensIns*). A closer look to households' wealth, income, and consumption, revealed that those in the Low-risk group had higher absolute indicators and a 24 percent higher average propensity to save $(1 - APC)$. This is coherent with the evidence that Low-risk tend to be more patient.[45]

Comparing our findings with those related to earning risk in the 1989 wave (see Table 2 in Guiso et al., 1992), we observe many similarities and a few differences. In particular, concentrating on differences, contrary to the 1989 survey, we did not find that high-risk are more concentrated in the private service sector, nor we found that managers belong to the high-risk group.

Next, we concentrated on the group of people declaring zero subjective risk; 57.45 percent of sample B. It is important to notice that almost a half (48,6%) of this group were pensioner (*i.e.* 2.4% more frequent than in the whole sample B). Among the occupied respondents, zero risk was about 7 percent less frequent for self-employed (only 50% of entrepreneurs and craftsmen declared zero risk, against an average of 56.7% of the other occupied individuals). Also, there was no clear sign that those occupied in the public sector perceive zero risk relatively more frequently than those in the private sector.[46] Further, we found a mild evidence that those declaring zero risk ware relatively less numerous in the South, among households living in larger cities and subject to economic distress (*i.e.* liquidity or credit constrained). Instead, there was no evidence that zero income risk was associated to a lower educational achievement or 'educational ability;'[47] something which can also be read as an indicator that a zero risk answer was not driven by a more limited ability to understand the survey question. Finally, in terms of preference characteristics, zero perceived risk was more frequently associate to more patient respondents (*i.e.* with a higher subjective discount factor).

A.3.1. *Individual preferences: impatience and risk aversion.* One of the major advantages of the 2012 survey with respect to 1989 is that it contains some questions which can be used to measure respondents' patience and risk attitudes.

Table 15 reports the sample distribution of the patience coefficient β. The dispersion of this subjective discount factor is substantial, the coefficient is defined between 0.77 and 0.99. However, most individuals seem to be fairly patient with 67 percent of the sample formed by respondents with a β above 0.85, and about 56 percent above 0.95. The dispersion detected in the data seems plausible. For example, Carroll and Samwick (1997), calibrating a canonical buffer stock model, find that β is between .88 and .95. More generally, studies provide a very mixed evidence, also depending on the differences among data set ('field' as opposed to experimental) and measures (*e.g.* bases on money or health, involving different time horizons).[48] Also, the most patient respondents are among those between 35-54 years old, employed in the public administration or managers of private companies and entrepreneurs.[49] Moreover, on average, β is increasing in the households'

[44]People in the group with no educational achievement is formed by 32 respondents only.
[45]These observations are confirmed by a simple linear regression analysis on $\sigma_y = Xb + \epsilon$ in which X represents sample characteristics (estimated coefficients b and t-statistics are in the last two columns of Table 14.
[46]Although 64% of worker in the public sector declared zero risk against 54% of those in the private sector; the evidence is somewhat reversed for employees (55% and 61% respectively) and managers (54% and 57% resp.).
[47]We used as an indicator of 'educational ability' the final vote received by the respondent in the highest degree obtained, relative to its maximum. 66.3% of the zero risk respondents have an indicator above .9.
[48]For a critical review of the empirical literature see, for example, section 6 in Frederick, Loewenstein and O'donoghue (2002).
[49]See section A.4 below for summary statistics.

β_j	Count	Freq.	Cum.
0.77	124	6.00	6.00
0.80	119	5.75	11.75
0.85	73	3.53	15.28
0.89	339	16.39	31.67
0.95	263	12.72	44.39
0.97	322	15.57	59.96
0.99	828	40.04	100.00
N	2066	100	

TABLE 15. Estimated average discount factor; sample distribution. Sample B.

net wealth. In terms of geographical residence, there is a slight tendency of the most impatient (respectively patient) to be resident in the South (North); while the average rate is the highest in the Centre.

Risk attitudes. The empirical distribution of the risk-aversion coefficients are presented in Table 16 and 17.

ARA_j	Count	Freq.	Cum.
≤ 0.1	1,936	93.62	93.62
0.1-0.2	79	3.82	97.44
0.2-0.3	26	1.26	98.69
0.3-0.4	15	0.73	99.42
0.4-0.5	6	0.29	99.71
0.5-0.6	1	0.05	99.76
0.8-0.9	1	0.05	99.81
>1	4	0.19	100.00
N	2066	100	

TABLE 16. Absolute risk aversion. Sample B.

RRA_j	Count	Freq.	Cum.
0.84	11	0.53	0.53
1.14	20	0.97	1.50
2.29	50	2.42	3.92
5.33	82	3.97	7.88
10.66	173	8.37	16.25
22.86	252	12.19	28.43
53.33	210	10.15	38.59
160	1,270	61.41	100.00
N	2066	100	

TABLE 17. Relative risk aversion. Sample B.

We use the empirical evidence arising from our data set to rationalize our indicator risk aversion. This is explained in the following.

Remark A.1 (Rationalizing the index of risk-aversion)**.** *For simplicity, we omit the respondent subscript and let $q \equiv dL$, to be the individual payment to the lottery considered. By definition, the maximal willingness-to-pay q^* for the lottery is the maximum value $q \leq L$ such that,*

$$(o) \qquad u(L) \leq \frac{1}{2}[u(L+q) + u(L-q/2)]$$

q^* can either be a corner or an interior solution of this problem; namely, either i) $q^* = L$ or ii) $q^* < L$ is such that (o) holds with equality (and $u'(L+q^*) - u'(L-q^*/2)/2 < 0$).[50]

*Next, SHIW 2012 data point to $d \equiv q/L \leq 0.1$ for more than 87 percent of respondents, and have none choosing $d = 1$ (*i.e. *$q = L$). Therefore, for every individual j with assets L_j, we let q_j^* be such that (o) holds with equality. Approximating each term on the right hand side of (o) to the second order, $0 = \frac{1}{4}u'(L_j)q_j^* + \frac{5}{16}u''(L_j)(q_j^*)^2$; which translates into the above approximate ARA coefficient r_j. It is worth pointing out that this approximation is actually a lower-bound for prudent households (*i.e. *with $u''' > 0$).*

[50]A maximum exists because the constrained set contains 0. Moreover at $q = 0$, (o) holds with equality. Assume u is twice continuously differentiable, strictly increasing and strictly concave. Then, the function $F(q) \equiv \frac{1}{2}[u(L+q) + u(L-q/2)] - u(L)$ has the same properties of u, with $F(0) = 0$ and $F'(0) > 0$. Also, $F'' < 0$. Finally, that $q^* < L$ is such $F'(q^*) < 0$ is easier to verify by forming the Lagrangian of the problem and showing that the multiplier associated to (o) is strictly positive at q^* iff $F'(q^*) < 0$ iff $u'(L+q^*) - u'(L-q^*/2)/2 < 0$.

Finally, data highlight an extremely high degree of risk aversion. To illustrate this with an example, assume that u is a CRRA with elasticity $\gamma > 0$, possibly different across households. Use the fact that, at an interior solution q^*, $u'(L+q^*) - u'(L-q^*/2)/2 < 0$; or, equivalently, $(L-q^*/2)^{-\gamma} > 2(L+q^*)^{-\gamma}$. Taking logs and approximating around zero participation, the latest condition translates into,

$$\gamma > \frac{\log 2}{\log(L+q^*) - \log(L-q^*/2)} = \frac{\log 2}{\log(1+d^*) - \log(1-d^*/2)} \approx \frac{2\log 2}{d^*}$$

Hence, referring to the data, $d^* \leq 0.1$ corresponds to a CRRA coefficient γ above 6 for most (more than 87%) of the individuals.

A.3.2. *Liquidity and credit constraints.* Recall that we defined three binary indicators for *liquidity constrained* households, two 'actual' (or 'effective') and one 'expected:' a subjective indicator (*SubjLiqCon*) that identifies as liquidity constrained respondents who declared to have a total disposable income that is insufficient to allow the household 'to live reasonably comfortably but not in luxury;' an 'objective' one (*ObjLiqCon*) that identifies as liquidity constrained those households who were more than three months late in the payment of their rent, utility bills or loans, during the 2012; an indicator of expected liquidity constraint (*ExpLiqCon*) that identifies households who think they are unable to save enough money to face future unexpected events.

Data show that households who perceive themselves as liquidity constrained ($SubjLiqCon = 1$) are more likely to be in the poorest part of the population (56% of those in the I quintile of the net-wealth distribution), among the workers (44 and 32% of those employed in the private sector and in the public administration respectively), and young people (44% among those younger than 35 and 34% of those in the interval 35-44).[51] Following workers, liquidity constrains emerge for about 25 percent of employees and 21 percent of pensioner. As expected, these figures do not completely match those obtained considering the objective measure $ObjLiqCon$. In particular, most liquidity constrained households are now in between age 45-54, followed by 35-44, and are more numerous among craftsman than workers of the public sector. Turning to expected liquidity constrains ($ExpLiqCon = 1$), differences are more evident. First of all, on average, there seems to be a much lower variation among classes of age, occupation, and wealth. Moreover, households falling in this group are mostly among the elderly: more of 83 percent of respondents are older than 65 and more than 82 percent are retired; this group is closely followed by the respondents younger than 35. In terms of the occupation, now those who expect to be liquidity constrained are numerous also among managers (more than 83% and 82%, respectively, of the private and public sector); while craftsman seem to be the most 'optimistic,' followed by the workers of the public sector. The markedly diffused fear to be liquidity constraints of the elderly is probably associated to the specific indicator considered, and to their perception of a reduced possibility to 'save for rainy days.'

As we anticipated, households' credit mostly consist in mortgages to acquire home ownership or for its renovation (overall, around 12.3% of households), something occurring manly around age 35-54. The relatively low fraction of constrained respondents may be due to the fact that households, especially if applying for a mortgage, tend to do so only when they believe they are eligible for it. Besides this, credit constrains seem to arise for those households headed by a self-employed individual, who depends more strictly on business credit (*e.g.* craftsman and entrepreneur), or for those who might rely more on consumer credit, such as workers or, more generally, people in the lowest percentiles of the wealth distribution. The major difference between groups is that discouragement seems to drop more sharply with the level of wealth and with age, and seems to be more widespread than credit-rejection. However, considering the small number of respondents, and the absence of marked differences in their characteristics, in the rest of the analysis we shall group them as 'credit constrained;' something that was also pursued in Jappelli (1990).

[51] See section A.4 below for summary statistics.

A.4. **Summary statistics.** In Table 18 we present the mean and std. deviation of some of the main variables defined in this appendix. Statistics are computed for each variable (in the first column) relative to different groups (columns 3-12), defined based on selected sample characteristics x, as detailed below.

$x1(0) =$	*Diploma No*	$x4 =$	*Manager*	$x8(1)$	$=$ *Wealth I quintile*
$x1(1) =$	*Diploma Yes*	$x5 =$	*Entrepreneur*	$\cdots$	$=$ $\cdots$
$x2 =$	*Worker*	$x6 =$	*Craftsman*	$\cdots$	$=$ $\cdots$
$x3 =$	*Employee*	$x7 =$	*Pensioner*	$x8(5)$	$=$ *Wealth V quintile*

Variables		x1(0)	x1(1)	x2	x3	x4	x5	x6	x7	x8(1)	x8(2)	x8(3)	x8(4)	x8(5)
β	mean	.933	.943	.933	.942	.945	.944	.933	.939	.930	.932	.940	.943	.950
	sd	.070	.064	.069	.068	.064	.065	.063	.065	.073	.071	.067	.060	.058
ARA	mean	.033	.020	.046	.027	.009	.020	.020	.015	.051	.029	.020	.015	.010
	sd	.063	.060	.078	.072	.022	.059	.048	.030	.083	.058	.046	.064	.036
σ_y^2	mean	.030	.029	.029	.029	.030	.031	.030	.028	.031	.030	.030	.026	.029
	sd	.033	.033	.032	.035	.034	.033	.030	.033	.034	.035	.032	.031	.033
CreditCon	mean	.055	.034	.052	.037	.031	.051	.079	.023	.097	.034	.026	.026	.026
	sd	.228	.181	.222	.189	.173	.222	.270	.149	.297	.181	.160	.160	.160
ObjLiqCon	mean	.077	.028	.114	.022	.015	.051	.047	.027	.109	.045	.034	.026	.019
	sd	.266	.165	.319	.148	.124	.222	.213	.161	.312	.208	.181	.160	.136
SubjLiqCon	mean	.332	.233	.432	.260	.162	.265	.283	.174	.558	.350	.232	.139	.075
	sd	.471	.423	.496	.439	.369	.443	.452	.380	.498	.478	.423	.347	.264
ExpLiqCon	mean	.293	.397	.251	.416	.462	.324	.228	.405	.206	.305	.367	.429	.481
	sd	.455	.490	.434	.493	.500	.470	.421	.492	.405	.461	.483	.496	.501

TABLE 18. Summary statistics based on selected characteristics x. Sample C.

APPENDIX B. ELASTICITIES

In this section we report the elasticities of wealth with respect to perceived income risk σ_y^2, as computed by Guiso et al. (1992), $\widetilde{\varepsilon} = 1 - \left(\exp\{\widehat{b}_2 \cdot \sigma_y^2/Y^P\}\right)^{-1}$ (see their footnote 23). Compared to our elasticity measure, ε, one obtains the following equivalence, $\widetilde{\varepsilon} = 1 - (\exp\{\varepsilon\})^{-1}$.

σ_y^2/Y^P		$\widetilde{\varepsilon}(1)$	$\widetilde{\varepsilon}(2)$	$\widetilde{\varepsilon}(3)$	$\widetilde{\varepsilon}(4)$
	mean	.0508	.0520	.0454	.0406
	sd	.1000	.1018	.0915	.0837

TABLE 19. Precautionary saving: Estimated elasticities with respect to Tot Net Wealth; mean and standard deviation; models (1)-(4). Sample C.

σ_y^2/Y^P		$\widetilde{\varepsilon}(4)$	$\widetilde{\varepsilon}(5)$	$\widetilde{\varepsilon}(6)$
	mean	.0406	.0505	.0487
	sd	.0837	.1004	.0967

TABLE 20. Precautionary saving: Estimated elasticities with respect to the three measures of wealth; models (4),(5),(6). Sample C.

σ_y^2/Y^P		$\widetilde{\varepsilon}(1)$	$\widetilde{\varepsilon}(2)$	$\widetilde{\varepsilon}(3)$	$\widetilde{\varepsilon}(4)$	$\widetilde{\varepsilon}(5)$	$\widetilde{\varepsilon}(6)$
	mean	.043	.043	.039	.033	.039	.027
	sd	.087	.088	.081	.072	.082	.061

TABLE 21. Precautionary saving: Estimated elasticities models (1)-(6). Sample B

σ_y^2/Y^P		$\widetilde{\varepsilon}(1)$	$\widetilde{\varepsilon}(2)$	$\widetilde{\varepsilon}(3)$	$\widetilde{\varepsilon}(4)$	$\widetilde{\varepsilon}(5)$	$\widetilde{\varepsilon}(6)$
Sample B	mean	.042	.043	.040	.031	.033	.010
	sd	.080	.088	.078	.063	.065	.023
Sample C	mean	.051	.054	.050	.038	.040	.031
	sd	.094	.098	.092	.072	.076	.060

TABLE 22. Precautionary saving: Estimated elasticities models (1)-(6), sample B and C, without self-employed individuals ($N_B = 1773$, $N_C = 1069$).

APPENDIX C. TOBIT REGRESSION ANALYSIS

In this appendix we present the result of a regression analysis on the average shares of households' portfolio composition. The final goal is to test whether these shares are significantly affected by subjective income risk. To this end, we divide assets into four aggregates, total deposits (bank plus postal accounts), government bonds, all other financial securities (also including non-business equities), real wealth (mainly composed by houses). Portfolio shares are defined as the ratio of these three aggregates and total household wealth. Each of the four regression models includes covariates representing respondent/household characteristics and economic conditions; variables which have been used above, in our models of permanent income and wealth accumulation. The only new covariate are: *DEconomics*, a binary indicator taking value 1 if the respondent has a college degree in economics or statistics, which aims at capturing 'financial literacy;' *Praise* a binary indicator on wether individuals with a college degree have obtained the highest grade, a generic indicator of the respondent's 'ability;' the distribution of total net wealth by quintiles. The age specification, a polynomial of order 2 or 3, captures the hump-shaped profile of the dependent variables, with securities shares rising up until about age 65, then declining. However, this typical life-cycle pattern is not perfectly homogeneous across the three models, perhaps capturing different motives and skills required for holding diverse asset classes. The choice of a Tobit model follows an established literature (*e.g.* see Guiso, Jappelli and Terlizzese, 1996, section IV, and references therein).

Results reject the hypothesis that subjective income risk, on average, affects households' portfolio allocations; the associated coefficient is statistically non-significative. We checked that this result is robust to a change of the sample definition, from our sample B to C. It is interesting to notice that the demand of financial assets decreases in risk aversion, while that of real assets is increasing. This seems very plausible at the time of a sovereign debt crisis, and is confirmed by the additional fact that the first effect is particularly evident for government bonds. As for the impact of expected liquidity shortage (ExpLiqCon), this conforms to a general consensus: households tend to prevent these situations by rebalancing their portfolios away from riskier and less liquid assets, which in the reference situation are Government bonds and real assets, increasing the proportion of deposits and other securities.

	(1) D/W		(2) GB/W		(3) OS/W		(4) R/W	
	b	se	b	se	b	se	b	se
$\beta \times 100$	-0.004	0.006	0.003**	0.001	0.003***	0.001	-0.001	0.001
ARA	-0.431***	0.062	-8.631***	1.239	-0.377***	0.102	0.517***	0.064
Age	0.007	0.014	0.000	0.006	0.010**	0.004	-0.006	0.016
Age2	-0.000	0.000	0.000	0.000	-0.000**	0.000	0.000	0.000
Age3	0.000	0.000					-0.000	0.000
Diploma	-0.016	0.010	0.022	0.023	0.064***	0.015	-0.010	0.011
Degree	0.026**	0.013	-0.007	0.027	-0.020	0.018	-0.020	0.015
Praise	-0.024	0.024	0.012	0.048	0.006	0.032	0.012	0.027
Male	0.002	0.009	-0.040**	0.019	0.042***	0.013	-0.014	0.010
NRecipients	0.005	0.006	-0.002	0.013	-0.013	0.009	0.002	0.007
NChildren	-0.017***	0.005	-0.001	0.013	0.010	0.008	0.014**	0.006
Northern	0.005	0.010	0.063***	0.022	0.034**	0.014	-0.032***	0.011
Southern	-0.014	0.012	-0.086***	0.031	-0.099***	0.018	0.033**	0.013
Employee	-0.012	0.015	0.017	0.040	0.032	0.024	0.004	0.017
Manager	-0.023	0.020	0.043	0.047	0.069**	0.029	-0.002	0.023
Entrepreneur	-0.030	0.019	-0.008	0.049	0.054*	0.029	0.006	0.022
Craftsman	-0.039**	0.019	-0.025	0.049	-0.006	0.030	0.024	0.021
Pensioner	-0.025	0.017	0.040	0.043	0.031	0.026	0.012	0.020
DEconomics	-0.003	0.027	0.014	0.051	0.055*	0.033	-0.005	0.030
II quintile W	-0.374***	0.013	-0.027	0.035	0.027	0.021	0.399***	0.014
III quintile W	-0.383***	0.013	-0.044	0.034	0.022	0.021	0.411***	0.015
IV quintile W	-0.396***	0.014	-0.003	0.033	0.043**	0.022	0.422***	0.015
V quintile W	-0.405***	0.015	-0.003	0.035	0.092***	0.022	0.417***	0.016
CreditCon	0.003	0.022	-0.022	0.063	0.028	0.036	-0.004	0.025
ObjLiqCon	-0.027	0.021	-0.020	0.079	-0.086*	0.047	0.027	0.024
SubjLiqCon	0.025**	0.010	-0.058**	0.027	-0.040**	0.016	-0.009	0.011
ExpLiqCon	0.034***	0.009	-0.003	0.018	0.073***	0.012	-0.055***	0.010
$\sigma_y^2/Y^P \times .01$	-0.001	0.002	0.001	0.003	-0.003	0.002	0.001	0.002
N	2066		2066		2066		2066	
R_p^2	21.61		0.248		0.334		3.003	
$N_{left\ cens.}$	28		1797		1452		33	
$N_{right\ cens.}$	25		1		0		0	

TABLE 23. Tobit analysis. Dependent variables: share of the value of asset class x in portfolio over total wealth W; x are bank and postal deposit (D), government bonds (GB), all remaining financial securities (OS), real assets (R). The reference categories are: non-Married, resident in the Centre of Italy, Illiterate, Workers, I quintile of the wealth distribution. Sample B.