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Subjective income risk and precautionary saving ☆

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ABSTRACT

While economists agree that prudent households save to hedge subjective risk in income, they still debate the relevance of precautionary saving. The main problem in estimating this saving motive is the lack of micro data on perceived income risk, preferences, trade opportunities, and its potential bias effects. In the present work we overcome this problem by exploiting a wave of the Italian Survey on Household Income and Wealth that contains unique information on households': perceived income risk, risk aversion, patience, saving attitudes, liquidity and credit constraints. Results robustly indicate that precautionary saving is significant but low: an average of 4%–6% of households' total net wealth. Data richness is used to produce a detailed analysis of the omission-variable bias discussed in earlier studies; both highlighting differences in signs and significance. Finally, we extend our analysis to group heterogeneity, with regard to precautionary saving of business owners and senior citizens.

1. Introduction

In essence, households' decision to save responds to the desire of smoothing consumption along two different dimensions. The first dimension is intertemporal and involves life-cycle and bequest motives. The second dimension concerns a precautionary motive and originates from the desire to ensure consumption against future adverse shocks, in an institutional context where other forms of private or social insurance are either insufficient or absent. Understanding the relative importance of these saving motives is key to interpret and predict both aggregate dynamics (*e.g.* consumption, income, interest rates, wealth) and the evolution of the wealth distribution. For example, macroeconomists highlighted that if households increase savings in response to a higher perceived risk in income, this can produce an overaccumulation of wealth that depresses long-term real interest rates and growth. Instead, the effects of precautionary saving on the wealth distribution are more controversial. For example, a rise of precautionary saving can decrease wealth inequality as it typically involves low- and middle-class households, rather than rich ones (*e.g.* in Hubmer et al., 2021); but it can also increase wealth inequality through a drop of the real interest rate, if this leads to capital gains in favor of the richest, typically, holding portfolios with a longer duration (*e.g.* in Greenwald et al., 2021).

Of the two dimensions of saving decisions, the relevance of the precautionary motive seems to be the most difficult to assess. By how much savings and accumulation of households change when their perceived risk in income increases? Who are the most sensitive to risk perceptions? What institutional factors might enhance precautionary savings?

Theory says that precautionary saving is associated with preferences exhibiting 'prudence' (decreasing marginal utility of consumption; Kimball, 1990). Prudent households decide to reduce their current consumption below the certainty equivalence when they perceive an increase in consumption risk (*e.g.* see Caballero, 1990; Deaton, 1991; Weil, 1993; Carroll, 1997); it is this reduction that identifies 'precautionary savings.' Thus, a natural way of measuring the relevance of this motive is through a classical Euler equation model, by estimating the elasticity of consumption growth with respect to the expected variance of consumption or income (*e.g.* see Dynan, 1993; Bertola et al., 2005; Kim, 2013). An alternative model is one that considers wealth accumulation relative to some target of 'human wealth' (or permanent income), in the spirit of a the buffer-stock version of a life cycle model (*e.g.* see Deaton, 1991; Carroll, 1997; Carroll and Samwick, 1997).

Although 'natural', both of these models are difficult to estimate, mainly because some of their key determinants are unobservables.

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Indeed, data sources typically lack of information on the expected risk and on individual preferences (*e.g.* patience and risk attitudes). Moreover, if one has access to information on income variance, but not on consumption variance, it is important to access data on households' insurance possibilities (*e.g.* access to credit, liquidity conditions), which are typically unavailable, even in the most accurate surveys. To remark this point, a recent literature review on this topic by Lugilde et al. (2019) concluded that differences in the measure of uncertainty considered and in the economic context in which saving decisions are taken, seem to account for most of the variation among the estimates of precautionary saving presented in the literature.

The main goal of this paper is to estimate the relevance of precautionary saving by exploiting an exceptionally rich wave of the Italian Survey of Household Income and Wealth (SHIW), run by the Bank of Italy in 2012. This wave is the only one that simultaneously includes questions eliciting information on households' expected income risk, subjective discount rates, degree of (relative and absolute) risk-aversion, detailed information on the households' financial conditions (both in terms of liquidity and credit conditions), saving attitudes. Two other waves of SHIW, the 1989 and 1991, have been used to assess the relevance of precautionary saving, respectively, in the seminal paper by Guiso et al. (1992) and in Lusardi (1997). However, these older surveys do not offer the information on households' individual preferences and access to credit that is present in the 2012. Moreover, the question on future income therein is formulated with respect to *earnings* and *pensions* as opposed to *total income* in the 2012 wave. This last aspect has two important implications on our empirical assessment; one quantitative, another qualitative. Quantitatively, it results in a measure of subjective (or perceived) risk that displays a sensibly higher cross-sectional variance than the one on labour income; and this is expected to avoid potential identification problems of precautionary saving.[1] Qualitatively, a measure of risk on total income allows to extend the analysis to those household groups whose main source of earnings is capital income; namely, business owners, senior citizens and pensioners who perceive important rents from holdings of private equities, financial assets and real estate properties.

Our results document that the effect of precautionary savings is significant but small: on average, about 4–6 percent of household's total net wealth, when we restrict the sample to respondents younger than 65 years. These figures are essentially consistent with the average ones 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 refers to a similar measure of perceived risk in total income.[2]

On the one hand, these results seem to suggest that the introduction of preference characteristics and indicators on households' consumption/saving opportunities does not lead to a significant improvement of the quantitative evaluation of precautionary saving, if compared to earlier studies. On the other hand, the possibility to introduce these additional controls highlights two relevant aspects. The first one is a marked improvement in the explanatory power of both models of wealth accumulation and permanent income, which considerably sharpens the estimates of the elasticity of precautionary saving. 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/saving opportunities allows to capture a significant part of the cross-sectional variance of saving decisions. The second improvement is to be able to actually test the importance of these different controls as potential sources of omitted variable bias. In particular, the presence and relevance of different kinds of biases have been often debated in the literature, and even held responsible of a pronounced variability in some of the estimates presented (*e.g.* see Browning and Lusardi, 1996; Fuchs-Schündeln and Schündeln, 2005). Our analysis highlights that the omission of preference characteristics, saving attitudes, 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 combine. Moreover, of these potential sources of biases, we find that the most significant are those that make possible to distinguish between 'prudence' and different attitudes for saving, such as: the desire to own the family house, the altruism associated with financancing the education of his/her grandchildren or to leave a bequest, the sensibility associated with the aspiration to remain independent and not burden their offspring.

Our estimation results are robust to the use of alternative measures of wealth, and to the introduction of business owners. Instead, including respondents as old as 80 reduces the average precautionary saving by about two percentage points; something that we argue not being in contrast with the 'wealth decumulation puzzle' documented for Italian households. Finally, because data are available in a single wave, for the year 2012, we performed a few check to address the concern that our results might not be valid beyond that specific year. Ideally, a robustness test should be carried out considering panel data or, at least, a different survey year. Unfortunately, this is not possible, since the particular question we used to measure perceived income risk is only present in the 2012 wave. However, we partially address the concern of sample-bias by estimating the elasticity of precautionary saving on the sample of respondents who reported to perceive their 2012 income and expenditure decisions as "normal". This test delivers an estimated average elasticity that almost exactly matches the one obtained on the full sample, providing support for the conclusion that the evidence presented could be valid more generally.

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 our estimation results on precautionary saving as a fraction of alternative measures of wealth on a sample of respondents as old as 65, excluding business owners. Some robustness checks and an empirical analysis of the main sources of omitted variable bias conclude this section. Section 4 explores the effects of extending our sample to include business owners and senior citizens. Some additional considerations are presented in Section 5. Appendices add useful information on data, measurements, and results.

2. Data and measurement

To assess the relevance of precautionary saving we measure the elasticity of wealth with respect to the subjective (or perceived) risk in income. This elasticity is obtained by estimating a log-linearized version of a popular, empirical model,

$$\log \frac{W_j}{Y_j^P} = b_0 + X b_1 + \frac{\sigma_{y_j}^2}{Y_j^P}\, b_2 + \epsilon_j \qquad (*)$$

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

This model choice is common to many studies using cross-sectional data.[3] It is typically supported by the consideration that one often

[1] 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.

[2] To our knowledge, the French 'Patrimoine 1997' survey on household wealth is the only one containing very similar questions on income of the 2012 SHIW.

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

finds no apparent relation between current consumption and perceived income-risk; while it is observed that individuals expecting greater uncertainty hold a larger stock of wealth, relative to their 'human wealth' (or permanent income).

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. The analysis is conducted on the subgroup of families that reports information regarding the main variables of interest: household financial condition and saving decisions, preferences, and perceived income risk. While the first characteristics are collected for each family, the perceived risk is elicited through a sequence of questions that are randomly asked to half of the sample only. This determines a significant reduction in the sample size. Additionally, standard filtering criteria are imposed, such as having positive income and net wealth and being under 65 years of age. The final sample sums up to 1264 observations. Further details on the selection process can be found in Appendix A.1 below.

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 a precise reference to survey questions, is made available in a separate file (Supplementary material).[4]

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 with higher uncertainty. However, we cannot ignore that home ownership, and more generally real estate, are typically the largest component of households' portfolios; likewise, mortgages are their most relevant liabilities. This phenomenon clearly emerges in Italy, but it is observed in most OECD countries (*e.g.* see OECD, 2022). Analogously, we should keep in mind that for households whose heads 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.'[5] 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. More precisely, if one divides households based on their percentile of total (gross) wealth, it becomes evident that those in the lowest 20% of the distribution mostly hold cash in the form of bank deposits; 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. Conversely, bonds and other securities play a minor role throughout the wealth distribution.

[4] Additional measurement issues are considered in Appendix A below.

[5] '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.

Table 1
Descriptive statistics – number of observations, mean, median, and standard deviation – of three measures of wealth. Values in thousands of 2012 Euros.

	Count	Mean	p50	sd
Total net wealth	1264	295.996	223.350	318.327
Adjusted wealth	1264	85.445	24.224	189.845
Financial wealth	1264	34.019	13.000	73.029

Table 2
Descriptive statistics – number of observations, mean, median, and standard deviation – of total net income, permanent income and transitory income. Values in thousands of 2012 Euros.

	Count	Mean	p50	sd
Total net income	1264	40.713	37.374	22.018
Permanent income	1264	46.345	45.029	18.734
Transitory income	1264	−5.632	−6.508	14.892

2.2.2. Permanent income

Permanent income is estimated 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-Mireaux (1982) and later exploited in a vast literature (*e.g.* Guiso et al., 1992; Lusardi, 1997, 1998; Arrondel, 2002). In this decomposition, a household permanent component Y_t^P is thought to depend on its fundamental demographic and economic characteristics. It is computed using the predictions of a regression model that uses Y_t as the dependent variable and a set of indicators of the household's 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 among these indicators some unique ones on the households' trade opportunities and preferences/attitudes, which are only made available in SHIW 2012.[6]

Table 2 contains summary statistics of our income decomposition. 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 the effects of a severe economic and financial crisis.[7]

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 (interval of) 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 (y) 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 $\sigma_{y,t+1} = \sigma_y Y_t$.

Two major problems emerged with the measure of earning risk computed using 1989 data, in Guiso et al. (1992): a high number of respondents declaring zero risk, and a low variance of the indicator. For a rough comparison of their evidence with ours, based on the total income of the 2012 wave, we present Fig. 1 detailing the empirical distributions of σ_{y_j} over individuals j, grouped by different classes of

[6] Appendix A.2 explains in greater detail the income decomposition and the estimation of permanent income.

[7] The Italian sovereign debt crisis had its worst time in the first half of 2012.

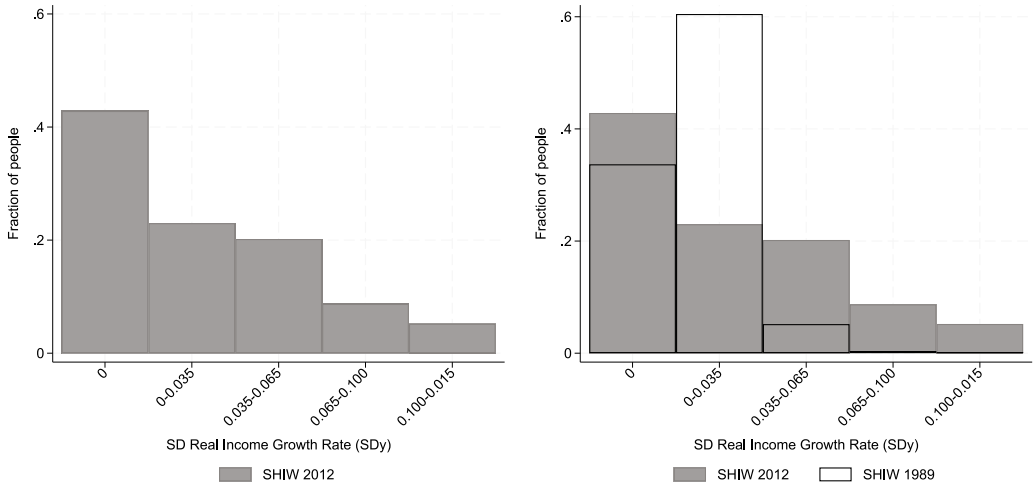

Fig. 1. Empirical distributions of the standard deviation of the subjective growth of real income σ_y.

risk.[8] Our findings reveal an even higher frequency of observations with a zero value; 43 percent of the 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. 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 perceived a significantly high income-risk, higher than 6.5 percent; the corresponding figures in the 2012 survey, respectively, are about 35 and 13 percent.[9] This greater variability is particularly important as it reduces the threat of being unable to consistently identify precautionary saving.

Finally, recall that our reference model (∗) of precautionary saving takes the ratio of wealth to permanent income as a dependent variable. 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 that 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, $\beta_j = 1 - \theta_j/100$.[10]

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 invest in a security that either duplicates its value or loses half of it every month, with equal probabilities. Then, every month, j can cash the reimbursement of the security or use it to gamble again. We derive an (approximate) measure of the Arrow–Pratt coefficient of relative risk aversion 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, an approximate measure of their *coefficient of absolute risk aversion* (ARA) is,

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

and the corresponding coefficient of relative risk aversion (*RRA*) is, $ARA_j L_j = (4/5)d_j^{-1}$.[11]

Table 3 contains sample statics for the two main measures of preference characteristics.

According to the expected utility 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, 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*).[12] Therefore, to appropriately detect these opposite effects, we define two variables:

$$EIS^P_j = I_p \cdot EIS_j, \quad EIS^I_j = (1 - I_p) \cdot EIS_j$$

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 20 below for a discussion of this definition). Data indicate that i is approximately 3 percent in the reference period.[13] Therefore, we let $I_p = 1$ for all respondents j with $\beta_j > .97$, and identify as 'impatient' ($I_p = 0$) every one else.

2.2.5. Liquidity and credit constraints

SHIW 2012 contains very detailed information on the occurrence of situations of financial distress. There are important theoretical reasons,

[8] This 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 2012.

[9] Some additional analysis on risk in income is presented in Appendix A.3.

[10] For further details and summary statistics, respectively, see Appendix A.4. For an analogous measure see, for example, Guiso et al. (2002).

[11] See Appendix A.4 for further details.

[12] If preferences are standard additively separable vNM, with CRRA felicity, the two coefficients 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.

[13] 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).

Table 3
Descriptive statistics – number of observations, mean, median, and standard deviation – of individual discount factor and absolute risk aversion coefficient.

	Count	Mean	p50	sd
β	1264	0.937	0.971	0.067
ARA	1264	0.030	0.006	0.071

we shall return later, to exploit this level of detail to obtain distinct indicators of liquidity and credit constraints.

In general, *liquidity constrained* individuals are those who found themselves short of cash or liquid assets (cash-on-hands). To identify the constrained group, we construct an indicator that takes value 1 if, in the reference year, a household did not regularly pay its ordinary (and predictable) living expenses (*e.g.* rent, utility bills, mortgage payments). We also included in the constrained group those who ended the period with a cash-on-hands position that was either null or insufficient to cover the household's net debt position. The households in this group are 164, about 13% of the sample.

We regard as *credit constrained* individuals those households who either have been denied credit or have been somewhat 'discouraged' to apply. Thus, first, we identify households who have been 'credit rejected';' namely, families who applied for a loan or a mortgage during the 2012 or in the previous two-year period, and received (even if only partially) a denial. Second, we consider households that are 'credit discouraged;' that is, with any of their members who had considered applying to a loan or a mortgage in 2012, but then did not because thought the request would be declined.[14] The resulting group of 'credit constrained' households is formed by few respondents; 15 are credit rejected and 41 are discouraged (respectively, about 1.2% and 3.2% of our sample). Moreover, only two households are simultaneously members of these two groups.

To verify that the two indicators of household financial distress effectively capture distinct phenomena, we compared the two groups and found that only 12 households (less than 1% of the sample) are simultaneously liquidity and credit constrained.[15]

2.2.6. Indicators of saving attitudes

To achieve a consistent estimate of the elasticity of precautionary saving out of a model of wealth accumulation, it is important to identify the presence and relevance of other saving motives and attitudes. To this end, we exploit a particular question introduced in SHIW 2012 that asks each household representative to indicate its most important reasons for saving, with the possibility of a multiple choice. Among the ten reasons suggested, those that are empirically most relevant in our sample are: buy a home; other major expenditures (other houses, vehicles, furniture, etc.); starting a business or financing an investment in an existing business; pay debts; save for old age; save for the education/economic support of children, grandchildren; legacy to children, grandchildren.[16]

Analyzing these reasons by the age of respondents, one can obtain an empirical representation of a typical life-cycle pattern of saving motives. Thus, for example, if for a family younger than 40, the household's primary reason to save is to buy a house, primary or secondary; for an older family that has accomplished this plan, other motives such as saving to finance the education of children, for old age, and to face unexpected events, become preponderant. Fig. 2 provides an illustration of this typical, empirical pattern.[17]

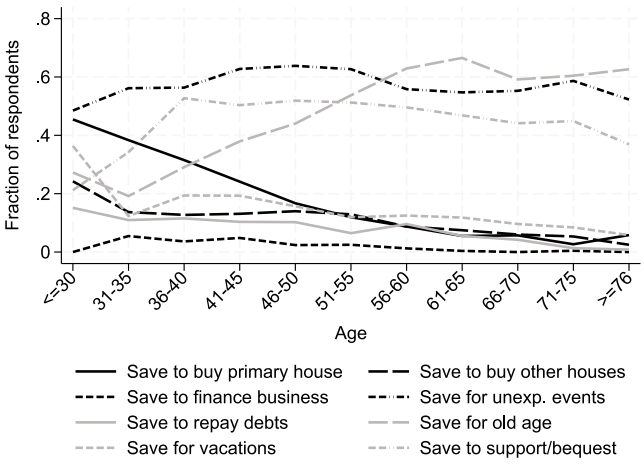

Fig. 2. Self-reported, principal motives for saving, by age of the household respondent.

Combining this pattern with an analysis of wealth composition by age confirms that buying the house of residence (*i.e.* becoming a 'homeowner') is a major patrimonial event. Indeed, as previously observed, real estate properties form more than the 80% of household wealth and, for most families, these properties consist in the house of residence. Moreover, purchasing the family house represents an important innovation plan, which typically affects households' patrimonial conditions for several years. Indeed, data show that before the purchase takes place, households tend to increase savings (*i.e.* 'save to buy a home') and build up assets, which they later use to downpay for mortgages and to complete the house acquisition. Thus, at the moment of the acquisition, and for a few years later, most households experience a decrease in their net asset position. This evolution of net-wealth positions, specifically associated with becoming a homeowner, is coherent with the observed life-cycle dynamics of family saving motives.

To capture these patrimonial effects of purchasing the residential house, we build an indicator variable distinguishing households who own their family house (*Homeowner*) from those who do not. Among homeowners, we also identify those who have recently (in the last 5 years) become so (*Homeowner by* $\leq$ *5 years*). Further, given the relevance of real estate properties for Italian households, we build an indicator that separates homeowners from those who also own other real estate properties (*Other houses*). This last group of households is typically characterized by individuals with more solid patrimonial conditions and a more diversified wealth; namely, a patrimonial situation that is also expected to increase their resilience to adverse shocks.

3. Main results

In this section, first, we quantify the elasticity of precautionary saving by estimating our model of total net wealth (∗) on a sample of employed respondents younger than 65. Second, we exploit our rich data set to test omitted variable bias on preference characteristics, indicators of trade opportunities, and of saving attitudes. In doing so we especially focus on whether the omission of certain controls significantly distorts the estimates of the elasticity of precautionary saving, as an established literature suggests. Next, we conduct two kinds of robustness tests. The first considers two alternative, more liquid measures of wealth presented above, Adjusted Net Wealth and

[14] The distinction between 'credit rejected', which we interpret as a narrow notion of 'credit constrained', and 'credit discouraged', has been first proposed in Jappelli (1990), who considered data from 1983 U.S. Survey of Consumer Finance.

[15] Further details and summary statistics are in Appendix A.5.

[16] Saving for business reasons is relevant also in the sample described in this section, which excludes 'business owners', but retains other self-employed individuals, such as members of a profession (*e.g.* craftsmen, lawyers etc.), working shareholder/partner, employees in a family business.

[17] For summary statistics and further comments see Appendix A.6.

Table 4
Regressions outcomes. Dependent variable: log of Total Net Wealth over permanent income. OLS with std errors robust to heteroschedasticity.

	(1)		(2)		(3)		(4)	
	b	se	b	se	b	se	b	se
$\frac{\sigma^2_x}{Y_p}$	0.085***	0.017	0.092***	0.017	0.087***	0.016	0.063***	0.012
EIS^P			−0.012	0.515	0.082	0.510	0.312	0.232
EIS^I			−0.486**	0.231	−0.402*	0.216	−0.380**	0.181
$\beta * 100$			0.018***	0.007	0.013**	0.006	0.006	0.004
Credit constraints					−0.441**	0.188	−0.017	0.125
Liquidity constraints					−0.892***	0.147	−0.360***	0.096
Homeowner							2.176***	0.083
Homeowner by ≤ 5 years							−0.261***	0.089
Other housing							0.605***	0.056
Saving to buy a house							−0.253***	0.080
Saving for business							0.616***	0.194
Saving to pay debts							−0.137	0.097
Saving for old age							0.150***	0.051
Saving to support/bequest							0.062	0.050
N.Obs.	1264		1264		1264		1264	
R^2_{Adj}	0.17		0.18		0.22		0.64	
AIC	4251		4246		4179		3204	

Table 5
Precautionary saving: Estimated elasticities with respect to Tot Net Wealth; mean and standard deviation; models (1)–(4).

	$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$
Mean	0.060	0.065	0.062	0.045
sd	0.133	0.144	0.136	0.099
N	1264			

Financial Wealth. The second is an attempt to verify that our results are not specific to the 2012 sample, but captures a more general attitude of the Italian households toward precautionary saving. Further analysis and extensions are postponed to Section 4.

3.1. The model of total net wealth

Based on model (∗), we regress the log-ratio of wealth to permanent income $\ln(W/Y^P)$ on our measure of subjective risk in income σ^2_y/Y^P, and on three types of household characteristics (see Table 4). Of these characteristics, we focus on three: *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* and *Credit constraints*, and by its status of real estate owner; *Saving attitudes*, represented by five dummies, one for each of the main reasons for saving.

Estimation results in Table 4 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 household characteristics.

In particular, 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 with this variable is positive and significant; although, the magnitude of precautionary saving is more easily interpreted in terms of the elasticity of total net wealth $\varepsilon(1)$ (i.e. the change of W due to a marginal change of σ^2_y) in Table 5.[18]

In specification (2) preference characteristics are introduced. According to the expected utility 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.4). 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 sign, depending on whether the individual is 'patient' or 'impatient', or may be non-significative. This is what we recurrently found in our preliminary analysis.[19] 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).[20] 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 the indicators of liquidity and credit constraints, discussed in Section 2.2.5. Liquidity constraints have potentially strong effects on households' saving decisions. As pointed out by Deaton (1991), failing to control for this phenomenon in empirical models of precautionary saving, makes it impossible to distinguish 'imprudent' individuals from, say, those who are 'prudent' but liquidity constrained. As a consequence, estimates of precautionary saving might be biased. Our estimates show that both indicators of liquidity constraints and credit constraints are significant and with the expected signs. The overall contribution of these two indicators in explaining the cross-sectional variance of wealth accumulation is substantial and seems to absorb part of the effect of the other 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

[18] The computation of the elasticities results from, $(\partial W/\partial\sigma^2_y)\cdot(\sigma^2_y/W) = \widehat{b}_2 \cdot (\sigma^2_y/Y^P)$, where $\widehat{b}_2$ is the estimated coefficient of σ^2_y/Y^P. To help comparisons with the elasticities in Guiso et al. (1992) and Lusardi (1997), we have reported the values obtained using their computation criterion in Appendix B. In general, these alternative two definitions give elasticities of the same order of magnitude.

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

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

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

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.

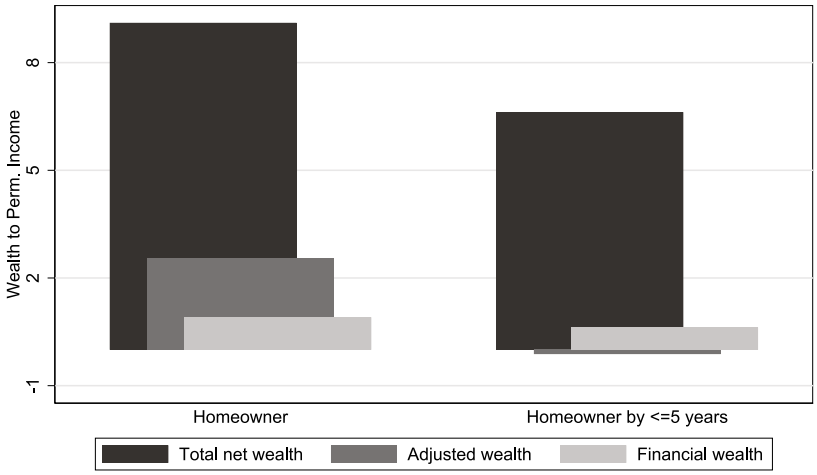

Fig. 3. Histogram values are log-ratios of wealth to permanent income for our three measures of wealth. A New Homeowner is a household who has owned its home for no more than 5 years, and has no other real estate properties.

decisions. Decisions concerning education, employment and saving, that might later in life affect permanent income and the household exposure to situations of financial distress.[21]

Finally, in (3) we also keep distinct situations in which households run into 'liquidity constraints' from 'credit constraints.' In reality, liquidity constraints are typically associated with circumstances in which an individual is short of cash or liquid assets. Thus, having excluded the entrepreneurs from our sample, we believe that the households in the sample do not finance their regular and recurrent expenses in debt. This is because they would most probably find it too costly, even when they could borrow exploiting their bank overdraft facilities and credit cards. Coherent to this picture, the most important component of household 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 prescribed down-payment. As noted above, such an interpretation is supported by the empirical evidence showing that those who have recently purchased their primary house experience a drop in their ratio of net wealth to permanent income.[22]

We illustrate the wealth effects of becoming a homeowner with a simple graphical representation in Fig. 3. The graph uses our sample data to compare the wealth of established homeowners (Homeowner) with the one of families who have acquired their first house by no more than five years (New Homeowner). The drop in wealth of new homeowners is especially evident for adjusted net wealth (in dark gray), which excludes the value of the primary house but includes mortgages. These changes of net wealth positions associated with changes in the homeownership status, is typically associated with a sequence of saving decisions and maps to different saving motives. For example, as noted in Section 2.1, if for a family head younger than forty years old, the household's primary reason to save is to buy a house, after this plan is implemented other motives such as to finance the education of children, to face unexpected events, and to save for old age, become preponderant. Accounting for these 'life-cycle' evolution of saving motives and household patrimonial conditions is clearly important to correctly assess the relevance of precautionary saving.

Based on all these considerations, in model (4) we introduce two sets of indicators. The first set represents the five major saving motives, distinct from precautionary one, as reported by the respondents.[23] The second set of indicators is specific to the home-ownership status and includes the two indicators used in Fig. 3: one identifying households who own their family house (*Homeowner*), and one for 'new homeowners' (*Homeowner by* $\leq$ *5 years*). We also consider a third indicator for households who also own other real estate properties (*Other houses*). This last indicator is especially relevant in order to identify a group of households that normally has more solid patrimonial conditions and a more diversified wealth; namely, households who might respond less to income risk, not because they are 'imprudent', but because they have built sounder patrimonial conditions and are more resilient to income shocks.

Comparing model (4) and (3), one immediately notices that two covariates, β and 'Credit constraints', lose their significance. Indeed, we believe that this is the consequence of the fact that the indicators of saving motives depend on individual preference characteristics and personal attitudes, other than 'prudence', and on specific household economic conditions. One of such attitudes is certainly 'patience', captured by the estimated coefficient β, which is most likely associated with the introduction of 'save for old age.' Instead, as discussed above, 'saving to buy a home' is associated with a particular phase of the household life-cycle that often corresponds to weaker patrimonial conditions. A similar line of reasoning seems to apply to households 'starting a business', who tend to display special financial needs.

Concerning the sign of the estimated coefficients, results have a natural interpretation. As expected, homeowners tend to have a relatively higher net wealth, compared to both those who do not own the family house and the new homeowners. Indeed, the estimated coefficient of this last variable is negative and significant, in line with our previous discussion: the negative effect of buying a house on the holding of other assets, and the positive one on liabilities. The indicator 'Other houses' is also positive and significant, confirming the relevance of real estate properties for Italian households.

Finally, we notice that the estimated elasticity of precautionary saving $\varepsilon(4)$ in Table 5, is much more accurate and it is significantly smaller than the estimates found in the other models. This last result

[21] 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.

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

[23] We claim they are 'distinct' because, among the possible motives, the respondents were also asked if saving to "cope with unexpected contingencies" was an important reason.

is important and will be further analyzed below, when we will discuss the relevance of omitted variable bias.

To summarize our quantitative results, estimations indicate that the average contribution of precautionary saving is significant, 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.[24]

However, the inclusion of covariates representing households' preferences, saving attitudes, and personal economic conditions, has considerably improved the explanatory power of the model and, as we are going to discuss in the next section, it has also significantly contributed to achieving robust estimates of the elasticity of the precautionary component. At the same time, the inclusion of a richer set of covariates does not come with an increase in the model complexity. Instead, we believe it results in a model specification that is rather clean and easy to interpret. For example, differently from most empirical models in the literature on precautionary saving, our does not include among the regressors the log of permanent income, capturing non-homothetic preferences;[25] nor it contains higher-order polynomial functions of the respondent's age, typically used to capture life-cycle properties of the cross-sectional distribution of wealth that were otherwise unexplained.[26]

3.2. Omitted variable bias and precautionary saving

We now ask to what extent the use of information on household preferences, trade opportunities, and patrimonial conditions, 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 significant changes in the estimated elasticities of precautionary saving. Moreover, given the empirical relevance of liquidity constraints, home ownership, and saving motives, we try to better understand how these indicators interact with each other and with preferences.

Before proceeding to a 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 with 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 data speak. Table 6 summarizes these signs and the resulting directions of the bias. The first aspect to notice is indeed that signs are not always the same, implying that the overall effect of omitting several variables does also depend on how their individual effects compose.

Turning to our estimation results in Table 5 above, we notice that the introduction of preferences in (2) tends to raise the elasticity of precautionary saving. Qualitatively, this is what we find for the patience parameter β and for our indicator of risk aversion (the reciprocal EIS^I). This is coherent with the commonly shared opinion of the existence of a selection bias associated with the measure of risk in income.[27] It is also consistent with the sign difference of the correlation coefficient of these indicators with income-risk. Indeed, this negative correlation of β is typically explained with the greater inclination of patient individuals to achieve higher educational levels, and with its effect of reducing unemployment risk. Instead, the negative (resp. positive) covariance between EIS^I (resp. risk aversion) 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.

Table 6
Coefficient signs are estimated from our model. Correlations are sample moments with respect to σ_y^2/Y^P. The sign of the omitted variable bias results from the product of the former signs.

	Coefficient	Correlation	Bias
β	+	−	−
EIS^P	+	−	−
EIS^I	−	−	+
Credit constraints	−	+	−
Liquidity constraints	−	−	+
Homeowner	+	+	+
Other houses	+	+	+
Homeowner by ≤ 5 years	−	−	+
Save to buy a home	−	−	+
Save for business	+	+	+
Save to pay debts	−	+	−
Save for old age	+	+	+
Save to support/bequest	+	+	+

On the other hand, quantitatively, the hypothesis that omitting preference indicators biases estimates is rejected by data, as the change of the estimated elasticity of precautionary saving is statistically non-significant. This is partially due to the fact that the estimated standard deviations associated with ε are quite large in models (1)-(2).

Similar considerations hold for the indicators of liquidity and credit constraints, introduced in model (3). Conversely, the inclusion of indicators of real estate ownership and of other reasons for saving, has a significant impact on the estimated mean elasticity in model (4). In both cases, the final effect is to reduce the estimated elasticities of precautionary saving by 1.5–2 percentage points, to a value of 4.5. Moreover, as Table 6 highlights, the sign of the bias associated with omitting every one of the new covariates in model (4) is positive, with the evident exception of the indicator of 'save to pay debts.'

As we have pointed out above, acquiring the primary house of residence is a major commitment for most households (at least for its size). Around the time this plan is realized, households experience a reduction of their net wealth (these are the *Homeowners* ≤ 5 *years*). Later on, becoming a homeowner is associated with a higher ratio of wealth-to-permanent income. This evidence is reinforced for those households who decide to purchase other real estate properties (*Other houses*). Clearly, one can claim that real estate acquisitions have a precautionary component too. However, it seems more reasonable to think that this decision has a strong motive different from prudence, especially when it involves the purchase of the family's primary house. Thus, failing to control for these motives is expected to produce an upward bias in the estimated elasticity of precautionary saving. This is consistent with the qualitative prediction of Table 6. The hypothesis that homeowners have a lower elasticity of precautionary saving was tested and accepted by Lusardi (1997), who then estimated precautionary saving by excluding this group from her sample.

Finally, controlling for saving motives other than prudence is important too. This is so mainly because it makes it possible to distinguish, say, a 'prudent' individual from one that is 'imprudent' but has different attitudes toward saving: the desire to own the family house, the altruism associated with financing the education of his/her grandchildren or to leave a bequest.

[24] See Table 17 in Appendix B for a closer comparison with the results in Guiso et al. (1992).

[25] Introducing this control we noticed that it tends to completely lose 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.

[26] 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. We ultimately found that controlling for the age is important only in our model of permanent income (see Appendix A.2).

[27] For example, see Browning and Lusardi (1996), and Fuchs-Schündeln and Schündeln (2005).

Table 7
Precautionary saving: Estimated elasticities model (4). The first three columns report elasticities for different types of wealth. The fourth column reports the elasticity of total net wealth in the "Normal" sub-sample.

	Final sample			"Normal" sub-sample
	Total Net W.	Adjusted W.	Financial W.	
Mean	0.045	0.067	0.050	0.040
sd	0.099	0.148	0.110	0.093
N	1264	1098	1264	929

3.3. Robustness

In this section, we conduct two robustness tests. In the first, we check if our results are sensitive to the measure of wealth considered. In particular, one may argue that some illiquid assets, such as the household's primary house, are not a natural instrument to self-ensure against 'rainy days'. If this were so, precautionary saving would be subject to a measurement error. 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. Using the specification of model (4) above, we found that eliminating the most illiquid components of wealth produces a small but significant increase in the estimated elasticity of precautionary saving. Yet, estimates show that the precautionary saving component does not significantly vary across the two more liquid definitions of wealth.

Our second robustness test regards the use of cross-sectional data for a particular year, the 2012, and the possibility that this would result in a sample bias. As we said earlier, SHIW 2012 survey was conducted between January and August 2013, just after an important turning point of the European debt crisis. Going back in time, 2010 is the year in which two important events adversely hit Italy: (i) the sharp increase of interest rate expenditure due to the first phase of the European debt crisis;[28] (ii) the economic slowdown of European countries. These two effects produced a sharp increase in the Italian government debt-to-gdp ratio in 2011 and a sovereign debt-crisis by the end of the summer of 2011. In November the country experienced a change in government and the inauguration of a new period of fiscal austerity. About one year later, on September 2012, the ECB announced a free unlimited support for all Eurozone countries involved in a sovereign state bailout/precautionary programme. Draghi's "whatever it takes" announcement put strength on the ECB monetary policy and resulted in a quite rapid decrease of the interest rates and sovereign debt spreads, which unfolded in the last months of 2012 and in the first semester of 2013.

Therefore, at the time the 2012 SHIW was conducted, Italy was experiencing a phase of financial markets normalization in a context of still seriously weak economic conditions. In this scenario, one may fear that the households' saving/consumption decisions of 2012 could not be a reliable description of their "normal" behavior. A natural response would be to estimate our model on panel data, or just on a different wave. Yet, this is not possible, since the 2012 SHIW is the only wave that includes information on households' perceived income risk (see the Introduction).[29] Instead, what we could do to, at least partially, address the issue was to directly test the hypothesis that households' 2012 decisions were "normal" (see Jappelli and Pistaferri, 2014). To this end, we exploited two particular questions that specifically ask whether respondents would, respectively, say that their total income and average expenditure were "normal" in 2012, compared with a "normal year". Focusing on the households who responded "normal" to both questions (a total of 929), we found that none of our results are significantly different from those obtained over the full sample of 1264 respondents (see Table 7). Qualitatively, analogous results were achieved by focusing on those answering "normal" to either one of the above questions.[30]

Table 8
Precautionary saving: Estimated elasticities models (1)-(4). Respondents as old as 65, including business owners.

	$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$
Mean	0.058	0.061	0.058	0.045
sd	0.162	0.170	0.161	0.126
N	1404			

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

In the previous section, we estimated the relevance of precautionary saving excluding households older than 65 and business owners. In this section, we explore how weakening this filtering changes our results. We point out that this extension may be problematic. Indeed, it is possible that some household groups accumulate assets for reasons other than smoothing income risk; reasons we are unable to satisfactorily control for. This could be the case of entrepreneurs for business risk, and of senior citizens for 'longevity risk' and 'health risk'.

4.1. Business owners

Including business owners, younger than 65, increases the sample by 140 respondents, to a total of 1404 households.

It is possible that entrepreneurs save for different reasons than prudence; motives that do not entirely map into differences in the control variables we have used (our proxies of preference characteristics, saving attitudes, and opportunities). In this regard, Hurst et al. (2010) presented some empirical evidence in support of this hypothesis and argued that failing to properly account 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. Indeed, they found that business owners tend to hold a relatively larger stock of wealth and face a higher income risk, but that this correlation between income risk and wealth has more to do with the specific source of risk they face, than with the precautionary motive. This observation seems to be particularly true if one considers small firms; firms whose 'business risk' is often perceived as uninsurable, or as particularly hard to diversify.

In this section, we test the hypothesis that business owners have a higher elasticity of precautionary saving.[31] Evidence shows that including business owners does not modify the estimated elasticity of precautionary saving (see Table 8). This result is also robust to the change of wealth measurement, especially, when considering adjusted wealth as opposed to total net wealth.[32]

[28] The crisis dates back to the last quarter of 2009 followed by the first ECB-IMF bailout of Greece in May 2010.

[29] The same limitation applies to earlier studies that used specific survey questions similar to ours; notably, Guiso et al. (1992), Lusardi (1997), and Arrondel (2002).

[30] Jappelli and Pistaferri cit., using our same data source to study the marginal propensity to consume, propose a similar normality test on consumption to validate their results.

[31] Model specifications are identical to those detailed above, (1) to (4), except that we dropped from correlates some controls for Entrepreneurs and Craftsmen.

[32] This last check, and the choice of wealth measure, is important, as entrepreneurs tend to privilege real assets for business reasons. Indeed, their average ratio of Adjusted Wealth to permanent income is about 4 times higher than any other category of employed individuals (for craftsmen it is about 2.8, slightly above the third highest of managers in the private sector). Moreover, entrepreneurs hold a ratio of financial wealth to total that is about 14%, higher than craftsmen's (10%), but smaller than employees' (20%) and pensioners' (19%).

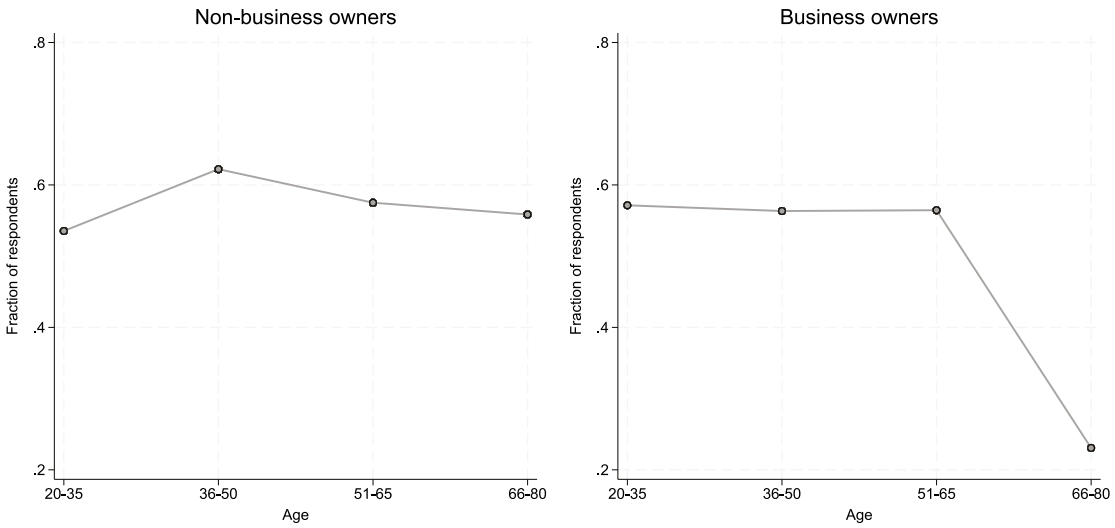

Fig. 4. Percentage of households who reported that 'save for unexpected events' is one of their main reasons for saving. Percentages are presented for four age classes, and distinguishing between non-business owners (left panel) and business owners (right panel).

Table 9
Precautionary saving: Estimated elasticities models (1)-(4). Extended sample with elderly respondents and business owners.

	$\varepsilon(1)$	$\varepsilon(2)$	$\varepsilon(3)$	$\varepsilon(4)$
Mean	0.046	0.047	0.045	0.035
sd	0.151	0.156	0.149	0.118
N	2203			

4.2. Senior citizens

We now add senior citizens to the sample including business owners. This increases the sample by 799 respondents, to a total of 2203 households. Reiterating our empirical analysis on this larger sample does not qualitatively change its results. Instead, quantitatively, we found that the estimated elasticity of precautionary saving falls by about two percentage points for the measure of net wealth (see Table 9).

A natural interpretation of this phenomenon is that, as people become older and approach, or enter, retirement age, the relative importance of income-risk diminishes with respect to other risks, such as longevity- and health-risk. However, it is also possible that perceived income risk itself drops significantly, especially, for those households whose main source of income is pension transfers, perceived as riskless, up to the point to make the 'precautionary motive' irrelevant.

Although we are unable to test the first conjecture on our data, we can provide some evidence supporting the hypothesis that precautionary motive for savings is decreasing with age. This is achieved considering a specific survey question that directly asks if 'save for unexpected events' is among the household's most important reasons for saving. Fig. 4 reports the percentage of positive answers to this question, dividing respondents by age groups (horizontal axis) and employment status (left panel for non-business owners, right panel for business owners). Interestingly, the age-decreasing pattern of precautionary saving is more evident for business owners, who exhibit a marked drop in this indicator around their retirement age.

Next, we provide some evidence that essentially rejects our second conjecture that precautionary saving might decrease with age, following a decrease in the income-risk. In fact, data show that the income risk perceived by retired respondents is more correlated with their household's wealth than with their income composition; namely, pension transfers seem more important than 'capital income' (*i.e.* income from financial and real assets). To illustrate this point, we divide pensioners into three groups, based on their fraction f of capital income to total income. Then, we notice that the group with the smallest f has a higher average perceived risk in income than the one with a low fraction of capital income. This is shown in the left panel of Fig. 5, where the three f-group are labeled "Low", "Mid" and "High", for increasing fractions of f.[33] The right panel of Fig. 5 shows that perceived income risk tends to decrease in total net wealth too. Both patterns in this figure hold irrespectively of the sample considered.

As a final remark, we notice that a lower average elasticity of precautionary saving of the elderly need not be in contrast with the 'wealth decumulation puzzle' observed for Italian households.[34] In fact, a reduction of saving against perceived income risk is compatible with a higher propensity to save for other risks (*e.g.* health and longevity risks) and reasons (*e.g.* the desire for bequests and intergenerational transfers).

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.[35] 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 cross-sectional data, this ambiguity has often been attributed to two main sources of *bias*: a measurement bias and an endogeneity bias. The first is primarily associated with 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, as well as on 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

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

[35] See, for example, Browning and Lusardi (1996) and Carroll and Samwick (1997) for early references. For more recent results, see Hurst et al. (2010).

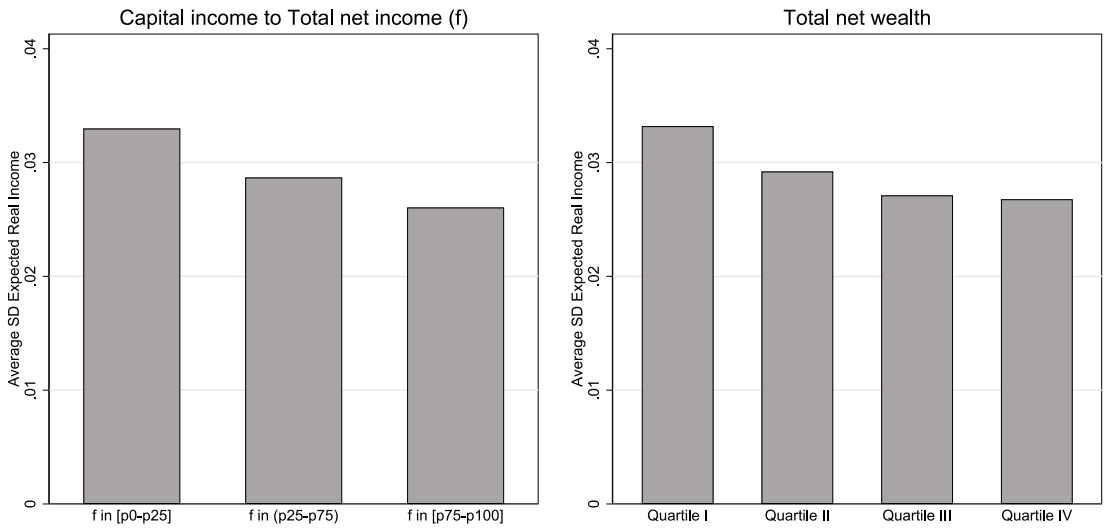

Fig. 5. Pensioners' perceived risk in income by their fraction of capital income (left panel) and their quintile position in the distribution of net wealth (right panel).

survey is that simultaneously contains a particular question that elicits the respondent's subjective risk in total income and some detailed information on individual preferences and on households' insurance possibilities.

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 seem roughly consistent with those found in Guiso et al. (1992) and in Lusardi (1997), based on SHIW 1989. However, the introduction of certain preference characteristics and indicators of the households' trade opportunities, highlighted two relevant aspects. First, a marked improvement in 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 trade opportunities (liquidity and credit constraints) allows to account for various kinds of endogeneity bias. The possibility to avoid endogeneity bias, in turn, did also affect our choice of the estimation method; it legitimated the use of OLS as opposed to following the slippery road of Instrumental Variables.[36]

The second improvement from considering data on individual preference characteristics and trade opportunities is to be able to actually test 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 combine. If the omission of the subjective discount rate and risk aversion tends to bias downward the elasticity of precautionary saving, failing to control for liquidity and credit constraints, or for alternative saving motives, has the opposite effect. Of all these potential sources of bias, data reveal that the only statistically significant ones are those associated with the omission of certain indicators of household trade opportunities and saving motives. In particular, controlling for saving reasons other than prudence is important, essentially, because it makes it possible to distinguish, say, 'prudent' individuals from those who are 'imprudent' but have different attitudes for saving: the desire to own the family house, the altruism associated with finance the education of his/her grandchildren or to leave a bequest, the sense of responsibility associated with the aspiration of remaining independent and self-sufficient. Moreover, as the relative importance of these motives changes over the life-cycle, their inclusion captures some relevant life-cycle patterns of saving; patterns that, in earlier cross-sectional studies on saving were partially explained by controlling for 'age', or by including some polynomial of age among the regressors.

Our estimation results are robust to the use of alternative measures of wealth and to the introduction of business owners. Conversely, including respondents as old as 80, has the effect of reducucing the average precautionary saving by about two percentage points; something that we argue not being in contrast with the 'wealth decumulation puzzle' documented for Italian households.

Perhaps the main weakness of our study is that it is based on a single survey wave; a wave that, in addition, refers to a period of potential economic turbulence. Thus, one can legitimately cast dubs that the results presented be a reliable description of the households' "normal" behavior. A natural robustness analysis would be to estimate our model on panel data, or just on a different wave. Yet, this is not possible, as the particular question we used to measure households' perceived income risk is only present in the 2012 survey. Instead, we have (at least partially) addressed this issue by directly testing the hypothesis that households 2012 decisions are "normal". This test is based on estimating our model on a subsample of households who explicitly answered to perceive their 2012 income and expenditure as "normal", compared with a "normal year". The test results unambiguously support "normality", something that is a partial confirmation of the fact that our estimates could be actually valid beyond 2012.

Declaration of competing interest

The author hereby declare that the authors of this manuscript have no financial/personal interest or belief that could have affected their objectivity.

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[36] 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.

Table 10
Sample selection.

	Raw count	Step 1 count	Step 2 count	Step 3 count	Step 4 count	Step 5 count
N	8151	6639	3371	2416	2203	1264

Appendix A. Data and measurement

A.1. Data

The 2012 Italian Surveys of Household Income and Wealth (SHIW) collected information on a sample of 8151 Italian households, approximately twenty thousand individuals, with interviews carried out between January and August 2013.[37] In SHIW, data are collected at the household and the individual level. Some characteristics such as demographics, employment status, and income are obtained for each person in the household. Others are only detected at the household level, considering the answers provided by a 'representative' individual: the head of the household, defined as the person primarily responsible for or most knowledgeable about the household budget. For this reason, the analysis presented only considers household heads. Once the reference person for each family has been identified, the selection criteria described in the following five steps are sequentially imposed.

(1) *Step 1:* Families are included if they have: no missing basic demographic characteristics, employment status, economic variables; strictly positive wealth and income; heads who are not unemployed (1153 observations). Applying this filtering, the sample reduces to 6639 observations;
(2) *Step 2:* Families are removed if they did not answer the questions on expected income and price growth rates – required to measure subjective income risk. The design of the survey is such that only half of the sample – randomly selected – answers these questions. Applying this filtering, the sample reduces to 3371 observations;
(3) *Step 3:* All families for which no information is available on the risk aversion coefficient and the degree of impatience are eliminated from the sample. At this step the sample reduces to 2416 observations;
(4) *Step 4:* Following Guiso et al. (1992), we remove families whose heads are more than 65 years old. At this step the sample reduces to 2203 observations;
(5) *Step 5:* Lastly, we remove families whose heads are business owners. The final sample has 1264 observations.

Table 10 summarizes the variations of the sample size resulting from the application of each selection step.

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,

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

where Z is a vector of observable household's characteristics, b are coefficients, f_t is polynomial function of the age.[38] Using our cross-sectional data on households' income and characteristics, we obtain estimated coefficients $\hat{b}$ and $\hat{f}_t$, 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,

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

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

We estimate model (**) on our sample using OLS (see Table 11). The set of covariates in Z includes observable attributes of the respondent and of his/her partner (*e.g.* preference characteristics, gender, education, marital 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's ability to access to insurance schemes (*e.g.* having a life, pension and/or health insurance). The overall goodness of fit is satisfactory with an adjusted R^2 equal to 53.8%.

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 99.9 Euro; conversely, a unitary change of ARA makes Y fall by about 10 thousand Euro. The third-order polynomial in the age captures the hump-shaped age-income relationship, and all its terms are highly significant but only the average partial effect is reported. Everything else equal, an additional year in the respondent age makes its income vary by 302 Euros. A married couple (or a widow) earns approximately 2.4 (3.1) thousand Euros more than a single. The number of income earners in the household significantly affects total net income, while the number of cohabitant children does not. The area of residence is another source of heterogeneity (North-West Italy is the omitted, reference category). People living in the South and on the Islands receive a lower income of 3.9 and 4.1 thousand Euro respectively, the difference for those residing in the North-East and in the Center is instead 2.5 and 3.5 thousand Euro.

Total net income is essentially increasing in the level of education of the family head and is also partially affected by the educational qualifications of the spouse. People with a middle school diploma have an income higher by 4.2 thousands Euro than the average illiterate and the wage-premium progressively increases for people with a high school diploma, a bachelor, a master, a PhD (respectively, by 8.4, 9.1, 16.1 and 18 thousands Euros).

The type of employment and the sector of occupation capture the labor income heterogeneity. Also in this case we check both the occupation of the head of the family and that of any partner. Retired heads are the (omitted) category with the lowest income. The difference is particularly significant with respect to managers in the private sector and entrepreneurs, who respectively earn almost 16 and 23.2 thousand Euro more than pensioners.

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 increases personal income by 4.6 thousands Euro, and being owner of other housing has an even more pronounced effect. Investing in short-term or long-term Government bonds, or in other bonds and equities, makes the outcome vary by about 5.4 and 7.3 thousands Euros respectively.

Indicators on insurance opportunities are also significant. Having a life insurance, and/or a health policy, positively affects income by 3.2 and 2.5 thousand Euro respectively.

Turning to the results of our income-decomposition, Fig. 6 shows that data differ considerably across respondents' occupations (by individuals in the labor force and pensioners) and employment sectors

[37] 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).

[38] 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 mix 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).

Table 11
Estimating Permanent income. Estimation: OLS with standard errors robust to heteroskedasticity. Reference sample: Step 4 sample. Dependent variable: Total net income. The reference categories are: non-Married, resident in the Centre of Italy, Illiterate and Workers.

	b	se
$\beta * 100$	99.896**	48.861
ARA	−10710.685***	2395.668
Male	1798.174**	840.013
Age	302.019***	76.829
Married	2475.778	2481.189
Divorced	1066.348	1459.445
Widowed	3169.398**	1394.072
Number of income recipients	13487.806***	1047.287
Number of cohabitant children	495.326	592.370
North-East	−2572.758**	1250.352
Centre	−3253.581***	1230.923
South	−3972.472***	1499.314
Islands	−4192.371***	1300.328
Elementary (head)	1030.653	1450.606
Low secondary (head)	4220.929***	1584.326
Vocational secondary (head)	5407.049**	2130.533
Upper secondary (head)	8437.895***	1901.027
Bachelor (head)	9131.165***	2860.916
Master (head)	16151.018***	2291.329
PhD (head)	18512.429***	4999.960
Elementary (spouse)	−4303.949*	2609.943
Low secondary (spouse)	89.563	2773.182
Vocational secondary (spouse)	332.540	3037.764
Upper secondary (spouse)	4939.580	3074.955
Bachelor (spouse)	5567.807	4387.644
Master (spouse)	10783.496***	3899.953
PhD (spouse)	16751.238*	8799.459
Worker public sector (head)	3644.083	2366.642
Worker private sector (head)	8866.424***	2303.736
Employee public sector (head)	5312.595**	2273.783
Employee private sector (head)	10367.858***	2437.571
Manager public sector (head)	8913.152***	2591.256
Manager private sector (head)	16071.930***	2765.095
Entrepreneur (head)	23243.201***	4523.908
Craftsman (head)	10506.771***	2701.328
Worker public sector (spouse)	−5455.428**	2484.565
Worker private sector (spouse)	−4581.689***	1440.478
Employee public sector (spouse)	−3710.357	2255.639
Employee private sector (spouse)	−5187.757***	1880.908
Manager public sector (spouse)	4766.021	4689.368
Manager private sector (spouse)	11246.771*	5911.101
Entrepreneur (spouse)	7114.845	5683.498
Craftsman (spouse)	3006.458	3310.436
Experienced unemployment (head)	−3669.548***	869.443
Experienced unemployment (spouse)	−2500.690**	1059.824
Main residence	4646.871***	1107.944
Other housing	9605.056***	1036.633
Government bonds	5417.784***	1634.462
Other risky bonds	7351.693***	1003.196
Life Insurance	3182.434*	1663.202
Pension Insurance	1879.590	1164.887
Health Insurance	2501.401**	1118.302
N.Observations	2203	
R^2	0.549	
R^2_{Adj}	0.538	

(by employed in the private sector PS and public administration PA). Entrepreneurs and managers in the private and public sector report the highest average permanent income, respectively around 72.9, 66.3 and 60.3 thousand Euros and a relatively lower standard deviation. Employees, craftsmen, and workers (operative and laborers), in the order, have progressively lower figure, about 50, 49 and 36 thousand Euros. Transitory income is negative on average. The lowest values are for workers, employees, and more generally for households in the low percentiles of the wealth distribution.

Table 12
Descriptive statistics – number of observations, mean, median and standard deviation – of the individual discount rate and the risk aversion coefficient. Reference sample: Step 5 sample.

	Count	Mean	p50	sd
β	1264	0.937	0.971	0.067
ARA	1264	0.030	0.006	0.071

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 assigned to the growth rate of nominal income (z) and 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 of inflation 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 a reference point, and we compute weighted averages, variances, and covariances:

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

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

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

From such measures we compute the variance of the expected real income, as the growth rate of real income (y) is $y = z - \pi$ (see the main text in Section 2.2.3).

Table 16 reports some descriptive statistics. The variance of the growth rate of real income has a slightly decreasing profile with age. People with low educational qualifications tend to have a higher perceived risk than those with at least a high school diploma. With respect to employment status, there is a fair amount of homogeneity. Finally, an inverse relationship is found with respect to net wealth.

A.4. 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 that can be used to measure respondents' patience and risk attitudes. Fig. 7 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 0.90, 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 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).[39]

Table 12 highlights that the average value of the impatience coefficient is equal to 0.937. Table 16 reports average values and standard deviations of the figure of interest in relation to some individual characteristics. In particular, it is noted that impatience has a hump-shaped

[39] For a critical review of the empirical literature see, for example, section 6 in Frederick et al. (2002).

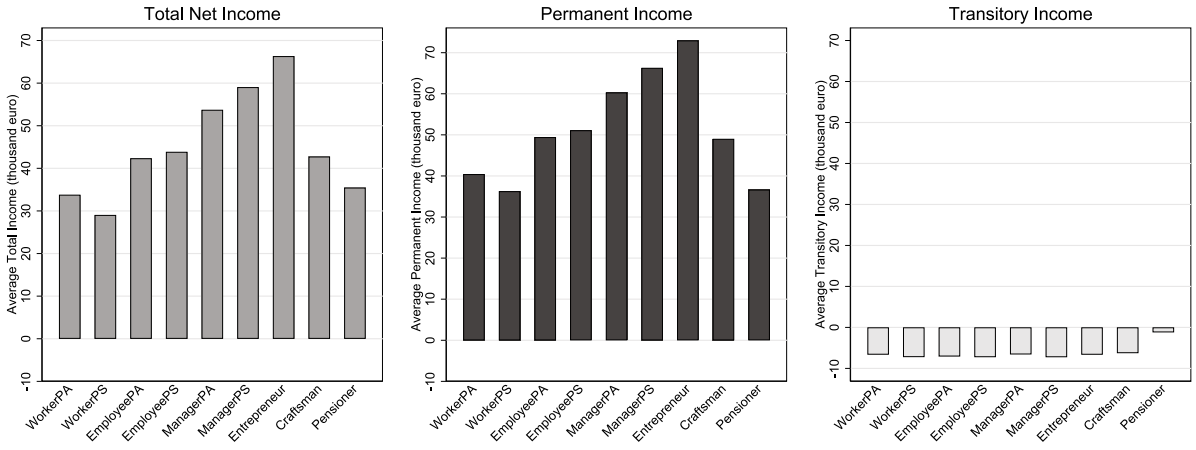

Fig. 6. Income decomposition across occupations. Reference sample: Step 4 sample.

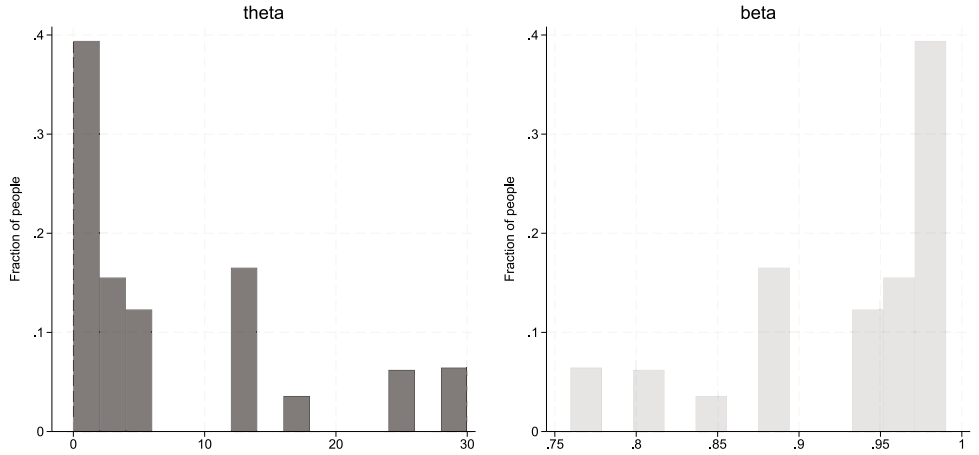

Fig. 7. Distributions of the share of the inheritance that one is willing to give up (left panel) and the individual's subjective discount factor (right panel). Reference sample: Step 5 sample.

profile with respect to age, people with a high school diploma are more patient than those without it; managers and employees are more patient than workers, craftsmen, and pensioners. Finally, impatience is inversely correlated with total net wealth, the greater the wealth, the greater the patience.

Fig. 8 shows the empirical distribution of the absolute risk-aversion coefficient. The majority of people decide to invest a very small sum and – consequently – exhibit a high risk aversion coefficient, the average value of which – reported in Table 12 – is equal to 0.3. Table 16 allows us to appreciate the links between risk aversion and some individual characteristics. There seems to be an inverse relationship between age and risk aversion, with a coefficient that tends to decrease as the years go by. People with a high school diploma have a much lower coefficient than those without a high school diploma. A substantial heterogeneity is also noted with respect to the type of employment: the group of workers is the one that reports the highest coefficient while that of managers has the smallest. There is an inverse relationship between wealth and risk aversion, the greater the wealth the lower the risk aversion.

As previously mentioned, most respondents report high risk aversion. 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,

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

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 $u'(L+q^*) - u'(L-q^*/2)/2 < 0$).[40]

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 $u''' > 0$).

Finally, data highlight an extremely high degree of risk aversion. To illustrate this with an example, assume that u is a CRRA with elasticity

[40] 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 with (o) is strictly positive at q^* iff $F'(q^*) < 0$ iff $u'(L+q^*) - u'(L-q^*/2)/2 < 0$.

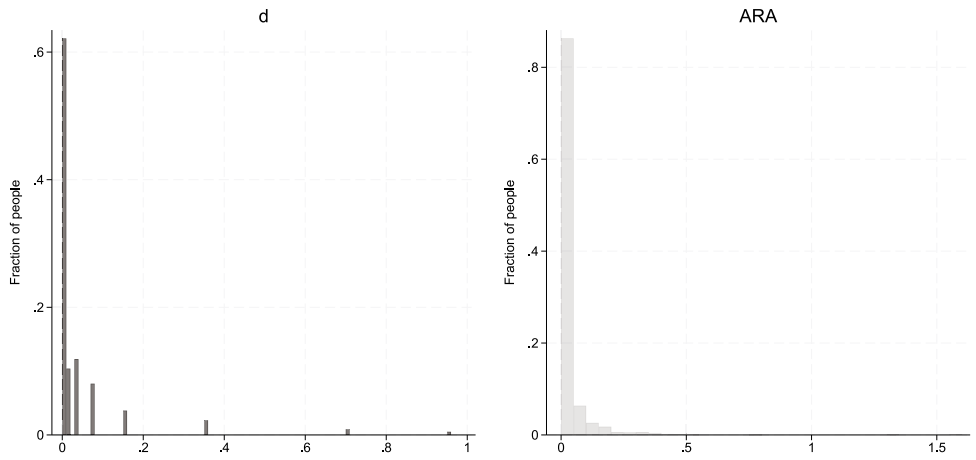

Fig. 8. Distributions of the share invested in the lottery (left panel) and coefficient of absolute risk aversion (right panel). Reference sample: Step 5 sample.

Table 13
Descriptive statistics – number of observations, mean, median and standard deviation – of household credit and liquidity constraints. Reference sample: Step 5 sample.

	Count	Mean	p50	sd
Credit constraints	1264	0.043	0.000	0.202
Liquidity constraints	1264	0.130	0.000	0.336

Table 14
Descriptive statistics – number of observations, mean, median and standard deviation – of home ownership. Reference sample: Step 5 sample.

	Count	Mean	p50	sd
Homeowner	1264	0.758	1.000	0.429
Homeowner by ≤ 5 years	1264	0.090	0.000	0.287

Table 15
Descriptive statistics – number of observations, mean, median and standard deviation – of household saving motives. Reference sample: Step 5 sample.

	Count	Mean	p50	sd
Save to buy primary house	1264	0.170	0.000	0.376
Save for other expenses	1264	0.119	0.000	0.324
Save for a business	1264	0.018	0.000	0.134
Save for unexp. events	1264	0.592	1.000	0.492
Save to pay debts	1264	0.089	0.000	0.285
Save for old age	1264	0.485	0.000	0.500
Save for travel/vacations	1264	0.150	0.000	0.358
Save to support/bequest	1264	0.480	0.000	0.500

$\gamma > 0$, 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.5. Liquidity and credit constraints

SHIW 2012 contains questions that can be used to build indicators on the presence of liquidity constraints or credit constraints.

To highlight individuals who found themselves short of liquid assets we use questions informative about the difficulty to cope with ordinary payments. Specifically, we define a binary indicator that takes value 1 if, in the reference year, a household was behind with payments of either mortgage, or rent, or utility bills by more than 90 days. Additionally, we also considered constrained households those who ended the period with a cash-on-hands position that is either null or insufficient to cover the household's net debt position. Table 13 shows that 164 households – 13 percent of the sample – are liquidity constrained.

To identify credit-constrained households we extended the definition in Jappelli (1990). In particular, individuals are *credit constrained* if they either has been denied credit or has been somewhat 'discouraged' applying. In the first category are included families who applied for a loan or a mortgage – in 2012 or in the previous two years – and received at least a partial denial. In the second category are included all the households who had considered to apply for a loan or a mortgage – in 2012 or in the previous two years – but then changed their mind because thought their request would be declined. The resulting group of credit-constrained households is formed by a few respondents; 15 are credit rejected and 41 are discouraged (respectively, about 1.2% and 3.2% of our sample). Moreover, only two households are simultaneously members of these two groups. As reported in Table 13, only 54 families – 4.3 percent of the sample – appear to be in this condition.

Table 16 highlights the association between credit and liquidity constraints and demographic characteristics. Exposure to both types of constraints decreases with age. People without a high school diploma are significantly more exposed to the risk of binding constraints than those with a higher education qualification. Workers and craftsmen fall into economic difficulty more often than others. Liquidity problems among pensioners should also be noted. The share of constrained people decreases as the resources available increase.

A.6. Saving attitudes

SHIW 2012 offers a complete picture of the financial condition of families as well as their saving motives. Regarding assets, home ownership is of particular importance. Residential home ownership is widespread. As shown in Table 14, 75.8 percent of families live in a home they own and – as shown in Table 16 – the share of owning families increases with age, is higher among families with a diploma, headed by a manager or retired, and substantially homogeneous in the top three quartiles of wealth. To better understand the timing of purchasing a home, a binary indicator is defined which highlights homeowners for no more than five years. These represent 9 percent of the sample and tend to be individuals under 50 years old, graduates, and employed as employees or managers.

With respect to saving motives, the head of the household is asked to choose one or more savings reasons (up to a maximum of three choices) from a predefined list. The various reasons for saving are: to buy the primary house, to make other significant expenses (such as other

Table 16
Descriptive statistics – mean and standard deviation – by individual/household characteristics of the main variables of interest. Reference sample: Step 5 sample.

		Age			Diploma		Status					Total net wealth			
		[20, 35]	[36–50]	[51–65]	No	Yes	Worker	Employee	Manager	Craftsman	Pensioner	I quartile	II quartile	III quartile	IV quartile
β	Mean	0.933	0.940	0.936	0.925	0.943	0.932	0.941	0.945	0.934	0.935	0.928	0.934	0.940	0.947
	sd	0.074	0.067	0.067	0.071	0.064	0.069	0.068	0.064	0.063	0.068	0.074	0.071	0.064	0.059
ARA	Mean	0.038	0.037	0.024	0.045	0.023	0.056	0.027	0.009	0.024	0.020	0.062	0.029	0.016	0.015
	sd	0.065	0.085	0.058	0.086	0.062	0.097	0.071	0.022	0.058	0.047	0.102	0.058	0.037	0.062
σ_x	Mean	0.033	0.029	0.028	0.030	0.029	0.029	0.030	0.029	0.030	0.028	0.031	0.028	0.029	0.027
	sd	0.038	0.032	0.033	0.033	0.033	0.033	0.035	0.034	0.030	0.033	0.034	0.034	0.033	0.032
Credit constraints	Mean	0.081	0.060	0.022	0.053	0.038	0.057	0.037	0.031	0.085	0.021	0.098	0.032	0.019	0.022
	sd	0.274	0.238	0.147	0.223	0.191	0.232	0.189	0.173	0.279	0.145	0.298	0.176	0.137	0.147
Liquidity constraints	Mean	0.263	0.158	0.085	0.174	0.108	0.247	0.098	0.046	0.138	0.079	0.293	0.108	0.070	0.047
	sd	0.442	0.365	0.280	0.380	0.310	0.432	0.298	0.210	0.347	0.270	0.456	0.311	0.255	0.213
Homeowner	Mean	0.566	0.707	0.831	0.728	0.773	0.620	0.784	0.824	0.731	0.857	0.221	0.898	0.959	0.956
	sd	0.498	0.456	0.375	0.446	0.419	0.486	0.412	0.382	0.445	0.351	0.415	0.303	0.199	0.206
Homeowner by ≤ 5 years	Mean	0.192	0.132	0.039	0.064	0.103	0.073	0.120	0.153	0.092	0.036	0.088	0.111	0.092	0.070
	sd	0.396	0.338	0.195	0.246	0.304	0.260	0.326	0.361	0.291	0.186	0.284	0.315	0.289	0.255
Save for primary house	Mean	0.424	0.229	0.081	0.138	0.186	0.228	0.192	0.176	0.169	0.071	0.322	0.165	0.114	0.079
	sd	0.497	0.421	0.272	0.346	0.389	0.420	0.394	0.382	0.376	0.258	0.468	0.372	0.318	0.270
Save for major expenditures	Mean	0.172	0.132	0.100	0.095	0.130	0.120	0.130	0.183	0.108	0.075	0.129	0.095	0.101	0.149
	sd	0.379	0.338	0.300	0.294	0.337	0.326	0.337	0.388	0.311	0.264	0.336	0.294	0.302	0.356
Save for business	Mean	0.020	0.026	0.011	0.014	0.020	0.016	0.015	0.015	0.069	0.004	0.016	0.016	0.009	0.032
	Mean	0.141	0.160	0.105	0.119	0.140	0.125	0.121	0.123	0.255	0.060	0.125	0.125	0.097	0.175
Save for unexp. events	Mean	0.535	0.622	0.575	0.563	0.606	0.601	0.627	0.573	0.592	0.539	0.571	0.581	0.601	0.614
	sd	0.501	0.485	0.495	0.497	0.489	0.490	0.484	0.497	0.493	0.499	0.496	0.494	0.490	0.488
Save to pay debts	Mean	0.131	0.105	0.070	0.100	0.084	0.114	0.098	0.046	0.131	0.050	0.126	0.102	0.073	0.057
	sd	0.339	0.307	0.255	0.301	0.278	0.318	0.298	0.210	0.338	0.218	0.333	0.303	0.260	0.232
Save for old age	Mean	0.222	0.376	0.618	0.549	0.453	0.402	0.430	0.466	0.477	0.671	0.385	0.470	0.535	0.551
	sd	0.418	0.485	0.486	0.498	0.498	0.491	0.496	0.501	0.501	0.471	0.487	0.500	0.500	0.498
Save for vacations	Mean	0.202	0.182	0.115	0.103	0.174	0.139	0.199	0.191	0.123	0.086	0.161	0.143	0.158	0.139
	sd	0.404	0.386	0.320	0.304	0.379	0.347	0.400	0.394	0.330	0.280	0.368	0.350	0.366	0.347
Save to support/bequest	Mean	0.313	0.509	0.482	0.451	0.495	0.462	0.479	0.588	0.438	0.471	0.334	0.451	0.516	0.620
	Mean	0.466	0.500	0.500	0.498	0.500	0.499	0.500	0.494	0.498	0.500	0.473	0.498	0.501	0.486
N	1264														

houses, vehicles and others), to start a business or financing investment in an existing business, to cope with unexpected contingencies, to pay debts, for old age, for travel and vacations, to economically support children/grandchildren or to leave a bequest. Table 15 highlights that the most common reasons are those linked to the need to cope with unexpected events, to cope with old age, and to help children and/or grandchildren financially or to leave an inheritance. Of particular interest are saving motives' dynamics over the life cycle. Savings aimed at buying the house of residence or other houses, as well as to repay debts, or for holidays tend to decrease with age. On the contrary, savings related to old age and to the willingness to give a bequest increase with age. Lastly, savings for unexpected events and to finance an economic activity follow a hump-shaped pattern. People with a low level of education tend to save more frequently than educated ones in order to repay debts and to accumulate for old age. There is no particular heterogeneity in the reasons for saving compared to the work situation. Indeed, although with different intensities, individuals seem to have the same priorities. The only exceptions are those of craftsmen who more often save to finance their business and pensioners who accumulate more frequently than others for old age. Both people in the lowest quartile of wealth and those in the highest quartile tend to save primarily to deal with unexpected events, for old age and to leave an inheritance. However, there are differences regarding housing: the poor people accumulate for the purchase of the house of residence while the rich people accumulate for other housing.

Table 17
Precautionary saving: Estimated elasticities with respect to Tot Net Wealth; mean and standard deviation; models (1)–(4).

			Regression model			
			1	2	3	4
Main results	This paper	Mean	0.060	0.065	0.062	0.045
		sd	0.133	0.144	0.136	0.099
Main results	Guiso et al.	Mean	0.052	0.055	0.053	0.040
		sd	0.097	0.103	0.098	0.077
Business owner	This paper	Mean	0.058	0.061	0.058	0.045
		sd	0.162	0.170	0.161	0.126
Business owner	Guiso et al.	Mean	0.048	0.051	0.048	0.039
		sd	0.096	0.099	0.096	0.080
Senior citizens	This paper	Mean	0.044	0.046	0.044	0.034
		sd	0.135	0.141	0.135	0.105
Senior citizens	Guiso et al.	Mean	0.038	0.040	0.038	0.031
		sd	0.075	0.078	0.075	0.062

Appendix B. Elasticities

Table 17 reports estimates of precautionary saving (the estimated 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, $\widetilde{\varepsilon} = 1 - (\exp\{\varepsilon\})^{-1}$.

Appendix C. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.econmod.2024.106965.

Data availability

The Replication folder was uploaded to Mendeley: V2, doi: https://10.17632/dxmjtbkttj.2.

References

Arrondel, L., 2002. Risk management and wealth accumulation behavior in France. Econom. Lett. 74 (2), 187–194.

Bank of Italy, 2014. Supplements of the Statistical Bulletin, Sample Surveys, Househ. Income and Wealth in 2012. In: New series, Year XXIV - 27 January 2014.

Bertola, G., Guiso, L., Pistaferri, L., 2005. Uncertainty and consumer durables adjustment. Rev. Econ. Stud. 72, 973–1007.

Browning, M., Lusardi, A., 1996. Household saving: Micro theories and micro facts. J. Econ. Lit. 34 (4), 1797–1855.

Caballero, R.J., 1990. Consumption puzzles and precautionary savings. J. Mon. Econ. 25 (1), 113–136.

Carroll, C.D., 1997. Buffer-stock saving and the life cycle/permanent income hypothesis. Q. J. Econ. 112 (1), 1–55.

Carroll, C.D., Samwick, A.A., 1997. The nature of precautionary wealth. J. Monet. Econ. 40 (1), 41–71.

Carroll, C.D., Samwick, A.A., 1998. How important is precautionary saving? Econ. Stat. 80 (3), 410–419.

Carroll, C., Slacalek, J., Tokuoka, K., White, M.N., 2017. The distribution of wealth and the marginal propensity to consume. Quant. Econ. 8 (3), 977–1020.

Chiuri, M.C., Jappelli, T., 2003. Financial market imperfections and home ownership: A comparative study. Eur. Econ. Rev. 47 (5), 857–875.

De Nardi, M., French, E., Jones, J.B., 2016. Savings after retirement: A survey. Annu. Rev. Econ. 8, 177–204.

Deaton, A., 1991. Saving and liquidity constraints. Econometrica 59 (5), 1221–1248.

Dynan, K.E., 1993. How prudent are consumers? J. Polit. Econ. 101 (6), 1104–1113.

Epstein, L.G., Zin, S.E.V., 1989. Risk aversion, and the temporal behavior of consumption and asset returns: a theoretical framework. Econometrica 57 (4), 937.

Frederick, S., Loewenstein, G., O'donoghue, T., 2002. Time discounting and time preference: A critical review. J. Econ. Lit. 40 (2), 351–401.

Fuchs-Schündeln, N., Schündeln, M., 2005. Precautionary savings and self-selection: evidence from the german reunification "experiment". Q. J. Econ. 120 (3), 1085–1120.

Greenwald, D.L., Leombroni, M., Lustig, H., Van Nieuwerburgh, S., 2021. Financial and Total Wealth Inequality with Declining Interest Rates. (No. w28613), NBER.

Guiso, L., Jappelli, T., Pistaferri, L., 2002. An empirical analysis of earnings and employment risk. J. Bus. Econom. Statist. 20 (2), 241–253.

Guiso, L., Jappelli, T., Terlizzese, D., 1992. Earnings uncertainty and precautionary saving. J. Monet. Econ. 30 (2), 307–337.

Hubmer, J., Krusell, P., Smith, Jr., A.A., 2021. Sources of US wealth inequality: Past, present, and future. NBER Macroecon. Annu. 35 (1), 391–455.

Hurst, E., Lusardi, A., Kennickell, A., Torralba, F., 2010. The importance of business owners in assessing the size of precautionary savings. Rev. Econ. Stat. 92 (1), 61–69.

Jappelli, T., 1990. Who is credit constrained in the U.S. economy? Q. J. Econ. 105 (1), 219–234.

Jappelli, T., Pistaferri, L., 2014. Fiscal policy and MPC heterogeneity. Am. Econ. J.: Macroecon. 6 (4), 107–136.

Kazarosian, M., 1997. Precautionary savings a panel study. Rev. Econ. Stat. 79 (2), 241–247.

Kim, S., 2013. Prudent consumers: new evidence from the consumer expenditure survey. Econ. Model. 33, 77–85.

Kimball, M.S., 1990. Precautionary Saving and the Marginal Propensity to Consume. (No. w3403), NBER, Cambridge.

King, M.A., Dicks-Mireaux, L.L., 1982. Asset holdings and the life-cycle. Econ. J. 92 (366), 247–267.

Kreps, D.M., Porteus, E.L., 1978. Temporal resolution of uncertainty and dynamic choice theory. Econometrica 46 (1), 185–200.

Lugilde, A., Bande, R., Riveiro, D., 2019. Precautionary saving: a review of the empirical literature. J. Econ. Surv. 33 (2), 481–515.

Lusardi, A., 1997. Precautionary saving and subjective earnings variance. Econom. Lett. 57 (3), 319–326.

Lusardi, A., 1998. On the importance of the precautionary saving motive. Amer. Econ. Rev. 88 (2), 449–453.

OECD, 2022. Housing Taxation in OECD Countries. In: OECD Tax Policy Studies, OECD Publishing, Paris, http://dx.doi.org/10.1787/03dfe007-en, No. 29.

Ventura, L., Horioka, C.Y., 2020. The wealth decumulation behavior of the retired elderly in Italy: the importance of bequest motives and precautionary saving. Rev. Econ. Househ. 18 (3), 575–597.

Weil, P., 1993. Precautionary savings and the permanent income hypothesis. Rev. Econ. Stud. 60 (2), 367–383.