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Anatomy of Consumption Risk

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Abstract
We use panel data from the 2023-24 Italian Survey of Consumer Expectations which provides information on the expected consumption growth, income growth, energy prices, health expenditure distributions, and expectations related to aggregate variables (GDP growth, inflation, unemployment, house prices, interest rates). We quantify the impact of underlying risks on the expected consumption risk estimating the pass-through coefficients of the individual and aggregate risks. Idiosyncratic risks account for 75% of the predicted consumption risk: health risk has the largest impact, followed by income risk. We find that aggregate risks also matter, especially the expected GDP variability and increase in house prices but account for less than 20% of the consumption risk. Thus, most of the uncertainty harming consumer welfare is due not to business cycle but to idiosyncratic shocks. The income risk pass-through is larger for young working individuals with low levels of cash-in-hand and reflects their greater exposure and fewer insurance opportunities. In the final step of our analysis we use subjective expectations data and an instrumental variables approach and show that expected consumption growth is related positively to expected consumption risk, as predicted by precautionary savings models. Our estimates imply a coefficient of relative prudence in the plausible range of 2-3.

JEL Classification: D12, D14, D15, C8, C99.

Keywords: Consumption Risk; Income Risk; Health Risk; Aggregate Risk.

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1. Introduction

Consumption risk poses significant problems for both individuals and households, has implications for their financial well-being, and at the macro level has implications for economic stability and long-term prosperity. Understanding the determinants of consumption risk, how individuals perceive risks, and how they respond to them are crucial to reduce vulnerability to shocks and implement effective mitigation strategies. In a context of incomplete insurance and credit markets, shocks must be absorbed ex-post by cutting consumption or leisure, reallocating portfolios, or relying on social networks or the welfare state. However, consumption volatility can be reduced ex-ante by means of private personal insurance, or formal or informal insurance against insurable risks.

Standard intertemporal consumption models assume that income is the only source of risk and that income risk is not insurable.[1] In the special case of linear marginal utility, one can derive a permanent income model according to which consumers do not react to predicted consumption variability. However if the marginal utility of consumption is convex, consumers respond to income risk by increasing current savings to protect consumption from income shocks.

In reality individuals are subject to more than one type of risk; these risks include fluctuations in asset prices, healthcare costs, energy prices, and environmental risks. For instance, Palumbo (1999) studied a structural model in which uncertain future medical expenses were an important motive to save for many households. De Nardi and Fella (2017) argue that earnings risk, life uncertainty, medical expenditure risk, and heterogeneity in return rates are important factors explaining consumption decisions and overall wealth inequality. Ryngaert (2022) finds that perceived inflation risk is associated with higher real consumption growth and increased propensity to purchase durables. Coibion et al. (2024) use data from a survey of European households to study how exogenous variation in household's perceived macroeconomic uncertainty affects spending decisions.

In intertemporal consumption models, what matters for consumers' decisions is expected *consumption variability*. This captures all consumption-relevant sources of uncertainty. Of course, the expected variability can differ from the variability in realized consumption, and because it is derived from the distribution of future consumption conditional on the information available at the time individuals make their consumption plans is not observed in realized

[1] For recent surveys, see Attanasio and Weber (2010), Jappelli and Pistaferri (2017), and Violante (2024).

consumption data. In this paper, we survey data to elicit the probability distribution of future consumption growth and to construct an individual-level measure of expected consumption risk. Of particular importance is that we are able to link this measure to some of the most important underlying sources of uncertainty for individuals. Therefore, we are able to trace the measure of expected consumption risk back to indicators of subjective individual-specific risks (income, health, energy bills) and aggregate risks (GDP, unemployment, inflation, asset prices). This allows us to characterize and quantify the relative importance of these sources of uncertainty for consumption volatility, and assess their heterogeneity across consumers. To our knowledge, this study is the first empirical anatomy of consumption risk and empirical assessment of the importance of each source of risk in overall consumption risk.

To elicit subjective expectations, we designed the 2023-24 Italian Survey of Consumer Expectations, a panel of 5,000 individuals which collects information on participants expected distributions of consumption growth, income growth, energy prices, health expenditure, and aggregate variables (economic growth, inflation, unemployment, house prices and interest rates). We elicited the density distribution of subjective expectations by asking respondents to allocate a portfolio of 100 probability points to a set of interval growth rates for each variable over the coming 12 months following the interview. In several cases, growth rate intervals ranged from very negative (less than 8%) to very positive (more than 8%) keeping support symmetric.

We retrieved measures of the moments of these distributions for each individual using the variance as our measure of risk. Consumption risk exhibited considerable heterogeneity across consumers and tended also to vary during the time period covered by our sample covered by the survey. Subjective consumption risk tends to be somewhat lower than labor income risk (sample mean of the standard deviation in January 2024 0.054 compared to 0.064 for labor income risk) and lower than health expenditure risk (standard deviation 0.048). Measures of both idiosyncratic and aggregate risk are correlated with observable characteristics such as age, education, and region of residence but most of the heterogeneity in measured risk is unobserved.

We run regressions of consumption risk on the variances of the underlying risk sources to obtain estimates of the pass-through coefficients under the working assumption that sources of risk are independent. Extending Banks et al. (2001), we show that pass through coefficients reflect the individual's exposure to the specific source of risk and his/her ability to insure (formally or informally) against it. In our preferred specification we control for individual fixed effects, thus exploiting only the time variation in measured risks.

We find that measured sources of risk have strong explanatory power on consumption risk, and are able to explain between 55% and 75% of the variation. Income risk, health risk, and energy price risk have the largest pass-through on expected consumption risk. Perhaps surprisingly, among these risks the highest pass-though applies to health expenditure risk which is 0.37, and larger than labor income risk 0.22, and energy risk 0.18. Because the weight of labor income on individual average consumption (measure of exposure) tends to exceed the share of health expenditure in individual consumption, the higher health risk pass-through possibly reflects the difficulty involved in substituting away health-related expenses once a health shock occurs. Aggregate risks also matter, and especially expected variability in GDP and house price growth. The pass-through of income risk is larger for young and poor households which reflects the greater exposure and fewer (self-) insurance opportunities for these groups.

Economically, expected consumption risk is explained mostly by idiosyncratic sources of risk which jointly account for about three-quarters of the predicted value of consumption risk. Aggregate risk explains only about 20% of predicted consumption risk, implying that most of the uncertainty harming consumer welfare is due not to business cycle uncertainty but to idiosyncratic shocks. Among the macroeconomic risks faced by consumers, GDP risk and house prices risk are the most important determinants of consumption risk with the contribution of interest rate risk, inflation risk, and unemployment risk combined being limited and accounting for only 4% of predicted individual consumption risk.

Finally, we include in the analysis subjective expectations data and employ an instrumental variables approach to estimate a Euler equation. We find that expected consumption growth is related positively to expected consumption risk in line with the predictions of precautionary saving models. Our estimates imply a coefficient of relative prudence in the plausible 2-3 range.

The paper contributes to the classic literature on precautionary saving in the presence of non-insurable risks (Carrol and Kimball, 1996; Banks et al. (2001), and to work on the estimation of prudence using the Euler equation approach (Dynan, 1993; Bertola et al. 2003). Our research contributes also to the growing stream of work which uses subjective expectations to elicit various measures of income and unemployment risks (Dominitz and Manski, 1997; Guiso et al., 2002; Jappelli and Pistaferri, 2000), pension risk (Guiso et al., 2013), inflation uncertainty (Crump et al., 2015), and consumption uncertainty (Christelis et al., 2020).

The rest of the paper is organized as follows. Section 2 reviews the literature on consumption risk in intertemporal models and describes our proposed framework. Section 3 presents the data and the survey questions related to a new panel of Italian individuals. Section 4 relates individual-specific and aggregate risks to socioeconomic variables. It shows that even when controlling for individual fixed effects these risks are able to account for a substantial component of consumption risk , and that there is considerable heterogeneity in the way that income and other risks affect expected consumption volatility. Section 5 uses our risk indicators to estimate the Euler equation for consumption. Section 6 summarizes our findings.

2. Measuring consumption risk

There are various approaches used in the literature to measure consumption risk: ex-post consumption volatility, income volatility, asset pricing models, and subjective expectations, and each has strengths and limitations. Some studies use realized consumption volatility to proxy for consumption risk in Euler equation estimates (e.g. Dynan, 1993; Bertola et al. 2005). One of the limitations of this approach is that expected consumption volatility does not coincide with realized volatility. In this case, in addition to reflecting genuine innovations realized volatility also reflects individual choice and therefore is endogenous.[2] Others approaches to measuring consumption risk proxy it with labor income volatility, such as the standard deviation or variance of realized labor income growth. In these approaches, one problem is that income risk although important in general, is just one of many risks people face, and its importance varies across consumers. Another problem is that realized income volatility does not coincide with expected volatility, and as in the case of consumption risk realized labor income reflects both real risk and choice (e.g. to work more or less extra hours). Finally, some studies employ consumption-based asset pricing models (e.g. CAPM) to directly estimate consumption risk. These models consider consumption growth as a determinant of asset returns and use financial market data to infer the riskiness of future consumption streams.

The approach adopted in the present paper is to rely on self-reported household spending behavior and subjective distributions of various risks. Guiso, Jappelli and Terlizzese (1992) and Manski (2004) pioneered this subjective expectations-based approach, and recent surveys by

[2] To address endogeneity issues in the Euler equation estimate, Dynan uses education and occupation as instruments but these instruments have low power.

Bachmann et al. (2022) and Stancheva (2022) provide many examples of subjective expectations being used in a range of different fields such as education, labor, health, and macro-finance.

Our starting point is that consumption uncertainty is shaped by many economic factors. To varying degrees income risk, price variability, health shocks, financial market volatility all contribute to consumption risk. Borrowing constraints can exacerbate the impact of labor income risk on the expected consumption variability since individuals facing such constraints may have limited ability to smooth consumption or cope with income volatility which leads to greater consumption uncertainty. Healthcare expenses, long-term care needs, and unexpected medical emergencies are all sources of significant consumption risk particularly for the elderly. Macroeconomic factors such as inflation, unemployment, and economic growth influence consumption risk at the individual level because economic downturns increase uncertainty about future income prospects, job security, and overall economic stability which affecting consumer perceptions and willingness and ability to spend. Also, technological advancements, market innovations, climate risk, natural disasters, and geopolitical tensions can create uncertainty regarding individual consumption growth.

In this paper we document how various sources of risk affect consumption uncertainty using insights from the literature on intertemporal consumption decisions. The first insight is that expected consumption volatility is the main variable affecting precautionary savings, because it is a relevant measure of the uncertainty characterizing consumers' saving response to risk. The second insight is that expected consumption volatility can be traced back to several sources of risks.[3] The third insight is that the need to engage in precautionary saving in response to a specific risk depends on the level of exposure to this risk. For instance, exposure to energy price shocks depends on the weight of energy costs in the individual budget constraint. The fourth insight is that some risks can be insured (either through the formal insurance market or using informal mechanisms) or can be avoided, and therefore their impact on overall consumption risk is attenuated by the available insurance opportunities.

To capture these insights, we build on Banks et al. (2001) and assume that consumers consumption preferences are constant relative risk averse (CRRA) and time separable. We

[3] E.g., workers with high future income variance will tend to have more volatile consumption (and higher savings). If they also face uncertain future medical expenses not covered by medical insurance, their consumption volatility will also reflect changes in the probabilities of future medical expenses, over and above the induced changes in the distribution of future earnings.

assume also that optimal consumption c_t (net of energy and health expenses) is approximately proportional to individual wealth w_t, $c_t \approx \mu w_t$. If the only risk is labor income risk, Banks et al. (2001) show that the expected variance of consumption growth to a second order approximation in the Euler equation is proportional to the expected variance of income growth, scaled by the ratio of income to total wealth. The scaling factor implies that the sensitivity of the expected variance of consumption growth (or consumption risk) and the expected variance of income growth (or income risk) is higher for poor people.[4]

We extend this framework to include multiple sources of risk. We make some simplifying assumptions to obtain an explicit solution that can be implemented empirically for the relation between the expected variance of consumption growth and the underlying risks. We use $\tilde{y}_{t+1}$ to denote random labor income in period *t*+1, and use $p_h \tilde{h}_{t+1}$ to denote random health expenditure as the product of the (certain and constant) price of health goods and services, p_h, and uncertain health status $\tilde{h}_{t+1}$. The value of uncertain energy costs is denoted $e\tilde{p}_{t+1}$, the product of the known quantity of energy needs *e* and the uncertain energy price $\tilde{p}_{t+1}$. Finally, $\tilde{r}_{t+1}$ is the uncertain rate of the return to wealth. These risks span the cases for which we were able to elicit consumer subjective probability distributions. The consumer budget constraint in period *t*+1 is

$$\widetilde{w}_{t+1} = (1 + \tilde{r}_{t+1} + v\,\widetilde{p}_{t+1})w_t + \tilde{y}_{t+1} - c_t - p_h \tilde{h}_{t+1} \qquad (1)$$

where we assume $e = vw_t$, that is, the quantity of energy purchased is a constant share of individual wealth, a simple way to capture the idea that energy consumption is highly price inelastic. In the appendix we show that a second order Taylor approximation of the expected marginal utility of consumption delivers the following expression:

$$\sigma_\xi^2 = \pi_y^2 \sigma_y^2 + \pi_h^2 \sigma_h^2 + \pi_p^2 \sigma_p^2 + \pi_r^2 \sigma_r^2 \qquad (2)$$

where σ_ξ^2 is the variance of the innovation of consumption growth, and the four variances on the right-hand-side of equation (2) are, respectively, innovations of income growth, health

[4] Banks et al. (2001) also show that transitory income processes have a small impact on consumption risk, and that this impact increases with the persistence of this process.

expenditure, energy prices, and interest rate variances, conditional on the information available to consumers in period *t*. In deriving the equation, we assume that all covariances between these risks are equal to zero.

The scaling factors π_z are proportional to the weight of each risk on expected consumption risk, and therefore measure the consumer's exposure to each of the four risks. We treat the scaling factors π_z as parameters, possibly varying across consumers. For instance, the conditional variance of income growth is more important for individuals whose wealth consists mostly of human capital (a high π_y term) relative to those less exposed to income risk (a relatively low π_y). Similarly, individuals close to retirement are less exposed to labor income risk than individuals who have just entered the labor market. In a world where these risks cannot be insured or protected against, the weight π_z^2 measures the pass-through of risk z to consumption risks.

In practice, consumers can avoid some of these risks through formal markets, informal networks, public intervention, or accumulated precautionary savings to attenuate the effect on consumption risk. For example, in Italy some health shocks are fully insured by the National Health System (NHS), and out-of-pocket health expenditure is related only to purchase of health-care services not covered by the NHS such as dental care and preemptive healthcare. Welfare programs including unemployment insurance, fiscal transfers, and access to social safety nets mitigate expected consumption volatility for individuals facing income shocks and unemployment risk. Other shocks to income are partly offset by transfers from parents, relatives, or friends (e.g. Fagereng et al. 2024). To allow for partial insurance we let the pass-through coefficient of risk *z* be equal to $\beta_z = \alpha_z \pi_z^2$, where $0 \leq \alpha_z \leq 1$ is a risk attenuation factor reflecting insurance opportunities vis a vis risk source *z*. Absence of insurance implies $\alpha_z = 1$, and full insurance $\alpha_z = 0$. We can than re-write equation (2) as:

$$\sigma_\xi^2 = \beta_y \sigma_y^2 + \beta_h \sigma_h^2 + \beta_p \sigma_p^2 + \beta_r \sigma_r^2 + \varepsilon \tag{3}$$

The β_z coefficients in equation (3) measure the pass-through of risk *z* on consumption risk and reflect both exposure and insurance possibilities. In the (unrealistic) case of complete markets, the β_z coefficients are all equal to zero, and the rate of growth of consumption is the same for all individuals, with no idiosyncratic consumption volatility. Otherwise, the coefficients reflect the sensitivity of consumption volatility to the underlying risks, due to both exposure and insurance.

Since our aim is to provide estimates of consumption risk decomposition using a regression framework, in equation (3) we also include the error term ε. Notice that this error is not an expectational error (i.e. the difference between planned and realized consumption) as in the Euler consumption equations which often are estimated with panel data. In fact, all terms in the equation are variances computed conditional on the information available to the consumer at the time they predict consumption, income, and the other variables of equation (3). However, the error term can contain additional determinants of expected consumption volatility linked for instance, to higher order terms omitted from the Taylor expansion, and unobserved factors that contribute to consumption risk such as ability to process information. In short, use of cross-sectional data to estimate equation (3) could result in inconsistent estimates of the pass-through parameters in the presence of unobserved heterogeneity. To address this concern, we estimate the regression using panel data and controlling for individual fixed effects, and for identification rely on the variation over time in the expected consumption risk σ_{ξ}^2, and the underlying sources of risk σ_z^2.

Equation (3) provides the framework for our decomposition exercise. It has several interesting implications. The equation shows that consumption risk reflects all sources of risk that affect the consumer's budget constraint. It shows also that what matters for expected consumption risk is the individual's subjective perception of their own risk which in general will be different from the ex-post volatilities calculated using historical data.

Notice also that since the β_z coefficients reflect risk insurability and exposure (i.e. the α_z parameters and the π_z shares), and since both might vary across individuals the estimated pass-throughs may also differ across individuals. To account for these differences, and indirectly to validate the decomposition of consumption risk, we estimate equation (3) for different groups of consumers with different exposure to specific sources of risk or with different capability to buffer consumption-relevant risks. In some specifications we allow also for covariances among risk sources. In general, allowing for covariances, model (3) can be written as:

$$\sigma_{\xi}^2 = \beta_y \sigma_y^2 + \beta_h \sigma_h^2 + \beta_p \sigma_p^2 + \beta_r \sigma_r^2 + \sum_z \sum_{x<z} \beta_{zx} \pi_{zx} \sigma_z \sigma_x + \varepsilon \tag{4}$$

where $\beta_{zx} = 2\rho_{zx}\pi_{zx}$, ρ_{zx} is the correlation coefficient of risk sources *z* and *x* and the product of the two exposures, $\pi_{zx} = \pi_z \pi_x$. Non-zero correlations imply that the interaction terms between the standard deviations of pairs of risk sources might also affect consumption uncertainty. The interaction terms are irrelevant if two risks are uncorrelated or if the consumer is exposed to only one of them, or if one of the two risks is fully insured.

Realistically, in the empirical section we assume that both the energy price and health risks and the rate of return and health risk are not correlated. Since income risk is mostly idiosyncratic it should be uncorrelated with the energy price risk and the return on wealth risk. If we impose these conditions, the consumption risk model extended to account for the correlation amongst risk sources reduces to:

$$\sigma_{\xi}^{2} = \beta_{y}\sigma_{y}^{2} + \beta_{h}\sigma_{h}^{2} + \beta_{p}\sigma_{p}^{2} + \beta_{r}\sigma_{r}^{2} + \beta_{yh}\sigma_{y}\sigma_{h} + \varepsilon \tag{5}$$

where $\beta_{yh} = 2\rho_{yh}\pi_{yh}$. In the empirical application, we estimate various versions of equation (3) and (5), accounting also for indicators of subjective aggregate risk, demographic variables, and time and individual fixed effects.

3. The Italian Survey of Consumer Expectations

The Italian Survey of Consumer Expectations (ISCE) is a quarterly rotating panel. Variables refer to October 2023 (wave 1), January 2024 (wave 2), and April 2024 (wave 3). The survey collects data on demographic variables, household resources (income and wealth components), consumption, individual expectations variables (consumption, income, energy bills, health expenditures), and macroeconomic variables such as inflation, nominal interest rate, and GDP growth.

The survey builds upon two international online, high-frequency surveys. The New York Federal Reserve Survey of Consumer Expectations collects information on consumers' views and expectations regarding inflation, employment, income, and household finances. The European Central Bank Consumer Expectation Survey collects monthly data on households' expectations from around 20,000 households in the euro area economies. Related surveys such as the Harvard Social Economic Lab surveys explore the determinants of social preferences, attitudes, and perceptions.

ISCE targets Italian resident population aged between 18 and 75. We administered a pilot survey (100 interviews) in September 2023. Interviews are conducted during the first 7-15 days of the reference month. Wave 1 included 5,006 interviews, waves 2 and 3 included respectively

5001 and 5,005 interviews. The retention rate (percentage of individuals interviewed in two consecutive waves) was 84% in wave 2 and 87% in wave 3.[5] To maintain population representativeness the sample is refreshed at quarterly intervals. The ISCE Statistical Bulletin provides detailed information on the survey, see Guiso and Jappelli (2024).

The ISCE sampling scheme is similar to that used for the Bank of Italy Survey of Household Income and Wealth (SHIW). The sample is based on a stratification of the Italian resident population according to the following criteria: area of residence (North-East, North-West, Central and South Italy), age group (18-34, 35-44, 45-54, 55-64, over 65), gender, education (college degree, high school degree, less than high school), and employment (working, not working). All interviews were enabled by the Computer Assisted Web Interviewing (CAWI) method. The average response rate (ratio of completed interviews to invitations) across waves is 33%. We use sample weights to make the descriptive statistics population-representative.

Appendix Table A1 compares the sample means of the selected ISCE variables with the corresponding variables included in the 2020 SHIW (the most recent available). The gender, age, and geographic distributions of the two samples are similar although there are also some differences between these two samples. The most important difference is the distribution by level of education: the proportion of respondents with college education is 22% in the ISCE and is 13% in the SHIW, and the proportion with secondary education is 32% in the ISCE and 39% in the SHIW. Also, the ISCE sample includes lower proportions of retired individuals (16% vs. 21% in the SHIW), and single households. Since education is correlated with income (for which we have only a coarse measure), our survey oversamples the segment of the population more likely to have internet access and more able to respond to online questionnaires.

The ISCE elicits the subjective probability distributions of several variables over the succeeding 12 months. For example, respondents provide probabilities related to 11 possible value intervals for income growth, ranging from less than 8% to more than 8%. We take the mid-point of the intervals chosen by respondent to construct the moments of the subjective income growth distribution; for the lowest and highest open intervals we assume the respective values of -10% and 10%. The variances in the individual distributions are the income risk measures used for our analysis of the determinants of consumption risk.

[5] Of the 5,005 individuals interviewed in the third wave, 3744 have participated since the 1st wave, 589 since the 2nd wave, and 673 were interviewed for the first time in the 3rd wave.

The ISCE elicits respondents' subjective distributions of individual and aggregate variables in a similar way. The first group includes idiosyncratic risk indicators for expected rates of growth of consumption, income, health, and energy expenses. The second group includes indicators of aggregate risk: economic growth, inflation, unemployment, nominal interest rates, and house prices. The appendix provides more detail on the survey questions and the method used to obtain respondents expectations.

4. Descriptive analysis

Table 1 reports the sample statistics of the subjective distributions (means and standard deviations), and the main demographic variables for each of the three waves (October 2023, January 2024, April 2024). Expectations vary over time among individuals and across risk variables. On average, the respondents expect consumption to grow by 0.5% in October, by 0.8% in January and 0.7% in April. They are less optimistic about growth of disposable income (about -1% in each wave). Health costs are expected to increase by approximately 1%, and energy costs are expected to increase by 2.2% in October, 1.2% in January and 0.7 in April, consistent with stabilization of energy prices over the period.

Expectations related to the aggregate variables (GDP, inflation, unemployment, house prices, interest rates) are fairly close to professional forecasts. For instance, in February 2024 the Italian national statistical agency forecast GDP annual growth of to grow 0.8%, and forecast inflation and unemployment to grow by respectively 2.5% and 7.5%. Our respondents were slightly less optimistic but expected GDP to grow by -1.2%, and expected inflation and unemployment to be respectively 1.6% and 9.6%. Table 1 shows the considerable cross-sectional dispersion of expectations with the standard deviations of the cross-sectional distributions generally higher than the mean.

The lower part of Table 1 reports the summary statistics of the first two moments of the derived distributions of consumption growth and underlying sources of risk. The cross-sectional average of the conditional variances of income, health, and energy risk growth rates are similar in magnitude and display considerable dispersion as indicated by the standard deviations of the cross-sectional distributions. The magnitudes of the consumption growth and income growth variances are similar. All variances fluctuate considerably over time.

Appendix Table C1 shows that the variances of the different risks faced by consumers are positively correlated in both the cross-section and the panel. This implies that individuals expecting a high level of risk in one domain, tend also to expect other risks to be high.[6] There are at least two possible explanations for these correlations. The first is behavior based; it is possible that individuals who have experienced adversity and instability in personal economic outcomes will likely have a heightened perception of uncertainty about macro-level outcomes (Ben-David et al, 2018). Alternatively, perception of uncertainty (and ability to understand probabilities) might be shaping the correlations among different risk domains.[7]

For the purposes of our exercise which is to identify the pass-through to consumption uncertainty of the underlying sources of risk, we need to address concern that respondents might respond automatically and similarly to the questions framed in similar formats. For seven risk indicators individuals were asked to attach probabilities to the same growth intervals, with the same support of the distributions (from "less than -8%" to "more than 8%"). For example, it could be argued that if the individual assigns a probability of 20% to a given growth interval to a question about a risk j, that individual will assign the same 20% probability to the same interval in relation to another risk. If this automatic behavior were to apply to all intervals, this would result in variances (and all moments) being the same across all risks for the same respondent. In that case, consumption risk would automatically be correlated with any (all) of the risk sources even those that do not cause consumption uncertainty.

Appendix C addresses this issue and reports regressions for the probability weights respondents assign to each interval of the expected rate of growth of the distributions considered in the paper. Appendix C also runs a formal test of the hypothesis that the values assigned to each interval are similar, controlling for individual, time and question fixed effects. This hypothesis is overwhelmingly rejected for all of the growth intervals, and common factors (individual fixed effects) explain only between 11% and 32% of the total variance of the reported probabilities in each interval. Overall, our test shows that there is genuine individual variability among responses across questions; thus, our estimated relation between consumption risk and risk indicators is unlikely to reflect automatic variance of consumption growth correlations with the other variances.

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[6] Notice that here we refer to the cross-sectional correlation of say, income risk variance and health risk variance and not to the correlation between the subjective *distribution* of income growth and health costs growth. Since our survey elicits the subjective marginal probability distributions of the two variables but not their joint distribution, we cannot make any claims about their correlation. That is, the fact that the variance of the subjective distribution of income growth might be correlated with the variance of the subjective distribution of health costs growth does not imply that income growth is correlated with health costs growth.

[7] For instance, Dovern (2024) finds that media consumption patterns affect the degree of expectation uncertainty across households.

To validate our measures of subjective uncertainty, we check their consistency with what might be expected a priori based on observable characteristics (e.g. age, occupation, wealth). Figures 1 and 2 plot the respective risk indicators against percentile age and cash-on-hand bins. Cash-on-hand is the sum of monthly income and financial assets.[8] Cash-on-hand percentiles show that perceived risk, measured by the variance of the distribution is higher for younger people (who face more career uncertainty) and economically poor respondents (who are more likely to have more precarious employment). In particular, for the youngest to the oldest group the variance of expected consumption growth falls from about 0.1 to 0.03 , and for the poorest to the richest segment of the sample it falls from about 0.08 to 0.04. These findings are reassuring that our respondents are likely aware of the uncertainty they face which is a necessary condition for their ability to consider this uncertainty when estimating consumption risk. These findings also guide our analysis of the heterogeneity of the pass-through effects among different sample groups.

Figure 1 shows that the risk-age gradients are steeper for consumption and income, intermediate for health, energy, and GDP, and flattest for interest rate risk. The relation between the variances and cash-on-hand in Figure 2 is negative for all risks but more noisy than for age. This might in part be due to our imperfect cash-on-hand variable measure.

Table 2 presents Ordinary Least Square (OLS) regressions of micro risk indicators (income, health, energy) against the demographic variables and cash-on-hand. The expected variances decline with age and cash-on-hand, confirming the patterns in Figures 1 and 2, and are lower for homeowners. Respondents with a college degree and residents in Northern or Central Italy expect lower risk compared to respondents with lower education who reside in the South of Italy.[9] There is also a significant decline in perceived risk between October 2023 and April 2024 for all risk indicators.

Table 3 relates indicators of aggregate risks (GDP, unemployment, inflation, interest rates, and house prices) to the same list of demographic variables. In this case, age, education, and region of residence have similar effects to micro risks. However, cash-on-hand is not correlated with perceived macro risks. Over time, we observe a significant decline in uncertainty

[8] Both variables are likely to be affected by considerable measurement error since they were elicited from questions that asked respondents to score them based on 11 intervals.

[9] D'Acunto et al. (2021) find that women have higher inflation expectations but this does not necessarily imply that they perceive prices as more volatile.

particularly in relation to GDP and house price risks.

5. Anatomy of consumption risk

Table 4 presents our main findings. Columns (1), (2) and (3) report the OLS estimates for a variant of equation (3). We regress the variance of consumption on the variance of the other risk indicators, separately for each of the three waves of the ISCE. In these regressions we exploit the cross-sectional variability of the risk indicators. The coefficient of income risk is positive and precisely estimated in each wave. The size of the coefficients indicates that about 20% of the expected income variance is transmitted to the consumption variance. As already explained, the pass-through coefficient reflects the weight of human capital in total wealth (π), and expected formal and informal insurance opportunities (α).

Also, the other coefficients of microeconomic risk (health and energy expenditures) are positive and precisely estimated, and in each wave are also significantly below.[1] Interestingly, among the macro risks, only the coefficients of GDP and house price risks are positive and statistically different from zero, while interest rate risk, inflation risk, and other things equal unemployment risk have a minor influence.

The results are similar if we pool the three samples and estimate the panel regression with time and individual fixed effects (column 4). Notice that because some individuals exit the panel the sample size drops to 13,315 individual-wave observations. In this more demanding specification, the results can be interpreted as showing that the reduction in consumption risk observed between October 2023 and April 2024 can be explained in part by the reduction in perceived income, energy, and health risks and in part by a reduction in aggregate uncertainty (especially GDP risk). As in Table 3, the regressions control also for demographic variables but given the short sample they vary little over time (and for age, gender, and education are constant). Their effects are largely absorbed by the fixed effects, and therefore the coefficients are not reported in Table 4. All pass-through coefficients of the risk indicators are considerably below 1, implying that that the share of each of these risks in average consumption risk is below 1, or that consumers expect to be able to insure completely, either formally or informally against the risks they face.

There might be concern that in these estimates the positive correlations between the underlying risk factors and consumption risk are due to the fact that several individuals report point expectations with the result that the variance of their distributions is zero. For instance, in

October 2023 about 30% of respondents reported zero variance of consumption growth, and this was about 50% in February and April 2024. Among these respondents, a significant fraction also reported zero variance for other risks. For instance, in October 2023 22% reported zero consumption and zero income variances. This pattern might be due to genuine lack of relevant uncertainty, poor understanding of the survey questions, or simply lack of attention and/or fatigue when responding to this part of the questionnaire. In Table 4 column 5 we drop all zero consumption observations in one of the three waves. The results are qualitatively similar although the coefficients of health risk and GDP risk drops respectively to 0.31 (from 0.38), and to 0.089 (from 0.11) supporting the hypothesis that the "zero variance" observations are partly responsible for the estimated coefficients in the full sample. We obtain similar results if we drop all zero variance observations for at least one of the risk indicators. In this restricted sample of 2,950 observations, the respective coefficients of income, health, and energy risks are 0.17, 0.31, and 0,18 and are precisely estimated.

Recall that the pass-through coefficients in equation (3) should vary across population groups with different risk exposure. Our data do not allow us to separate exposure from access to insurance that is, they do not allow us to provide separate estimates for the α_z and π_z coefficients. However, we can infer their importance by focusing on those groups where a priori we expect different impacts of risk exposure (π coefficients) and insurance. To identify these groups, the descriptive analysis in Section 4 is useful. In particular, individuals with high levels of human capital relative to wealth (the young with more career uncertainty) should be more exposed to income risk (have higher π_y^2 in equation 2) whereas those individuals with high levels of wealth relative to income (older and retired individuals) have a larger buffer and are less exposed to income risk.

Tables 5 and 6 report separate regressions for different consumer groups based on age, occupation (employee, self-employed, retired), and cash-on-hand. Splitting between occupation and age is aimed at capturing the fact that most heterogeneity comes from exposure to labor, health, and energy risks. Cash-on-hand splits are intended to capture heterogeneity in access to self-insurance.

Table 5 shows that the pass-through of income risk is considerably more important for employees, self-employed, and young respondents compared to retired respondents. For the retired group it is likely that labor income risk has a lower weight on consumption than in the former groups. On the other hand, energy risk pass-through is much larger for the self-employed

(0.35) than for employees (0.18) and retired (0.07). This is consistent with the idea that for self-employed individuals energy expenses are likely to be a relevant input and thus represent a high share of their total consumption expenses compared to the groups of employees and of retired, implying a higher π_p and thus a high pass-through. Table 5 shows also that the pass-through of health risk is similar across occupations, that unemployment risk matters for employees but not for self-employed and retired, and that house price risk has a much larger effect for retired who are older in age and whose wealth is often largely invested in real estate in the form of homeownership.

The results in Table 6 are consistent with our expectation that the pass-through coefficients are related inversely to cash-on-hand since richer individuals have a better buffer against consumption fluctuations. The pass-through of income risk is 0.27 in the group of relatively poor individuals (cash-on-hand below €10,000), and 30% lower (around 0.2) in groups with cash-on-hand above that level. Similarly, the pass-through of health risk into consumption risk is lower in the group with high cash-on-hand compared to the group with low cash-on-hand (0.25 compared to 0.35) as is the pass through of energy risk (0.17 in the high cash-on-hand group compared to 0.25 in the low cash on hand). Overall, this evidence supports our decomposition exercise and suggests that both exposure and access to insurance help to explain the drivers of consumption risk.

Table 7 reports the panel fixed effects estimates of equation (4) taking account of the interaction between income and health risks (product of the two standard deviations of the subjective distributions). In column (1) the right-hand-side variables include only the health cost growth and income growth variances. In column (2) we include the covariance term and show that the coefficient is positive and significant. For comparison, column (3) reports the same regression as that in table 4 column (3) including all the risk indicators. In column (4) the coefficient of the covariance term remains positive but is less precisely estimated and rather small in value.

To assess the economic importance of the various sources of risk, Table 8 reports the contribution of each risk source to predicted consumption risk. We rely on the estimated pass-through coefficients in Table 4 column 4 and estimate the contributions at the mean of each of the right-hand-side variables. In practice, for each risk source the contribution to predicted consumption risk is the product of the estimated pass-through multiplied by the sample mean of the variance of that risk source, divided by the sample average consumption risk. We distinguish between the contributions of idiosyncratic and aggregate risks and present calculations for the total sample and for various sub-groups of consumers (young and old, based on age; employed, self-employed, and retired, based on employment).

Table 8 presents several interesting findings. First, in the total sample and in all groups idiosyncratic risks account for the bulk of consumption risk. Proportions vary across groups with an average of 73% in the total sample and a minimum of 52% among the retired, and a maximum of 81% among the self-employed. Aggregate risks accounts for only 18.5% of total consumption risk in the total sample, 35% among the retired, and only 10% among the self employed. Demographic variables and time effects combined account for less that 10% of consumption risk in all groups except the retired (13%).

It is interesting that the source of idiosyncratic risk that contributes the most to expected consumption risk is health expenditure risk which accounts for around 33% of individual consumption risk in all groups and contributes more than labor income risk. Because how much a risk type contributes is the product of pass-through and average risk size, the high contribution of health risk mostly reflects the higher pass-through documented in Tables 4 to 7. In fact, the average variance of this risk tends to be somewhat lower than or similar to income risk.

6. Euler equation estimates

The first step of our analysis showed that the expected volatility of consumption is due to multiple risks. We show also that the passthrough coefficients are significantly below 1, reflecting a mix of risk exposure and insurance opportunities. Whether consumption risk actually affects expected consumption growth remains to be seen. In this final section we use the insights from the determinants of consumption risk to estimate a Euler equation for consumption. The aim is to assess whether expected consumption volatility affects the expected rate of growth of consumption, and to measure the strength of precautionary saving.

Following Blanchard and Mankiw (1988), we approximate the Euler equation with a second-order Taylor series expansion of $u'(c_{t+1})$ around c_t. Solving for the expected growth rate of consumption we obtain:

$$E_t\left(\frac{c_{t+1}-c_t}{c_t}\right) \cong EIS\left(\frac{r-\delta}{1+r}\right) + \frac{1}{2}p(c)E_t\left(\frac{c_{t+1}-c_t}{c_t}\right)^2 \quad (5)$$

where $p(c) = -\frac{u'''(c_t)c_t}{u''(c_t)}$ is Kimball's coefficient of relative prudence, and $EIS = -\frac{u'(c_t)}{u''(c_t)c_t}$ is the elasticity of intertemporal substitution which in this framework is also equal to the inverse of the coefficient of relative risk aversion. The second moment of the conditional distribution of consumption growth $E_t\left(\frac{c_{t+1}-c_t}{c_t}\right)^2$ is a measure of the expected variability of consumption.

Equation (5) shows that the anticipated variability of consumption growth is associated with a higher growth rate of consumption. Uncertainty induces consumers to defer current consumption and increase saving to an extent that depends on their degree of prudence.[10] As noted by Carroll (2001), both consumption growth and consumption risk are endogenous variables implying that simple OLS regression of consumption growth on consumption volatility produces inconsistent estimates of the strength of the precautionary motive. Below we draw on the discussion in the previous sections on the variation in the sources of risk in order to generate instruments for consumption risk.

Table 9 presents the first estimates of various versions of equation (5). Column (1) includes the entire sample and estimates equation (5) using OLS. The coefficient of consumption risk is 1.14, implying a coefficient of relative prudence of 2.28. Column 2 uses the panel sample and estimate the same equation but adding individual fixed effects which provides a coefficient of relative prudence of 2.88. The Euler equation (5) is derived assuming perfect capital markets but this equation fails in the presence of liquidity constraints or myopic consumers. A simple alternative is a model in which consumers set consumption equal to income in each period. Column 3 nests the two models and adds expected income growth to the regressors. Then the coefficient of consumption risk is 1.85 (relative prudence 3.7), and the coefficient of income growth is 0.27, consistent with a large body of empirical evidence which shows that consumption growth is sensitive to expected income growth, see Jappelli and Pistaferri (2017), Havranek and Sokolova (2020), Crawley and Theloudis (2024).

As already mentioned, expected consumption volatility reflects both risk and choice which results in biased OLS estimates. In column (4) we draw on use the results of our analysis and instrument consumption risk by the second moment of the future income growth,

[10] In the certainty equivalence model consumers do not respond to uncertainty and $p(c) = 0$. Caballero (1991) shows that if utility is exponential and income follows a random walk then expected consumption growth is equal to the product of the coefficient of relative prudence times the variance of income normalized by current income. An exact solution can also be obtained if utility is isoelastic and consumption growth is normally distributed.

healthcare costs, and energy costs distributions. Table 9 column 5 extends the set of instruments by adding GDP, inflation, interest rate, unemployment, and house price risks. The estimated coefficients of consumption risk are always precisely estimated in the range 1.37 in column (4) to 1.16 in column (5), implying a coefficient of relative prudence within the realistic range of 2-3.[11] Excess sensitivity remains almost unchanged in all the specifications and is precisely estimated.

7. Summary

Intertemporal consumption models posit that consumers' decisions depend on the expected variability of consumption which captures all the sources of uncertainty faced by consumers. In this paper, we constructed a measure of individual expected variability of consumption elicited via a survey for the probability distribution of future consumption growth. We then linked this measure to indicators of subjective individual-specific and aggregate risks.

To elicit respondents' expectations we designed the 2023-24 ISCE that includes 5,000 individuals and collects quarterly information on participants' expected distributions of individual variables (consumption, income, energy costs, and health costs) and aggregate variables (GDP growth, inflation, unemployment, house prices, and interest rates).

Our conceptual framework shows that consumption risk can be traced back to several risk factors based on pass-through coefficients that reflect both exposure to risk and insurance opportunities. Estimates of the pass-through coefficients imply that income risk, health risk, and energy price risk have the largest impact on expected consumption risk, accounting for around 75% of predicted consumption risk. We observe that aggregate risks also matter, and especially expected variability of GDP and house prices growth but contribute less than 20% to overall consumption risk. The pass-through of income risk is larger for young working individuals with low income and liquid wealth, and reflects their exposure to and fewer insurance opportunities against risk.

Finally, we used subjective expectations data and employed instrumental variables approach to estimate a Euler equation for consumption. We show that expected consumption risk is related positively to expected consumption growth as predicted by precautionary saving

[11] Dynan (1993) estimates the Euler equation with realized consumption data and an instrumental variable approach. Bertola et al. (2005) use the subjective variance of income growth available in the SHIW as an instrument for realized consumption variability and find a coefficient of relative prudence of about 2.

models. Our estimates imply a coefficient of relative prudence in the plausible range of 2-3.

To our knowledge this is the first paper to provide a decomposition of consumption risk and a quantitative evaluation of the importance of each risk in overall expected consumption volatility. Our analysis shows that empirical models of consumption decisions should take account of the fact that individuals face multiple risks, and should distinguish between the effects of insurance and exposure to risk in the coefficients of pass-through.

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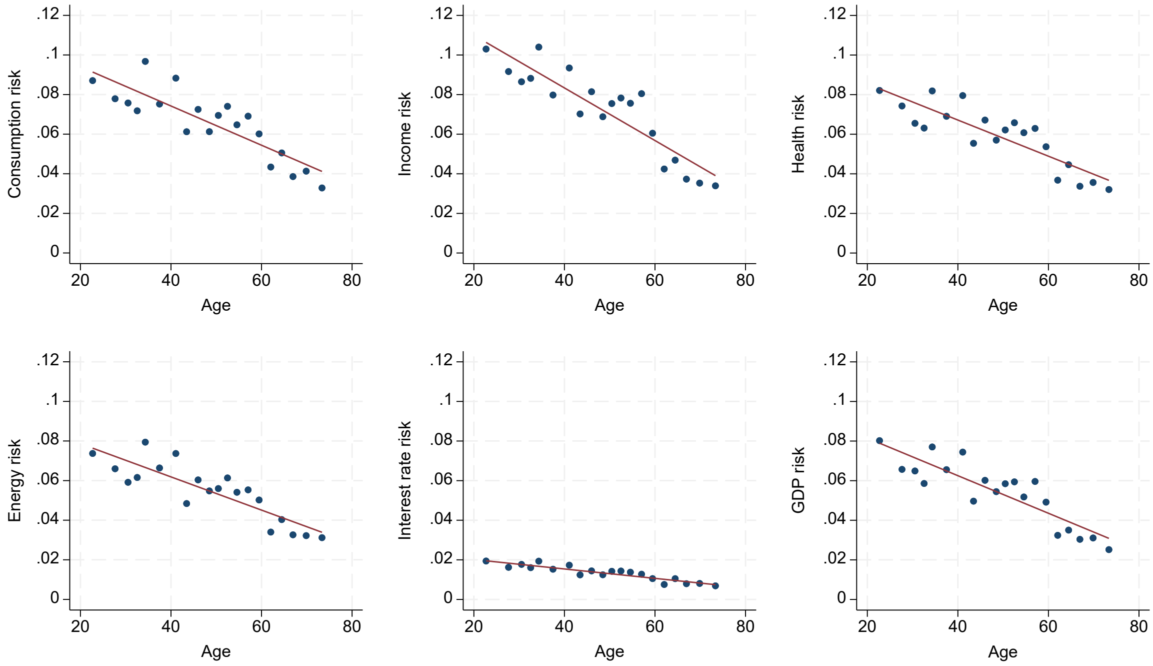
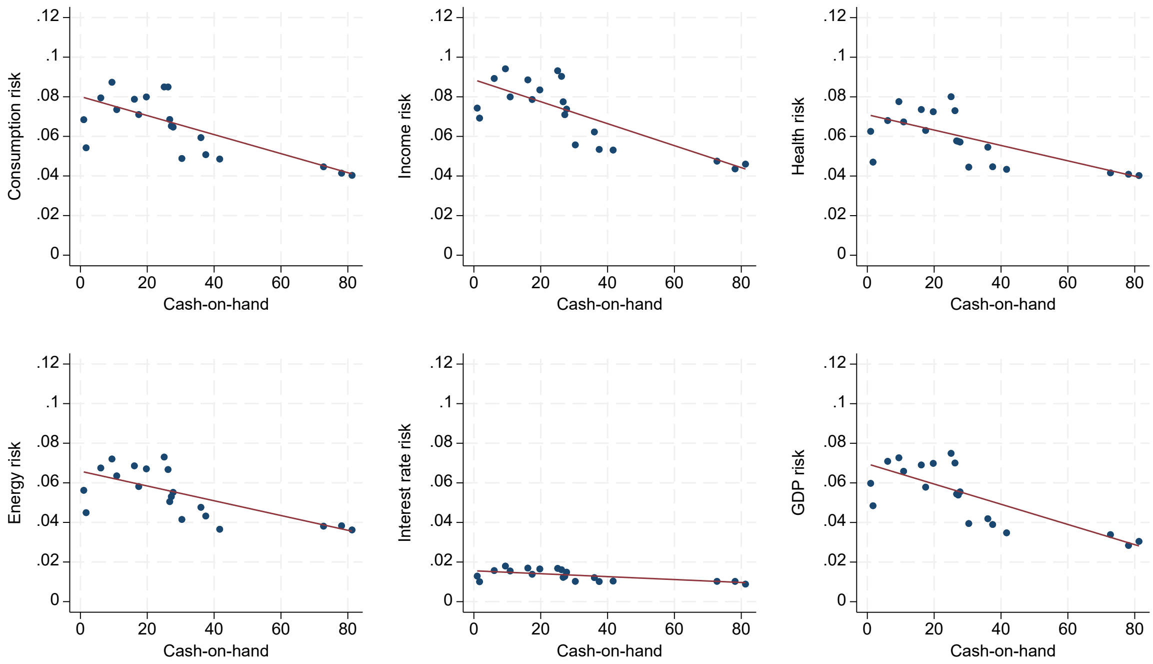
Figure 1. Uncertainty declines with age



Note. Each of the risk indicators is the variance of the expected distribution. The sample includes all three waves of ISCE.

Figure 2. Uncertainty declines with cash-on-hand



Note. Cash-on-hand (in €'000) is financial wealth plus monthly income. Each of the risk indicators is the variance of the expected distribution. The sample includes all three waves of ISCE.

Table 1. Descriptive statistics

	Wave 1: October 2023		Wave 2: January 2024		Wave 3: April 2024	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Male	.492	.5	.495	.5	.494	.5
Age	48.476	14.471	48.07	14.464	48.388	14.261
Family size	2.776	1.144	2.779	1.137	2.779	1.127
College degree	.229	.42	.232	.422	.217	.412
North	.464	.499	.471	.499	.461	.499
Centre	.192	.394	.192	.394	.198	.398
Employed	.44	.496	.426	.495	.46	.498
Self-employed	.094	.292	.086	.281	.088	.283
Cash-on-hand	28.612	22.342	29.401	23.146	30.008	23.382
Homeowner	.744	.437	.761	.427	.765	.424
Average of						
Consumption growth	.005	.042	.008	.041	.007	.038
Income growth	-.012	.037	-.011	.036	-.009	.033
Health cost growth	.01	.036	.009	.037	.008	.035
Energy cost growth	.022	.04	.012	.039	.007	.035
Nominal interest rate	.034	.024	.03	.022	.03	.022
GDP growth	-.018	.039	-.012	.037	-.012	.036
Inflation	.016	.041	.013	.04	.012	.038
Unemployment rate	.096	.038	.089	.04	.089	.04
House price growth	0	.035	0	.033	.001	.031
Variance of						
Consumption growth	.096	.133	.054	.109	.048	.104
Income growth	.095	.128	.064	.112	.058	.11
Health cost growth	.089	.13	.048	.106	.042	.1
Energy cost growth	.084	.123	.043	.099	.039	.095
Nominal interest rate	.019	.028	.011	.024	.01	.022
GDP growth	.08	.125	.043	.103	.04	.098
Inflation	.079	.124	.038	.095	.036	.091
Unemployment rate	.054	.08	.029	.066	.027	.062
House price growth	.078	.126	.038	.1	.035	.097
Observations	5,006		5,001		5,005	

Note. Sample statistics computed using sample weights.

Table 2 – Idiosyncratic risks

	Consumption risk	Income risk	Health risk	Energy risk
	(1)	(2)	(3)	(4)
Male	0.001	-0.000	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Age 35 to 50	-0.006	-0.013	-0.004	-0.003
	(0.004)	(0.004)***	(0.003)	(0.003)
Age 51 to 65	-0.015	-0.025	-0.015	-0.014
	(0.004)***	(0.004)***	(0.003)***	(0.003)***
Age 66 to 75	-0.035	-0.049	-0.033	-0.029
	(0.004)***	(0.004)***	(0.004)***	(0.004)***
Family size	0.004	0.005	0.004	0.004
	(0.001)***	(0.001)***	(0.001)***	(0.001)***
College degree	-0.009	-0.011	-0.011	-0.010
	(0.003)***	(0.003)***	(0.003)***	(0.003)***
North	-0.022	-0.023	-0.021	-0.020
	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Centre	-0.014	-0.013	-0.011	-0.010
	(0.004)***	(0.004)***	(0.004)***	(0.003)***
Employed	-0.000	0.000	-0.002	-0.000
	(0.003)	(0.003)	(0.003)	(0.003)
Self-employed	0.004	0.008	0.002	0.001
	(0.005)	(0.005)*	(0.005)	(0.004)
Log cash-on-hand	-0.001	-0.002	-0.000	-0.000
	(0.001)	(0.001)**	(0.001)	(0.001)
Homeowner	-0.016	-0.019	-0.018	-0.016
	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Wave 2	-0.042	-0.031	-0.041	-0.041
	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Wave 3	-0.047	-0.036	-0.047	-0.045
	(0.002)***	(0.002)***	(0.002)***	(0.002)***
R^2	0.06	0.06	0.06	0.06
N	15,012	15,012	15,012	15,012

Note. OLS regression estimations. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%.

Table 3. Aggregate risks

	GDP risk	Unemp. risk	Inflation risk	Interest rate risk	House price risk
Male	-0.003	-0.003	-0.001	0.001	0.002
	(0.002)	(0.002)*	(0.002)	(0.001)	(0.002)
Age 35 to 50	-0.005	-0.004	-0.006	-0.003	-0.003
	(0.003)	(0.002)*	(0.003)*	(0.001)***	(0.003)
Age 51 to 65	-0.017	-0.010	-0.016	-0.005	-0.014
	(0.003)***	(0.002)***	(0.003)***	(0.001)***	(0.003)***
Age 66 to 75	-0.033	-0.020	-0.031	-0.009	-0.030
	(0.004)***	(0.002)***	(0.004)***	(0.001)***	(0.004)***
Family size	0.005	0.003	0.004	0.001	0.004
	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.001)***
College degree	-0.012	-0.008	-0.010	-0.002	-0.011
	(0.003)***	(0.002)***	(0.003)***	(0.001)**	(0.003)***
North	-0.018	-0.012	-0.019	-0.004	-0.018
	(0.003)***	(0.002)***	(0.003)***	(0.001)***	(0.003)***
Centre	-0.012	-0.007	-0.010	-0.002	-0.007
	(0.003)***	(0.002)***	(0.003)***	(0.001)***	(0.003)**
Employed	-0.002	-0.001	-0.001	-0.000	-0.000
	(0.003)	(0.002)	(0.003)	(0.001)	(0.003)
Self-employed	0.001	0.001	-0.001	-0.000	0.004
	(0.004)	(0.003)	(0.004)	(0.001)	(0.005)
Log cash-on-hand	-0.002	-0.001	-0.002	0.000	-0.001
	(0.001)**	(0.001)	(0.001)*	(0.000)	(0.001)
Homeowner	-0.018	-0.010	-0.015	-0.003	-0.013
	(0.003)***	(0.002)***	(0.003)***	(0.001)***	(0.003)***
Wave 2	-0.037	-0.025	-0.040	-0.008	-0.040
	(0.002)***	(0.001)***	(0.002)***	(0.000)***	(0.002)***
Wave3	-0.040	-0.027	-0.042	-0.009	-0.043
	(0.002)***	(0.001)***	(0.002)***	(0.000)***	(0.002)***
R^2	0.06	0.06	0.06	0.05	0.06
N	15,012	15,012	15,012	15,012	15,012

Note. OLS regression estimates. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%

Table 4. Determinants of consumption risk

	Wave 1	Wave 2	Wave 3	FE	FE dropping zeros	Lagged risk
	(1)	(2)	(3)	(4)	(5)	(6)
Income risk	0.196	0.221	0.208	0.216	0.249	0.101
	(0.022)***	(0.025)***	(0.026)***	(0.018)***	(0.026)***	(0.018)***
Health risk	0.377	0.407	0.364	0.374	0.316	0.048
	(0.039)***	(0.033)***	(0.042)***	(0.029)***	(0.033)***	(0.024)**
Energy risk	0.131	0.190	0.225	0.182	0.172	0.109
	(0.035)***	(0.042)***	(0.051)***	(0.030)***	(0.034)***	(0.038)***
Interest rate risk	0.136	-0.090	0.005	0.068	0.073	0.318
	(0.078)*	(0.102)	(0.086)	(0.073)	(0.095)	(0.077)***
GDP risk	0.109	0.106	-0.008	0.076	0.043	0.066
	(0.025)***	(0.034)***	(0.025)	(0.022)***	(0.027)	(0.025)***
Inflation risk	0.015	-0.034	0.022	0.019	0.026	0.065
	(0.025)	(0.040)	(0.037)	(0.026)	(0.033)	(0.029)**
Unemp. risk	0.024	0.074	0.020	0.019	0.008	0.126
	(0.028)	(0.043)*	(0.041)	(0.027)	(0.037)	(0.034)***
House price risk	0.122	0.072	0.199	0.109	0.081	0.062
	(0.031)***	(0.043)*	(0.045)***	(0.029)***	(0.035)**	(0.028)**
R^2	0.71	0.74	0.79	0.57	0.46	0.31
N	5,006	5,001	5,005	13,315	7,281	8,529

Note. Columns (1)-(3) regressions are OLS estimates. Columns (4)-(6) are panel fixed effects estimates. The regression in column (5) excludes observations with variance of consumption equal to zero. All regressions include demographic variables. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%.

Table 5. Determinants of consumption risk. Sample splits by employment and age

	Employees	Self-employed	Retired	Age<=35	Age>60
	(1)	(2)	(3)	(4)	(5)
Income risk	0.235	0.236	0.146	0.208	0.142
	(0.028)***	(0.057)***	(0.041)***	(0.029)***	(0.033)***
Health risk	0.352	0.310	0.351	0.345	0.381
	(0.043)***	(0.062)***	(0.062)***	(0.048)***	(0.068)***
Energy risk	0.181	0.348	0.069	0.267	0.062
	(0.044)***	(0.080)***	(0.049)	(0.056)***	(0.054)
Interest rate risk	0.085	0.290	-0.032	0.056	0.045
	(0.118)	(0.298)	(0.142)	(0.153)	(0.136)
GDP risk	0.075	0.179	0.128	0.078	0.140
	(0.030)**	(0.084)**	(0.046)***	(0.044)*	(0.044)***
Inflation risk	0.039	-0.092	0.099	-0.031	0.045
	(0.037)	(0.111)	(0.054)*	(0.048)	(0.041)
Unemp. risk	0.015	-0.071	0.022	0.091	0.025
	(0.046)	(0.101)	(0.051)	(0.062)	(0.045)
House price risk	0.121	0.001	0.234	0.100	0.233
	(0.042)***	(0.082)	(0.079)***	(0.055)*	(0.064)***
R^2	0.55	0.58	0.63	0.57	0.59
N	5,856	1,158	2,643	3,203	3,437

Note. All regressions use the panel fixed effects estimator. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%
.

Table 6. Determinants of consumption risk. Sample splits by cash-on-hand

	Cash-on-hand<=20	20<Cash-on-hand<=40	Cash-on-hand>40
	(1)	(2)	(3)
Income risk	0.274	0.213	0.193
	(0.047)***	(0.029)***	(0.052)***
Health risk	0.347	0.404	0.248
	(0.069)***	(0.048)***	(0.048)***
Energy risk	0.253	0.174	0.166
	(0.099)**	(0.061)***	(0.065)**
Interest rate risk	0.172	0.013	0.078
	(0.182)	(0.134)	(0.223)
GDP risk	0.049	0.060	0.034
	(0.046)	(0.039)	(0.062)
Inflation risk	-0.057	0.050	0.052
	(0.066)	(0.051)	(0.076)
Unemployment risk	0.047	0.039	0.121
	(0.076)	(0.042)	(0.095)
House price risk	0.094	0.119	0.128
	(0.063)	(0.050)**	(0.083)
R^2	0.56	0.59	0.52
N	2,871	5,933	2,396

Note. Cash-on-hand is financial assets plus monthly income in euro. All regressions use the panel fixed effect estimator. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%
.

Table 7. Determinants of consumption risk allowing for health-income risk correlation

	(1)	(2)	(3)	(4)
Income risk	0.277	0.174	0.216	0.175
	(0.018)***	(0.025)***	(0.018)***	(0.025)***
Health risk	0.572	0.369	0.374	0.297
	(0.022)***	(0.052)***	(0.029)***	(0.049)***
Health-income risk interaction		0.003		0.001
		(0.001)***		(0.001)**
Energy risk			0.182	0.172
			(0.030)***	(0.030)***
Interest rate risk			0.068	0.057
			(0.073)	(0.072)
GDP risk			0.076	0.075
			(0.022)***	(0.022)***
Inflation risk			0.019	0.016
			(0.026)	(0.026)
Unemployment risk			0.019	0.018
			(0.027)	(0.027)
House price risk			0.109	0.104
			(0.029)***	(0.029)***
R^2	0.53	0.54	0.57	0.58
N	13,315	13,315	13,315	13,315

Note. All regressions use the panel fixed effect estimator. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%
.

Table 8. Anatomy of consumption risk

	Total	Age <=35	Age >60	Employed	Self-Employed	Retired
	(1)	(2)	(3)	(4)	(5)	(6)
Income risk	0.237	0.238	0.135	0.260	0.263	0.138
Health risk	0.337	0.310	0.335	0.311	0.283	0.317
Energy risk	0.151	0.227	0.050	0.148	0.263	0.059
Micro risks	**0.726**	**0.775**	**0.520**	**0.720**	**0.809**	**0.514**
GDP risk	0.063	0.069	0.098	0.058	0.140	0.100
House price	0.083	0.075	0.164	0.093	0.021	0.173
Interest rate risk	0.014	0.016	0.008	0.016	0.053	-0.008
Inflation risk	0.015	-0.032	0.037	0.029	-0.064	0.077
Unemployment risk	0.011	0.048	0.014	0.007	-0.042	0.011
Macro risks	**0.185**	**0.175**	**0.320**	**0.204**	**0.107**	**0.353**
Demographic and time effects	**0.089**	**0.050**	**0.160**	**0.077**	**0.083**	**0.133**
Total	1.000	1.000	1.000	1.000	1.000	1.000
Consumption risk	0.066	0.082	0.041	0.069	0.075	0.042

Note. The contribution of microeconomic and aggregate risks (evaluated at the sample means) to consumption risk is reported for the panel sample and different demographic groups. Column (1) uses the regression coefficients from Table 4 column (4);columns (2) to (6) use the corresponding regression coefficients in Table 5.

Table 9. Euler equation estimates

	OLS	Fixed effect	Fixed effect	IV Fixed effect	IV Fixed effect
	(1)	(2)	(3)	(4)	(5)
Consumption risk	1.145	1.442	1.855	1.366	1.157
	(0.110)***	(0.150)***	(0.147)***	(0.314)***	(0.304)***
Income growth			0.271	0.265	0.263
			(0.013)***	(0.013)***	(0.013)***
Wave 2	0.001	0.001	0.001	0.001	0.001
	(0.001)*	(0.001)**	(0.001)**	(0.001)**	(0.001)**
Constant	0.004	0.003	0.005	0.006	0.007
	(0.000)***	(0.001)***	(0.001)***	(0.001)***	(0.001)***
R^2	0.01	0.01	0.06		
N	15,012	13,315	13,315	13,315	13,315

Note. The dependent variable is expected consumption growth. Consumption risk is the 2nd conditional moment of the distribution of expected consumption growth. Column (1) presents OLS estimations; columns (2) and (3) are panel fixed effects estimations; column (4) presents instrumental variable fixed effects panel estimations using micro risks as instruments; column (5) presents instrumental variable fixed effects panel estimations using micro and macro risks as instruments. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%.

Appendix

A1. Derivation of equation (1)

Following Banks, Blundell and Brugiavini (2001) we assume that preferences are CRRA and time separable. We also assume that optimal consumption c_t (net of energy and health expenses) is approximately equal to a fraction of individual wealth w_t, $c_t \approx \mu w_t$. The Euler equation is:

$$c_t^{-\theta} = \beta(1+r)E_t c_{t+1}^{-\theta} = \beta(1+r)E_t[\mu(\widetilde{w}_{t+1} + \xi_{t+1})]^{-\theta} \qquad \text{(A1)}$$

where expectations are taken at time t, θ is relative risk aversion, and $\widetilde{w}_{t+1} = \overline{w}_{t+1} + \xi_{t+1}$ are the sum of the predictable component $\overline{w}_{t+1}$ and an innovation ξ_{t+1} described below. Banks et al. (2001) focus on a single source of labor income risk. We assume several sources of uncertainty. The consumer faces labor income risk, health expenditure risk arising from variation in health conditions, energy cost risk arising from variations in the price of energy, and capital income risk.

In equation (A2) $\tilde{y}_{t+1}$ is random labor income at t+1, $p_h\tilde{h}_{t+1}$ is health expenditure which is the product of (certain) price of health services p_h and goods and uncertain health status $\tilde{h}_{t+1}$, $e\tilde{p}_{t+1}$ is the value of uncertain energy costs which is the product of known quantity of energy needs e and the uncertain energy $\tilde{p}_{t+1}, and\ \tilde{r}_{t+1}$ is the uncertain rate of return on wealth. Then the consumer budget constraint at t + 1 is

$$\widetilde{w}_{t+1} = (1 + \tilde{r}_{t+1} + v\,\tilde{p}_{t+1})w_t + \tilde{y}_{t+1} - c_t - p_h\tilde{h}_{t+1} \qquad \text{(A2)}$$

where we assume that $e = vw_t$ that is, that the quantity of energy purchased is a constant share of individual wealth which provides a simple way to capture the idea that energy consumption is highly price inelastic.

The innovation in wealth (in euro) is $\xi_{t+1} = (\xi_{t+1}^r + v\xi_{t+1}^p)w_t + \xi_{t+1}^y$+p$\xi_{t+1}^h$ where ξ_{t+1}^z is the innovation in the source of risk z in the budget constraint (in euro for energy, health expenditure, and income, and as a percentage for the return on wealth).

Taking a second order approximation to $E_t[\mu(\widetilde{w}_{t+1} + \xi_{t+1})]^{-\theta}$ around $\xi_{t+1} = 0$, we get:

$$E_t[\mu(\widetilde{w}_{t+1} + \xi_{t+1})]^{-\theta} \approx (\mu\overline{w}_{t+1})^{-\theta}[1 + \theta(1+\theta)]\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2}$$

The Euler equation can be written as:

$$c_t^{-\theta} = \beta(1+r)(\mu\overline{w}_{t+1})^{-\theta}[1 + \theta(1+\theta)]\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2}$$

$$c_t = \left\{\beta(1+r)(\mu\overline{w}_{t+1})^{-\theta}[1 + \theta(1+\theta)]\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2}\right\}^{-\frac{1}{\theta}}$$

$$c_t = \left\{\beta(1+r)(\mu\overline{w}_{t+1})^{-\theta}[1 + \theta(1+\theta)]\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2}\right\}^{-\frac{1}{\theta}}$$

Considering the ratio $\frac{c_{t+1}}{c_t}$ and then taking logs we obtain:

$$\Delta lnc_{t+1} = \frac{1}{\theta}(r-\delta) + (1+\theta)\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2} + \zeta_{t+1} \quad \text{(A3)}$$

where $\zeta_{t+1} = ln\frac{w_{t+1}}{\overline{w}_{t+1}} \approx \frac{\xi_{t+1}}{\overline{w}_{t+1}}$, $(1+\theta)$ is the degree of relative prudence and $\frac{E\xi_{t+1}^2}{(\mu\overline{w}_{t+1})^2} = \frac{var(\xi_{t+1}^2)}{(\mu\overline{w}_{t+1})^2}$ is the variance of the proportional innovation to w_{t+1}. It captures all underlying sources of risk that impact the consumer budget constraint and affect individual consumption uncertainty. Using the expression $\xi_{t+1}$and letting $\rho_{z,x}$ denote the correlation between x and z we can write:

$$\sigma_\xi^2 = \pi_y^2\sigma_{\xi y}^2 + \pi_h^2\sigma_{\xi h}^2 + \pi_p^2\sigma_{\xi p}^2 + \pi_r^2\sigma_{\xi r}^2 + 2\rho_{ry}\pi_{ry}\sigma_{\xi r}\sigma_{\xi y} + \\ +2\rho_{hy}\pi_{hy}\sigma_{\xi h}\sigma_{\xi y} + 2\rho_{rh}\pi_{rh}\sigma_{\xi r}\sigma_{\xi h} \quad \text{(A4)}$$

where $\sigma_{\xi z}^2$ is the variance of the proportional innovation to factor z defined as $\frac{var(\xi_z)}{z_t^2}$. π_z^2 is the square of the ratio of factor z at time *t* to predictable consumption $(\mu\overline{w}_{t+1}), and$thus measures the consumer's exposure to the variance of risk z. Similarly, $\pi_{zx} = \pi_z\pi_x$ measures exposure to the covariance between proportional risks z and x, measured by $\rho_{zx}\sigma_{\xi z}\sigma_{\xi z}$. The single terms are defined as:

$$\pi_r^2 = \frac{w_t^2}{(\mu\overline{w}_{t+1})^2}; \quad \sigma_{\xi r}^2 = var(\xi^r)$$
$$\pi_p^2 = \frac{(vp_t)^2}{(\mu\overline{w}_{t+1})^2}; \quad \sigma_{\xi p}^2 = \frac{var(\xi^p)}{p_t^2}$$
$$\pi_y^2 = \frac{y_t^2}{(\mu\overline{w}_{t+1})^2}; \quad \sigma_{\xi y}^2 = \frac{var(\xi^y)}{y_t^2}$$
$$\pi_h^2 = \frac{(ph_t)^2}{(\mu\overline{w}_{t+1})^2}; \quad \sigma_{\xi p}^2 = \frac{var(\xi^p)}{h_t^2}$$
$$\pi_{ry} = \frac{w_t y_t}{(\mu\overline{w}_{t+1})^2}; \quad \pi_{hy} = \frac{ph_t y_t}{(\mu\overline{w}_{t+1})^2}.$$

Our decomposition exercise is based on the above expression. It has two implications: (1) consumption uncertainty reflects all sources of risk that affect the consumer's budget constraint, (2) these sources matter only if they affect the consumer budget constraint.

The importance of each risk depends on the annual share of expenditure on z in lifetime resources. This share can vary systematically across individuals, and for some individuals can vary over states of nature or lifecycle. For example, interest rate risk should have a greater effect on consumption risk for people with larger stocks of current wealth, while labor income risk should matter more for people with a high income to wealth ratio. Similarly, health risk should be more important for the elderly. These predictions guide our empirical analysis.

Covariances also might matter. Realistically, we can assume that energy price and health risks are not correlated, and neither are rate of return and health risks. Since income risk is mostly idiosyncratic it should be uncorrelated with energy price risk and return on wealth risk. If we impose these conditions, then total consumption risk reduces to:

$$\sigma_\xi^2 = \pi_y^2\sigma_{\xi y}^2 + \pi_h^2\sigma_{\xi h}^2 + \pi_p^2\sigma_{\xi p}^2 + \pi_r^2\sigma_{\xi r}^2 + 2\rho_{hy}\pi_{hy}\sigma_{\xi h}\sigma_{\xi y} \quad \text{(A5)}$$

This decomposition assumes that each of these risks is passed through to consumption. If the consumer can partially avoid some of these risks or can obtain insurance protection against them, the effect on consumption risk should be mitigated. For example, health shocks may be fully insured which means that health expenditure should not be affected and should only reflect voluntary purchases - e.g. for pre-emptive healthcare. Similarly, labor income shocks may be buffered by transfers from parents. In general, allowing for partial insurance on risk source z say β_z, we can write the above equation as:

$$\sigma_\xi^2 = \beta_y \pi_y^2 \sigma_y^2 + \beta_h \pi_h^2 \sigma_h^2 + \beta_p \pi_p^2 \sigma_p^2 + \beta_r \pi_r^2 \sigma_r^2 + 2\beta_{hy} \rho_{hy} \pi_{hy} \sigma_h \sigma_u \quad \text{(A6)}$$

B. Comparison between ISCE and SHIW

Table B1. Demographic variables

	ISCE	SHIW
Male	0.48	0.49
Female	0.52	0.51
Age 18-34	0.26	0.23
Age 35-54	0.39	0.37
Age 55-75	0.35	0.40
Family size = 1	0.12	0.13
Family size = 2	0.30	0.25
Family size = 3	0.29	0.27
Family size = 4	0.23	0.25
Family size >= 5	0.06	0.10
Primary education	0.32	0.47
Secondary education	0.46	0.37
Tertiary education	0.22	0.16
Employees	0.44	0.39
Self-employed	0.09	0.13
Unemployed	0.13	
Not in the labor force	0.34	0.48
North	0.45	0.46
Centre	0.20	0.19
South and Islands	0.34	0.35
Total	**6,483**	**11,373**

Note. The table compares the sample means of selected demographic variables between ISCE (2023) and SHIW (2020). The SHIW considers individuals between 18 and 75 years old. ISCE considers all respondents interviewed for the first time in the various waves. In both surveys, means computed using sample weights.

Table B2. Income, consumption, and wealth

	ISCE	SHIW
Disposable income	21,000	23,533
Total consumption	15,000	14,500
Financial wealth	25,000	9,726
Real assets	148,378	155,000
Debt	12,870	0
Total wealth	125,000	154,000
Homeownership	0.74	0.79
Investing in		
Bonds	0.18	0.10
Stocks	0.18	0.08
Private pensions	0.20	0.17
Life insurance	0.24	0.15
Number of observations	6,483	5,065

Note. The table compares sample medians of consumption, income, and wealth and proportions investing in real and financial assets in the 2023-24 ISCE and the 2020 SHIW. In the SHIW we consider individuals aged between 18 and 75 years. In the ISCE we consider all respondents interviewed for the first time. In both surveys, medians computed using sample weights.

C. Correlation of responses across questions

Our estimates of the relation between consumption risk and underlying risks (income, health, etc.) might attract the criticism that the similar formats of some questions might cause respondents to mechanically report similar answers.

The table below presents the answer choices to the expectations questions, and is the same for the 7 subjective expectations elicited in the survey and used in the paper.[12] All the questions follow a similar format: "*in the next 12 months, you expect that (your household's income / total consumption / gas and energy bills / health expenditures / house price / GDP / inflation)*:

Interval		Probability (%)
g_1	*will decrease by more than 8%*	p_1
g_2	*will decrease between 6 and 8%*	p_2
g_3	*will decrease between 4 and 6%*	p_3
g_4	*will decrease between 2 and 4%*	p_4
g_5	*will decrease between 0 and 2%*	p_5
g_6	*will remain constant*	p_6
g_7	*will increase between 0 and 2%*	p_7
g_8	*will increase between 2 and 4%*	p_8
g_9	*will increase between 4 and 6%*	p_9
g_{10}	*will increase between 6 and 8%*	p_{10}
g_{11}	*will increase more than 8%*	p_{11}
Total		100

Thus, the potential problem can be exemplified by the following:

(i) people indicate a certain probability p_m that the distribution of *income* over the following 12 months lies in the growth interval g_m (m = 1,…M), for instance that income growth has a 20% chance of increasing by 4 to 6% in the next 12 months;
(ii) they respond to the questionnaire rather automatically , reporting the same probability that the future distribution of *consumption* will be in the g_m interval;
(iii) they do this for each of the other intervals in the given distribution of income and consumption growth.

According to this example, the expected income and consumption growth distributions will be identical, as will be the estimated variances, so that the correlation between the two cross-sectional distributions of the second moments of subjective expected income and consumption will be equal to 1.

Suppose also that respondent behavior is similar in each of the waves, so that the variances of the distributions change over time but move in the same way for each respondent. Then the correlation between the changes in the variances of consumption and income will also equal 1. In this appendix we provide evidence that our estimates are unlikely to be affected by

[12] The format of the questions referring to unemployment and interest is different since respondents are presented with only positive intervals ranging from 0 to "over 14%" for unemployment and from 0 to "over 8%" for interest rate.

mechanical induced correlation.
Figure C1 depicts the average reported probabilities for each question, across the three waves. Tables C1 and C2 present the correlation matrices of the variances of the 7 subjective distributions and the change in these variances between waves 1, 2, and 3. Correlations in levels are of the order of 0.6-0.7, and correlations in first differences are of the order of 0.4-0.5.[13]

We exploit the similar format of the questions to gauge whether "mechanical correlation" is affecting our data. To do so, we analyzed the data underlying the construction of the moments of each distribution and estimated to what extent respondents tended to assign the same (or similar) probability weights to a particular interval g_m. The descriptive statistics in Table C3 show that the intervals assigned the largest weights are the central interval g_6 and the two extreme intervals g_1 and g_{11}.

Next, we organize the interval data in a panel, stacking the data related to the seven questions in one file which contains 105,084 observations. These observations result from 7 questions and 15,012 total interviews conducted during the three waves (5,006 in wave 1, 5,001 in wave 2 and 5,005 in wave 3). We use q to index the seven questions and use δ for the three waves and for each of the g intervals we ran the following panel regression with fixed effects:

$$p_{j,i,t,m} = \beta_0 + \sum_{j=1}^{Q} \beta_{j,m,} q_{j,m} + \delta_{t,m} + \mu_{i,m} + \varepsilon_{j,i,t,m} \qquad \text{(C.1)}$$

where:

$m = 1, \ldots M$	indicates the 11 intervals;
$q_{j,m}: j = 1, \ldots Q$	are indicators for the 7 questions considered and each of the intervals;
$\mu_{i,m}: i = 1, \ldots N$	are indicators for each individual respondent and each interval;
$\delta_{t,m} = 1,2$	are wave (or time) dummies, specific to each interval;

and where $p_{j,i,t,m}$ is the probability assigned by individual *i* to interval *m* in response to question *j* in wave *t*. The $\beta_{j,m}$ coefficients measure the average probability reported in any interval for each of the questions after controlling for wave and individual specific effects.

If respondents assign the same weight to each interval regardless of the particular question, then holding constant the interval (i.e. for a given m), the value of the $\beta_{j,m}$ coefficients across questions should be similar. In other words, a test to check whether respondents mechanically assign the same probability to a given growth interval of different variables implies the null of:

$$H_{0,m}: \beta_{1,m} = \beta_{2,m} = \cdots \beta_{7,m} \text{ for all } m.$$

Since the regression includes a constant term, the test for significance of the correlation of probabilities across questions tests for whether for any m, the $\beta_{j,m}$ are all equal to zero (we exclude the dummy for the consumption question).

Table C4 reports the results of the 11 panel regressions (one for *each* interval) in model (C.1). The baseline and omitted categories in each regression are the probability weights attached to the *particular interval in the distribution* of expected consumption growth. Table C4 shows that

z

in each regression the coefficients vary considerably.

The null that for given m the $\beta_{j,m}$ are all equal to zero is overwhelmingly rejected in each regression (i.e. for all m). Note also that the R-squared in all of the regressions is low, meaning that fixed effects overlook a large amount of the variability in the reported probabilities for each interval. Furthermore, in all of the regressions the fraction of total variance explained by fixed effects ranges from 11% to 32% (in the central interval reporting "no change"), which shows the considerable individual level variability in the intervals.

Overall, the analysis of the correlation across the intervals of the distributions suggests that there is genuine individual variability of responses across questions, and therefore that the relation between consumption risk and risk indicators identified in the paper is unlikely to reflect mechanical correlation across questions.

Figure C1. Average probability in each interval

Note. The graphs plot the probabilities reported for each interval for the seven questions with a common format.

Table C1. Correlation matrix of the variances of the subjective distribution of risk sources– total sample

Variance of	Consumption	Income	Health	Energy	GDP	Inflation	Unemp.	Interest rate	House price
Consumption	1.000								
Income	0.724	1.000							
Health	0.818	0.698	1.000						
Energy	0.783	0.687	0.812	1.000					
GDP	0.606	0.552	0.625	0.653	1.000				
Inflation	0.718	0.645	0.735	0.761	0.668	1.000			
Unemployment	0.716	0.637	0.748	0.781	0.693	0.834	1.000		
Interest rate	0.651	0.583	0.669	0.699	0.756	0.742	0.761	1.000	
House price	0.766	0.662	0.794	0.834	0.663	0.767	0.785	0.711	1.000

Note. Statistics use sample weights. Sample includes all observations in the three waves.

Table C2. Correlation matrix of first difference of the variances of the subjective distribution of risk sources– total sample

Variance of	Consumption	Income	Health	Energy	GDP	Inflation	Unemp.	Interest rate	House price
Consumption	1.000								
Income	0.518	1.000							
Health	0.662	0.458	1.000						
Energy	0.593	0.433	0.640	1.000					
GDP	0.322	0.247	0.338	0.387	1.000				
Inflation	0.494	0.371	0.521	0.565	0.421	1.000			
Unemployment	0.479	0.354	0.525	0.575	0.474	0.676	1.000		
Interest rate	0.385	0.273	0.411	0.458	0.572	0.513	0.567	1.000	
House price	0.551	0.401	0.591	0.690	0.419	0.574	0.604	0.482	1.000

Note. Statistics use sample weights. Sample includes all panel observations.

Table C3. Sample means, by wave, risk type and growth intervals

Wave 1	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11
Income risk	8.713	3.941	4.283	4.516	5.17	33.583	8.837	8.317	7.188	5.704	9.748
Cons. Risk	4.484	2.189	2.275	2.92	3.519	29.667	10.906	11.315	9.646	8.154	14.924
Health risk	15.362	5.692	6.982	9.076	11.089	27.034	11.657	4.635	2.852	2.075	3.546
Energy risk	5.75	2.863	2.671	2.934	4.017	42.662	9.176	8.399	6.832	5.307	9.391
House price risk	7.269	3.361	3.774	4.507	5.615	46.913	7.782	5.947	4.859	3.766	6.205
GDP risk	12.53	6.091	5.962	6.456	6.312	39.269	7.669	4.894	3.441	3.019	4.358
Inflation risk	4.855	2.645	3.689	5.254	6.944	23.684	11.444	12.255	9.687	6.965	12.579

Wave 2	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11
Income risk	10.533	5.117	5.685	5.784	6.015	46.11	7.794	4.523	3.028	1.986	3.423
Cons. risk	6.37	3.128	3.652	4.303	4.903	36.553	9.678	10.815	7.115	4.775	8.708
Health risk	4.787	2.284	2.478	2.861	3.509	46.759	10.319	8.665	5.518	4.483	8.339
Energy risk	4.536	2.027	2.766	3.824	4.794	36.562	12.368	11.648	7.82	4.911	8.745
House price risk	4.828	2.551	3.225	4.195	5.86	54.927	8.089	5.931	3.664	2.274	4.457
GDP risk	10.963	3.838	5.761	7.837	10.419	35.72	14.586	4.55	2.274	1.496	2.556
Inflation risk	3.565	2.408	3.503	5.346	7.36	29.12	13.601	12.799	8.339	4.536	9.424

Wave 3	g1	g2	g3	g4	g5	g6	g7	g8	g9	g10	g11
Income risk	5.037	2.82	3.142	4.132	5.611	38.654	11.664	10.597	7.25	4.233	6.861
Cons. risk	4.133	2.351	2.784	4.342	6.231	39.621	13.423	11.511	6.187	3.442	5.976
Health risk	9.786	3.949	5.636	7.81	10.504	36.336	15.521	4.93	1.85	1.312	2.365
Energy risk	4.18	2.043	2.397	3.079	4.125	49.058	10.831	8.221	5.623	3.727	6.715
House price risk	4.019	2.402	3.261	4.294	6.243	54.57	9.367	6.104	3.417	2.277	4.046
GDP risk	8.543	4.732	5.121	5.827	6.919	48.527	8.167	4.932	2.618	1.736	2.875
Inflation risk	3.507	2.056	3.047	5.472	7.703	29.5	15.059	13.106	7.951	4.249	8.351

Note. Table C3 presents the average probability reported for each of the 11 intervals for each risk question and each wave related to each of the 6 expectations questions.

Table C4. Panel regressions for specific intervals

	$p<-8$	$-8<p<-6$	$-6<p<-4$	$-4<p<-2$	$-2<p<0$	No change
Income growth	3.829	2.017	1.897	1.705	1.187	8.371
	(0.213)***	(0.117)***	(0.144)***	(0.174)***	(0.197)***	(0.415)***
Health exp growth	-1.801	-0.900	-1.177	-1.359	-1.344	9.896
	(0.213)***	(0.117)***	(0.144)***	(0.174)***	(0.197)***	(0.415)***
Energy price growth	-2.322	-1.108	-1.084	-0.622	-0.380	-0.981
	(0.213)***	(0.117)***	(0.144)***	(0.174)***	(0.197)*	(0.415)**
House price growth	-1.334	-0.525	-0.272	0.015	0.678	15.872
	(0.213)***	(0.117)***	(0.144)*	(0.174)	(0.197)***	(0.415)***
GDP growth	5.331	1.197	2.434	3.924	5.443	-3.234
	(0.213)***	(0.117)***	(0.144)***	(0.174)***	(0.197)***	(0.415)***
Inflation	-2.731	-0.927	-0.279	1.040	2.107	-8.829
	(0.213)***	(0.117)***	(0.144)*	(0.174)***	(0.197)***	(0.415)***
Wave 2	-1.704	-0.697	-0.358	-0.212	0.053	5.817
	(0.150)***	(0.082)***	(0.101)***	(0.122)*	(0.139)	(0.292)***
Wave 3	-2.333	-0.775	-0.530	-0.068	0.702	6.955
	(0.156)***	(0.085)***	(0.105)***	(0.127)	(0.144)***	(0.304)***
Constant	8.052	3.787	3.988	4.410	4.976	32.007
	(0.175)***	(0.096)***	(0.118)***	(0.143)***	(0.162)***	(0.341)***
N	105,084	105,084	105,084	105,084	105,084	105,084
Explained $\mu_{i,m}$	0.26	0.21	0.13	0.11	0.11	0.32
F test	448.29	212.35	191.45	204.23	252.46	862.87
p value	0.000	0.000	0.000	0.000	0.000	0.000

	$0<p<2$	$2<p<4$	$4<p<6$	$6<p<8$	$p>8$
Income growth	-2.183	-5.126	-4.155	-2.657	-4.887
	(0.260)***	(0.227)***	(0.181)***	(0.141)***	(0.218)***
Health exp growth	0.049	-1.481	-1.193	-0.398	-0.291
	(0.260)	(0.227)***	(0.181)***	(0.141)***	(0.218)
Energy price growth	2.172	1.582	0.700	0.598	1.443
	(0.260)***	(0.227)***	(0.181)***	(0.141)***	(0.218)***
House price growth	-1.647	-3.915	-3.204	-2.131	-3.536
	(0.260)***	(0.227)***	(0.181)***	(0.141)***	(0.218)***
GDP growth	3.861	-5.204	-4.859	-3.277	-5.616
	(0.260)***	(0.227)***	(0.181)***	(0.141)***	(0.218)***
Inflation	3.308	2.811	1.475	0.346	1.679
	(0.260)***	(0.227)***	(0.181)***	(0.141)**	(0.218)***
Wave 2	1.270	0.485	-1.062	-1.511	-2.080
	(0.183)***	(0.160)***	(0.128)***	(0.099)***	(0.154)***
Wave 3	2.427	0.469	-1.630	-2.073	-3.144
	(0.190)***	(0.166)***	(0.133)***	(0.103)***	(0.160)***
Constant	8.828	9.592	8.081	6.098	10.180
	(0.214)***	(0.187)***	(0.149)***	(0.116)***	(0.179)***
N	105,084	105,084	105,084	105,084	105,084
Explained $\mu_{i,m}$	0.14	0.11	0.11	0.13	0.23
F test	165.94	405.80	376.99	249.55	384.81
p value	0.000	0.000	0.000	0.000	0.000

Note. Table C4 presents the fixed effects panel estimates of the reported probability for each of the 11 intervals for the 7 questions. In all the regressions, the omitted category is the probability assigned to the interval of expected consumption growth. The F-test and associated p-values show that the coefficients are all equal to zero. "Explained $\mu_{i,m}$" is the fraction of total variance explained by fixed effects. Standard errors in parentheses. * significance at 10%, ** significance at 5%, *** significance at 1%.