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Inflation expectations and household choices: the role of financial knowledge

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Abstract
Using the Consumer Expectations Survey from the European Central Bank, this study explores the role of financial knowledge in consumers' inflation expectations formation process and in the mechanism linking such expectations with choices. It is found that short-term expectations are generally lower and medium-term expectations are closer to the inflation target for individuals with a higher level of financial knowledge both in the euro area and Portugal. It also estimates an elasticity of intertemporal substitution − response of expected consumption growth to changes in expected inflation between 0.6 and 0.7. The link weakens as financial knowledge increases.
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"Inflation expectations are terribly important.
We spend a lot of time watching them."

Jerome Powell − September 22, 2021

1. Introduction

Over the past decade, researchers and central banks have started to collect survey data on the expectations from consumers, firms, and professional forecasters. These surveys convey insights into how the economic agents form and update their expectations, the heterogeneity and biases in these expectations, and how they feed into economic decisions that can have wide implications for the economy and for the monetary policy. This article studies how the formation process of inflation expectations by households and subsequent economic choices are influenced by financial knowledge. It focus on the euro area and Portugal, shedding light on why higher levels of financial knowledge may help central banks maintain expectations closer to the inflation target.

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Consumers' inflation expectations are of paramount importance in macroeconomics as they may affect the prices and the wages set by firms and the consumption-savings decisions of households. In most theoretical dynamic models, inflation expectations shape economic agents' decisions, thus affecting consumption, investment, and inflation through three main channels, as stated in Crump *et al.* (2022) and D'Acunto *et al.* (2024). First, all else equal, higher inflation expectations should lower real interest rates and therefore encourage consumption and investment today ("*real interest rate channel*"). Higher inflation expectations may also lead households to demand higher wages to avoid a loss in real income, and firms tend to offer higher wages to retain staff ("*wage-setting channel*"). Third, in the presence of price rigidities, it may be optimal for the fraction of firms capable of adjusting prices to do so in response to expected inflation over the period during which their prices will remain fixed ("*price-setting channel*"). Given their relevance for individual and aggregate outcomes, studying the patterns of inflation expectations in the cross-section and time series is crucial.

It is widely accepted as well that monitoring the evolution of inflation expectations is of great importance for central banks, who are committed to a credible and price stability-oriented monetary policy. Anchored expectations enhance policy effectiveness by ensuring that shifts in monetary policy influence inflation outcomes as expected, while also reducing uncertainty and volatility in the economy. The driving forces behind heterogeneity in expectations across individuals can also help understand why economic agents react differently to the same shocks and policy interventions. One important driver of these differences is financial literacy, as it has been documented in the literature that it influences the way households act on their subjective beliefs about inflation. In fact, research by Lusardi (2008), Armantier *et al.* (2010) and Bruine *et al.* (2011) demonstrated that consumers with lower financial literacy and a reduced ability to process financial statistics and information tend to overestimate inflation.

The aim of the present study is twofold. First, it explores the expectations formation process by households, studying how financial knowledge helps them to build more accurate expectations for the evolution of prices. Several dimensions are analysed: first, survey responses are investigated to measure answering effort; then, it looks at the disagreement of short-term expectations across financial knowledge levels; finally, it also delves into the relationship between deviations of medium-term expectations from the inflation target and financial knowledge. To assess the effects of inflation expectations on consumers' intertemporal choices, it examines the *real interest rate channel* mentioned above. Using the methodology from Crump *et al.* (2022), the Euler equation is estimated with measures of households' expectations of both consumption growth and inflation. The elasticity of intertemporal substitution (EIS) is estimated for households in each group of financial knowledge to understand whether it varies significantly among them.

This article uses household-level information on expectations of euro area consumers about the economy, as well as socioeconomic and demographic characteristics from the European Central Bank's (ECB) Consumer Expectations Survey (CES), a novel online, mixed-frequency panel survey. This monthly survey asks a rotating panel of euro area household heads a series of qualitative and quantitative questions on perceptions and expectations for several macroeconomic and financial developments. Importantly,

from the survey responses, it is also derived a *proxy* for financial knowledge as it contains specific questions made during the background interview to each household, covering important dimensions such as compounding, real interest rates and investment decisions. It is important to note that our focus will be on financial knowledge and not on the other dimensions of financial literacy, namely financial attitudes and financial behaviour. The CES also contains individual-level data since April 2020 on inflation and spending expectations that are used to estimate the consumption Euler equation.

This study begins with an overview of the survey methodology, presenting a detailed evaluation of its sample representativeness for both the euro area and Portugal. An index of financial knowledge is built and it yields qualitatively similar results to other indices, such as the one from the European Commission (EC). Around one fourth of the surveyed euro area consumers answered correctly to all questions, while Portugal presents the fourth smallest percentage of respondents obtaining a high score. The index is used to examine the role of financial knowledge on inflation expectations and economic choices.

It proceeds by investigating the heterogeneous inflation expectations of consumers. The analysis unveils that those with high scores employ more effort to answer survey questions on inflation expectations: the proportion of respondents answering zero or multiples of 5 is lower while the use of decimals and answers between -10 and 10 is more prevalent. It concludes that enhanced financial knowledge generally means inflation perceptions closer to actual inflation rate and lower short-term expectations. Regarding medium-term expectations, those with high financial knowledge tend to expect changes in prices around the inflation target of 2% defined by the ECB.[1]

Turning to consumers' spending plans, this article studies a mechanism prevalent in macroeconomic models, the consumption Euler equation. Using variations in expected inflation, it is estimated an elasticity of intertemporal substitution between 0.6 and 0.7, consistent with other findings in the literature. Estimates for Portugal slightly exceed these figures. Upon segmenting based on levels of financial knowledge, it is concluded that the responsiveness of expected real consumption growth to changes in inflation expectations is attenuated among consumers with greater financial knowledge. This result is less pronounced in Portugal, as no statistically significant differences are found.

Related Literature. Recently, a growing number of studies has been using surveys data to explore inflation expectations and their impact on economic choices. In fact, Weber *et al.* (2022) provide a comprehensive review of this literature, emphasising the importance of households' and firms' inflation expectations in both macroeconomic and microeconomic models. The authors discuss how they are measured, the patterns they display, their determinants, and how they shape decisions. This study relates to two main streams of research that emerged from the literature on consumer inflation expectations: exploring their patterns by demographic characteristics and how they affect economic decisions, estimating the elasticity of intertemporal substitution.

1. For the sake of simplicity, throughout the article, it is referred to a 2% inflation target, even though the author is aware of the previous quantitative definitions of price stability. These include the one in place after 2003: "Price stability shall be defined as a year-on-year increase in the Harmonised Index of Consumer Prices (HICP) for the euro area of below, but close to 2% over the medium term."

Knowing the central role of households in driving economic activity, policymakers have increasingly focused on monitoring their expectations, placing them in the centre of modern monetary policy (Woodford (2004), Bernanke (2007), Gali (2008), and Sims (2009)). To address this, several measures and surveys have been developed to track household expectations. Armantier *et al.* (2017) discuss the role of the New York Fed Survey of Consumer Expectations in providing a comprehensive view of household economic outcomes. It complemented the existing data sources (such as, the University of Michigan Survey of Consumers, the Federal Reserve Board's Survey of Consumer Finances, and the Bureau of Labour Statistics' Consumer Expenditure Survey) by providing a more integrated data approach while covering a broad range of topics related to households expectations and decisions. In the euro area, the CES was created to assume a similar role, complementing the information from the Business and Consumer Surveys (BCS), conducted by the EC on a quarterly basis. Gomes *et al.* (2024) examine inflation expectations among euro area consumers, focusing on these surveys. They find that the CES is a valuable addition to the set of inflation expectation measures, aligning more closely with two established indicators of inflation expectations (those of professional analysts and market expectations) when compared with the EC's BCS.

Several patterns regarding households' inflation expectations consistently emerged across surveys, regions, and time periods. These include an upward bias in numerical inflation expectations against actual inflation, significant disagreement and uncertainty surrounding future inflation, strong correlations in short- and medium-term inflation expectations, and their predictability using perceived inflation. As an example, one can mention the work by Weber *et al.* (2022) that finds average and median numerical inflation expectations of households systematically higher than the actual inflation rates that occur subsequently with survey data from the University of Michigan Survey of Consumers. Moreover, examining demographic groups provides insight into the sources of the observed upward bias in inflation expectations. Several studies indicate that this bias varies a lot across demographics: women tend to exhibit a higher positive bias compared to men (Armantier *et al.* (2010) and D'Acunto *et al.* (2021)), while those with more cognitive abilities display a lower bias (D'Acunto *et al.* (2019)). Furthermore, cross-sectional variations in macroeconomic expectations, including inflation expectations, can be partially explained by a combination of formal education and income levels (see, for example, Armantier *et al.* (2010) and Das *et al.* (2020)). Notably, households from lower socioeconomic backgrounds often exhibit systematically higher inflation expectations compared to their counterparts. This paper departs from the upward bias in euro area consumers' inflation expectations relative to actual inflation found in Gomes *et al.* (2024) to check whether their level varies across different levels of financial knowledge. At the same time, it highlights novel empirical findings for Portugal, given that it is the first to explore the CES data for this country.

Recent research has also departed from the standard theoretical models to examine the causal link between inflation expectations and economic decisions, recognising that observed variations in decision-making may stem from similar underlying determinants affecting inflation expectations. Initial studies, such as Bachmann *et al.* (2015), showed limited evidence of high inflation expectations leading to increased spending plans,

but subsequent research has provided more affirmative results. For example, Crump *et al.* (2022) used inflation expectations from the New York Fed's Survey of Consumer Expectations, estimating an intertemporal elasticity of substitution value of between 0.5 and 0.7. This work inspires the empirical setting in Section 4. Similarly, Drager and Nghiem (2021) found similar results for German households using a survey developed by the University of Hamburg and Ichiue and Nishiguchi (2015) presented evidence consistent with the Euler equation using household survey data in Japan during the zero-lower bound period between 2006 and 2013. Duca-Radu *et al.* (2021) pooled data from seventeen European countries and found that households exhibit more positive attitudes towards spending on consumer durables when expecting inflation to rise.

In this line, a study by D'Acunto *et al.* (2022) exploiting a natural experiment setting uses the pre-announced increase in the VAT in Germany in 2005 as a source of exogenous variation in inflation expectations among German households relative to those of other European countries. Their findings indicate that the rise in expectations of German households relative to comparable households in neighbouring countries was associated with higher reported willingness to spend in the future, despite no differences in their expectations of future income and other factors. Together, these results suggest a causal chain running from higher inflation expectations to higher consumption levels, especially in the absence of offsetting interest rate responses, e.g the zero-lower bound.

Nevertheless, much of this research relies on cross-sectional datasets. Vellekoop and Wiederholt (2019) look at changes in expectations within individuals over time, finding a positive link between inflation expectations and future consumption choices. Finally, D'Acunto *et al.* (2023) highlight that controlling for multiple characteristics and cognitive abilities is crucial in establishing a positive association between inflation expectations and the willingness to purchase durable goods.

Outline. The paper is organised as follows. Section 2 describes the data used in the empirical applications. Section 3 explores the formation process of inflation expectations, investigating how financial knowledge shapes these expectations. Section 4 presents the estimation of the elasticity of intertemporal substitution and documents the differences by level of financial knowledge. Section 5 concludes with final remarks.

2. Data

2.1. ECB's Consumer Expectations Survey

This study uses survey data from the ECB's CES between April 2020 and March 2024.[2] The CES is an internet-based survey of a rotating panel of household heads conducted at a monthly frequency since January 2020 and data is available since April 2020. The survey initially covered participants from six euro area countries: Belgium, Germany, Spain, France, Italy and the Netherlands. In 2022, work began on the collection of data for five more euro area countries: Ireland, Greece, Austria, Portugal and Finland.

2. For a comprehensive overview of the CES, see ECB (2021) and Georgarakos and Kenny (2022).

The survey was first piloted in January 2020. This phase enabled an evaluation of the quality and usefulness of the survey responses. The targeted sample size during the pilot phase was approximately 10,000 respondents and has now increased to 19,000, as shown in the Online Appendix (Figure A.1). The number of respondents increased steadily throughout the development phase, allowing better analysis of the behaviour of certain population subgroups and enhancing the overall quality and country coverage.

The CES is a mixed-frequency modular survey with timely data comparable across countries. The underlying approach is to use mixed frequencies, with some questions asked monthly and others at a quarterly or annual frequency. This approach is designed not to overburden respondents, while collecting information at meaningful intervals. After being recruited into the panel, survey respondents are first asked to complete a background module that collects information on relatively time-insensitive variables as gender, employment status, educational background, and annual income. After that, the CES is composed by three parts. An annual interview aims to collect information on incomes, financial and real asset holdings, debts and household demographics. A quarterly module collects information on topics such as consumption, credit access and employment at a lower frequency. A monthly core module includes perceptions and expectations as regards inflation, labour market, spending, housing and credit decisions, as well as other time-sensitive information that can be introduced for some months.[3]

The CES has an unbalanced panel as consumers respond to the survey over multiple rounds but not always uninterruptedly, meaning that there is a different number of observations for each unit of analysis. The vast majority of panel members, irrespective of the sampling method used, normally complete their first monthly module in the same round as the background survey. Only a few panel members remain inactive for one or more rounds before their first complete participation. To help limit the impact of conditioning and sample selectivity effects on the quality of CES data over time, the survey is set up as a rotating panel so that panel members who exit the survey normally are replaced by new members. A panel rotation has been implemented in a gradual manner. The target maximum length of participation in the CES is set to 24 completed survey rounds. The panel retention has proven effective as most panel members always complete their monthly survey tasks, as shown in the Online Appendix (Figure A.2). Excluding the initial sample building phases, the share of new entrants in each wave was around 10%. The survey gathers both qualitative and quantitative data. Qualitative variables involve questions where respondents choose from predefined categories or non-numeric options. In contrast, quantitative variables involve questions where respondents provide numeric estimates. To address outliers, data points for all quantitative indicators are adjusted at the 2^{nd} and 98^{th} percentiles of the weighted distribution of responses for each survey round and country. Median values are calculated using the symmetric linear interpolation, proposed by Cox (2009),

3. As stated by ECB (2021), the development of the CES involved cognitive interviewing sessions with panel participants to ensure that respondents' understanding aligns with the intended meaning of the questions. Additionally, it drew upon international best practices and insights gained from similar surveys.

to accommodate response patterns (clustering around integer values) and questionnaire constraints (allowing only one decimal place).

Sample Evaluation. The survey targets the population aged 18 and above residing in each country. The number of unique individuals surveyed by country is shown in the Online Appendix (Figure A.3). The sample aims for representativeness across age, gender, and region. While individuals aged 70 or above are included, initially, the focus is on the $18 - 70$ age range due to challenges in recruiting older people for online questionnaires. The age group of 70 or above is not included in the our applications. The CES comprises a probability sample, where all individuals have a known chance of selection, and a non-probability sample drawn from existing online panels, where only a specific subset of individuals belonging to the target population has a non-zero probability of being selected. This combination helps control for sampling effects.

ECB (2021) reveals that the main discrepancy observed in the sample in comparison to population benchmarks is the under-representation of elderly individuals, those aged 70 and above, in both samples. This under-representation is likely influenced by the online mode of data collection. In non-probability samples, there is a notable over-representation of females, even in monthly modules with gender quotas. Probability samples exhibit a relatively better representation, accounting for sampling error that can be calculated for probabilistic samples. Although the unweighted sample proportions fulfil the minimum requirement of representing at least 50% of the population in the main sub-regions, they also reasonably align with population shares. To address these limitations, survey results are re-weighted using age, gender, and region benchmarks from Eurostat for this calibration. In this investigation, cross-sectional weights, available for each household and survey round and blended combining probability and non-probability samples, are used to obtain more accurate results.[4]

A comprehensive sample evaluation was conducted for Portugal, given that this is the first study highlighting the results for this country from the CES. This assessment used data collected during the initial waves spanning from April to December 2022, the pilot phase of the survey.[5] The participation of individuals in the panel exhibits a notably short duration, with a median span of only 2 months within a 9-month period. Despite this brevity, there is a striking stability in the characteristics of individuals across different waves of participation. The sample size has remained stable around 1,100 individuals, as shown in the Online Appendix (Figure A.4). Regarding the demographic representation, evident issues emerge, particularly in terms of age and education levels.

Regarding the calibration variables and the unweighted structure of the sample, there is a significant under-representation of individuals aged 71 and above, echoing trends observed in other countries as referred above, while the $35 - 54$ age group consists of 52% of the sample instead of 35% found in the population. Regarding gender, the balance replicates well the share of men and women. Female participation slightly declines,

4. The blended weights indicate the number of adults in the population represented by each respondent, ensuring that the sample aligns with population sizes within each country and across all countries.

5. Administrative (Census 2021) and survey data (EU-SILC 2021) is used as benchmarks for Portugal.

however, along the survey rounds. There is an over-representation of *Lisboa* and under-representation of *Alentejo*, in what concerns the regional coverage.

Using sample weights, there is an under-representation of low education levels, with only 9.5% of participants having education below secondary level, starkly contrasting with the expected 55%. There is also an over-representation of tertiary education levels (51% vs. 21%). Other minor discrepancies include an over-representation of employed, constituting 62% of the panel compared to the expected 52%. Within the employed, employees are over-represented, comprising 86% compared to the anticipated 78% and of certain sectors like manufacturing, trade, transportation, and storage. No big differences against EU-SILC data in terms of the household disposable income structure.

Nevertheless, the weighted aggregate statistics, such as expectations for economic growth or unemployment rate and perception about the households' own financial situation, show a comparable alignment with those obtained from similar questions in the EC BCS. Furthermore, the median of CES responses emerges as a more suitable metric for robust comparisons with actual data from the Statistical Office.

2.2. *Financial Knowledge*

As a first step, it is built a *proxy* for financial knowledge using four questions from the background module of the CES. The questions cover important topics such as simple and compound interests, real interest rates and risk diversification. These are detailed in the Online Appendix (Table B.1) along with the percentage of correct answers for each one.

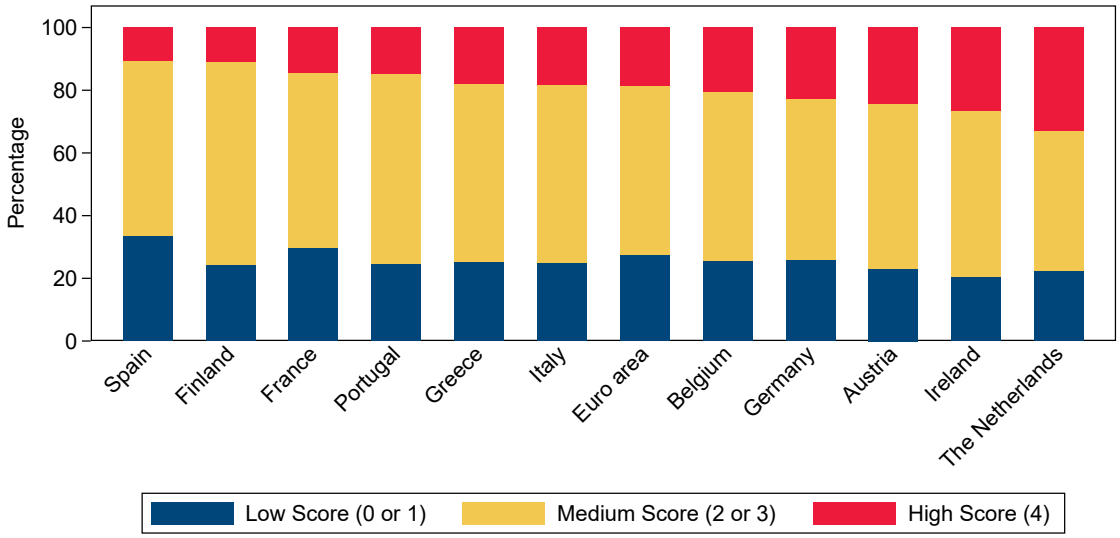
The correct responses provided by each household are aggregated, assigning a score in line with equivalent indices, e.g., the one from the EC.[6] The low-score group includes households with 0 or 1 correct answers. The group with a medium score is the one with those that got 2 or 3 correct answers. The ones with correct answers in all questions are classified with a high score.[7] The results for each country are shown in Figure 1.

Only 19% of the surveyed consumers in the euro area answered correctly all the four questions, with over half managing only two or three correct answers, and more than a quarter struggling with the questions (unable to answer any or just one out of four). The Netherlands and Ireland stand out as the best performers, with approximately three in ten respondents demonstrating a high level of financial knowledge (33% and 27%, respectively). On the contrary, Portugal ranks among the ones with a small percentage of households achieving a high score (15%), alongside Spain, Finland and France, which have even lower proportions. Overall, the majority of respondents (74%) grasp the impact of inflation and its potential repercussions on purchasing power. However, only 32% understand the workings of compound interest, despite its significance for personal finance management and long-term saving objectives. Concerning investment risks, 61%

6. Check the results of the study "*Monitoring the level of financial literacy in the EU*" from the EC here.

7. The results are robust to other specifications of the financial knowledge index: (1) a combination of questions 1 and 2 which are the questions related to real rates (cf. Online Appendix B); (2) a self-assessment question, in which households report how knowledgeable do they see themselves on financial matters.

correctly state that investing across a diverse range of companies is generally less risky than putting all investments into a single company.



Notes: All observations available until March 2024 are included. Weights are used in the computation.

FIGURE 1: Level of financial knowledge by country

2.3. *Inflation Expectations*

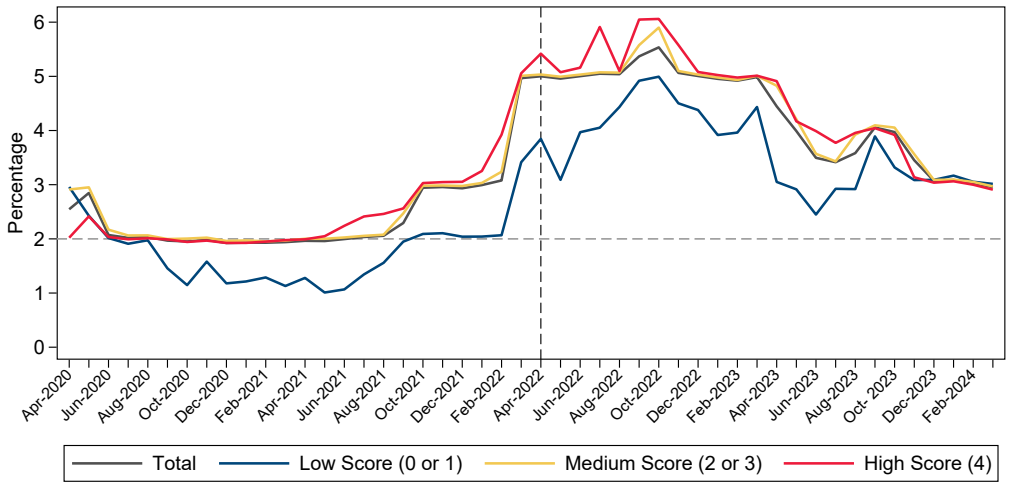
The CES asks several questions measuring consumer expectations about the evolution of prices in the next 12 months and between two and three years ahead, aligning well with the ECB's projection horizon in Macroeconomic Projection Exercises. Combining these with detailed information on household characteristics allows to shed light on both the inflation expectations formation process and the mechanism linking such expectations with choices. A common feature underlying these questions is that they are asked with reference to "changes in prices in general" instead of "inflation" (or "deflation"). Using the latter would require some familiarity of respondents with the concepts of inflation or deflation and may prompt (at least some of them) to respond based on their knowledge (or lack thereof) of the underlying statistical measure.

The question considered regarding short-term expectations comes from the following open-ended question on the expectation for prices in general during the next 12 months:

> *How much higher (lower) do you think prices in general will be 12 months from now in the country you currently live in? Please give your best guess of the change in percentage terms. You can provide a number up to one decimal place. ___._%*

The valid range is from -100.0 to 100.0. The value is 0 if the respondent chose "*Prices will be exactly the same (0% change)*" in the respective qualitative question (Online Appendix C).

Figure 2 illustrates the dynamics of inflation expectations over the next 12 months in the euro area by level of financial knowledge. Historically, medium-term expectations



Notes: All observations available until March 2024 are included. Weights are used in the computation. Median values are calculated using the symmetric linear interpolation, proposed by Cox (2009). The euro area sample includes from April 2022 onwards data from the five new countries included in the survey. The break in the series is represented by the vertical dashed gray line.

FIGURE 2: Inflation expectations for the next 12 months by financial knowledge

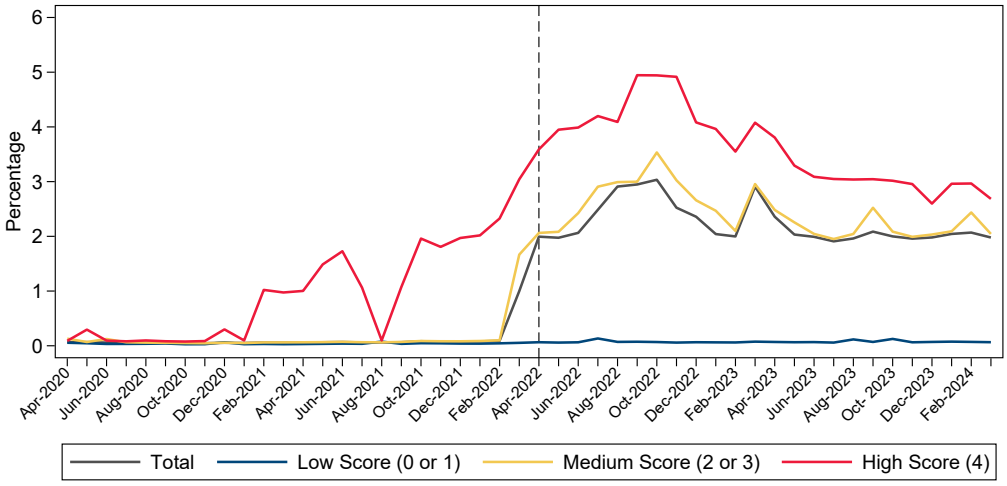
remained relatively stable until December 2021, aligning closely with the ECB's inflation target of 2%, mainly among households with heightened financial knowledge. The sudden up-tick in March 2022 suggests that households perceived the actual inflation rise in the first quarter of 2022 as potentially more persistent in nature. Furthermore, there's a discernible upward trend in inflation expectations from the end of 2021 through the end of 2022. In 2023, this trend reversed, with expectations decreasing towards 3% but not returning to the 2% target level. These movements have been similar across levels of financial knowledge, however the median consumer in the low score group had always lower inflation expectations. This reflects a higher disagreement between individuals in this group as many have negative expectations for the evolution of prices, as shown by the descriptive statistics for each group, available in the Online Appendix (Table A.1). Between the medium and high score groups, there are no visible differences at the aggregate level. A similar figure for Portugal is available in the Online Appendix (Figure A.6).

2.4. *Spending Expectations*

To estimate the elasticity of intertemporal substitution, it is also examined households' plans for the level of consumption. This is an open-ended question on the expectation for household spending on all goods and services during the next 12 months:

> *By what percent do you expect your household spending on all goods and services to change during the next 12 months compared with your spending in the past 12 months? Even very small changes in the amount your household will spend are of interest. Please give your best guess of the change in percentage terms.* ___._%

The valid range is from -100.0 to 100.0, but in this question there is also the option to report "Don't know". The value is 0 if the respondent chose "*My household spending will remain exactly the same (0% change)*" in the respective qualitative question (Online Appendix C).



Notes: All observations available until March 2024 are included. Weights are used in the computation. Median values are calculated using the symmetric linear interpolation, proposed by Cox (2009). The euro area sample includes from April 2022 onwards data from the five new countries included in the survey. The break in the series is represented by the vertical dashed gray line.

FIGURE 3: Spending expectations for the next 12 months by financial knowledge

Spending expectations were relatively stable until the end of 2021 for the low and medium score groups, while for the ones with a higher score it increased up to 2%, as shown in Figure 3. In 2022, the group with a medium score also shifted expectations upwards, coinciding with the increase in inflation expectations reported and the shock in energy and food prices at the start of the Ukraine war. Thereafter, the expectations for the growth rate of consumption remained relatively stable, despite a slight trend downwards. This did not happen for the median household with a low score. A similar figure for Portugal is available in the Online Appendix (Figure A.7).

Other variables are used hereafter, e.g. inflation perceptions, 3-years ahead inflation expectations and for total net income in next 12 months. The wording of these questions can be seen in the Online Appendix C. One should note that the country dimension indicates the country of residence of the respondent. Moreover, the euro area sample includes from April 2022 onwards data from the five new countries included in the survey. The results are qualitatively unchanged if we keep only the six initial countries in the sample.

3. Heterogeneous Inflation Expectations

The wealth of information gathered by CES presents an opportunity to delve into the heterogeneity of inflation expectations among distinct demographic and socioeconomic cohorts. In this section, the aim is to investigate how financial knowledge influences the shaping of these expectations. First, it is important to better understand how

accurate perceptions of inflation are, since consumers depart from these when forming their expectations. Then, relevant properties that characterise the survey responses about short-term inflation expectations are presented. It is also investigated whether financial knowledge is relevant in driving disagreement in inflation expectations at the individual level. Finally, it is assessed how medium-term expectations deviate from the inflation target for each level of financial knowledge. While the rationality assumption in consumers' inflation expectations has already been scrutinised through aggregate analysis (cf. Dias *et al.* (2008)), this study contributes with a micro-level approach.

3.1. Accuracy in Inflation Perceptions

Consumers' beliefs regarding recent inflation dynamics strongly influence expectations about future inflation.[8]. Thus, the starting point of this analysis must be to inspect whether inflation perceptions, i.e., the perception about the evolution of the prices over the last 12 months, would be more accurate with higher levels of financial knowledge.

To do so, the error made by an individual i of country j at time t is computed as the absolute difference between the respective point estimate and the actual inflation of country j at time t, $\pi^p_{ijt} - \pi_{jt}$. Formally, we test the association between the perception error and the level of financial knowledge, denoted by lit^{medium}_{ijt} for the medium score and lit^{high}_{ijt} for the high score, in Equation 1, which goes as follows

$$\pi^p_{ijt} - \pi_{jt} = \alpha + \omega_1 lit^{medium}_{ijt} + \omega_2 lit^{high}_{ijt} + \beta X_{ijt} + \varepsilon_{ijt}, \quad (1)$$

where it is also included a set of demographic controls, represented by X_{it}.[9]

Table 1 shows the results for the eleven countries together and for Portugal. Notably, the constant term underscores a significant positive bias in inflation perceptions, which is exacerbated by the exceptional period of analysis considered. This bias is reduced as the level of financial knowledge increases in both cases. The magnitude of the reductions is surprisingly large and statistically significant at the 1% level of significance for the medium and high score groups in comparison with the low score group.

3.2. Disagreement in Short-term Inflation Expectations

Recent research has been collecting evidence on multiple drivers behind disagreement in inflation expectations. In fact, these range from shopping experiences to demographic characteristics as they influence how each individual receives information about prices. For instance, Gomes *et al.* (2024) find that older and low-income households have higher inflation expectations, on average, when using the CES data. Weber *et al.* (2022) also show that heterogeneous cognitive abilities contribute to shape inflation expectations. In this subsection, we explore the role of financial knowledge in driving this disagreement.

Table 2 shows descriptive statistics on survey responses about short-term inflation expectations. The share of zeros represents the fraction of those reporting that "*prices*

8. This was initially identified among Swedish households by Jonung (1981) and consistently confirmed for households, firms and professional forecasters thereafter by other studies, such as Weber *et al.* (2022).

9. The demographic controls include: age, gender, income, education, housing type, size and partner.

	For all countries together			For Portugal		
	(1)	(2)	(3)	(1)	(2)	(3)
Constant	7.12***	7.26***	7.69***	13.88***	13.91***	16.52***
	(0.33)	(0.04)	(0.38)	(0.55)	(0.21)	(0.68)
Financial Knowledge (omitted = Low Score)						
Medium Score	-0.88***	-1.12***	-0.45***	-2.91***	-2.93***	-1.62***
	(0.07)	(0.05)	(0.07)	(0.28)	(0.27)	(0.27)
High Score	-2.48***	-2.58***	-1.46***	-5.38***	-5.47***	-2.96***
	(0.13)	(0.11)	(0.10)	(0.32)	(0.29)	(0.28)
Observations	714,802	714,802	714,802	26,185	26,185	26,185
Adjusted R^2	0.10	0.16	0.13	0.10	0.13	0.14
Within R^2	0.10	0.11	0.13	0.10	0.11	0.14
Country- and time-fixed effects		✓			✓	
Demographic controls			✓			✓

Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are used in the estimations. Robust standard errors, clustered at the household and month level, are reported in parentheses. Data on actual inflation rates at the country-level was collected from Eurostat. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

TABLE 1. Effect of financial knowledge on individual inflation perceptions

will remain exactly the same (that is 0% change)" in the qualitative question. The remaining statistics are calculated from the open-ended expectation question mentioned above.

Financial Knowledge	Low Score	Medium Score	High Score
Share of 0s			
For all countries together	22.7%	14.0%	9.2%
For Portugal	8.5%	7.3%	5.9%
Decimals use			
For all countries together	24.7%	25.3%	29.1%
For Portugal	17.1%	16.3%	18.0%
Multiples of 5			
For all countries together	50.8%	44.2%	35.0%
For Portugal	59.9%	56.0%	46.9%
Between -10 and 10			
For all countries together	80.4%	84.1%	89.9%
For Portugal	70.4%	75.2%	85.2%
Observations			
For all countries together	192,247	391,400	136,109
For Portugal	6,370	15,880	3,935

Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are not used in the computation.

TABLE 2. Descriptive statistics about survey responses for short-term inflation expectations

One finds that significant divergences emerge between the responses across levels of financial knowledge. Notably, across all countries, the proportion of respondents reporting a zero change in prices decreases as financial knowledge rises, with the lowest share observed among individuals with high score (9.2%). In contrast, those with low score exhibit the highest proportion of zero responses (22.7%). This trend persists when focusing on Portugal alone, where the disparities remain present, but in a much smaller magnitude (8.5% for low, 5.9% for high). Moreover, the use of decimals in inflation expectations slightly increases with higher financial knowledge across all countries, reaching 29.1% among individuals with high financial knowledge, compared to 24.7% among those with low financial knowledge. Similar trends are observed for Portugal.

Regarding the propensity to report the short-term expectations in multiples of five, individuals with low scores exhibit a higher inclination towards this pattern (50.8%) compared to those with medium (44.2%) or high financial knowledge (35.0%) across all countries. In Portugal, this trend persists, with the percentage of responses adhering to multiples of five decreasing as financial knowledge increases (59.9% for low, 46.9% for high). Furthermore, the majority of respondents across all countries expect inflation within the range of -10 to 10, with the highest percentage observed among individuals with high financial knowledge (89.9%). Similarly, in Portugal, a higher percentage of respondents with high financial knowledge (85.2%) report inflation expectations within this range compared to those with low financial knowledge (70.4%).

Next, it is presented a test on how financial knowledge impacts the level of inflation expectations. It is used a panel regression in which expectations for prices are modelled as a function of the score obtained in the questions highlighted above.

Formally, this relationship is expressed in Equation 2 as follows:

$$\pi^{e}_{ijt} = \alpha + \gamma\pi^{e}_{ijt-1} + \varphi\pi^{p}_{ijt} + \omega_1 lit^{medium}_{ijt} + \omega_2 lit^{high}_{ijt} + \beta X_{ijt} + \varepsilon_{ijt}, \quad (2)$$

where π^{e}_{ijt} corresponds to inflation expectations 12-months ahead for individual i from country j at time t, π^{p}_{ijt} corresponds to perceived inflation in the past 12 months, lit^{medium}_{ijt} and lit^{medium}_{ijt} are dummies for the level of financial knowledge. As robustness of the results, several demographic controls are added as dummies, denoted by X_{ijt}.[10]

Table 3 presents the results for these specifications with all countries included in the CES together and for Portugal alone. For all countries collectively, the coefficients associated with financial knowledge reveal significant effects. Specifically, individuals with a medium level of financial knowledge exhibit, on average, a lower level of inflation expectations than the ones with a lower level, with coefficients of -0.19 without controls and -0.17 with demographic controls, both statistically significant at the 1% level. Similarly, a high level of financial knowledge also leads to a significant negative impact on inflation expectations, with even stronger coefficients of -0.28 without controls and -0.21 with demographic controls, again significant at the 1% level. With country- and time-fixed effects, results remain very similar to these.

10. The demographic controls include: age, gender, income, education housing type, size and partner.

For Portugal, similar patterns emerge but, compared to individuals with lower scores, there is no clear difference for those with medium level. Those with high financial knowledge levels display on average lower inflation expectations, with the coefficients of -0.59 and -0.50 for each specification, both statistically significant at the 5% level.

These findings suggest that individuals with greater financial knowledge tend to have lower inflation expectations.[11] The coefficients for the demographic controls are broadly aligned with the patterns estimated by a number of recent studies that use household survey data from various sources. Namely, inflation expectations are higher for the older individuals, the low-income ones, numerous households and females.

	For all countries together			**For Portugal**		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Constant	0.66***	0.53***	0.28***	0.48***	0.45***	0.12
	(0.03)	(0.10)	(0.06)	(0.22)	(0.30)	(0.54)
Lagged Inf. Expectations	0.39***	0.39***	0.39***	0.47***	0.45***	0.47***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Inflation Perceptions	0.34***	0.36***	0.34***	0.24***	0.25***	0.24***
	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Financial Knowledge (omitted: Low Score)						
Medium Score	-0.19***	-0.17***	-0.17***	-0.17	-0.15	-0.10
	(0.05)	(0.03)	(0.03)	(0.22)	(0.23)	(0.22)
High Score	-0.28***	-0.24***	-0.21***	-0.59***	-0.54***	-0.50**
	(0.05)	(0.05)	(0.04)	(0.21)	(0.22)	(0.21)
Observations	593,147	593,147	593,147	19,928	19,928	19,928
Adjusted R^2	0.55	0.56	0.55	0.53	0.54	0.53
Within R^2	0.55	0.51	0.54	0.53	0.53	0.53
Country- and time-fixed effects		✓			✓	
Demographic controls			✓			✓

Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are used in the estimations. Robust standard errors, clustered at the household and month level, are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, resp.

TABLE 3. Effect of financial knowledge on individual inflation expectations

The findings underscore the role of financial knowledge in shaping individual inflation expectations. Previous studies, such as Lusardi (2008), Armantier *et al.* (2010) and Bruine *et al.* (2011), show that consumers with a lower ability to process financial statistics and information tend to overestimate inflation, as they are less informed about short and medium-term price trends. Their consumption baskets may also be different, which is more vulnerable to increases in prices. This study extends these conclusions to expectations about prices as it concludes that consumers with a lower level of financial knowledge tend to have higher point-estimates about the future evolution of prices.

11. This result does not contradict the information presented in Figure 2 as controls for inflation perceptions and other characteristics are included and the average effects are considered, *ceteris paribus*.

3.3. Deviations from the Inflation Target

It is also relevant to inspect whether financial knowledge affects consumers' ability to foresee inflation in the medium-term. The article proceeds to test whether any systematic heterogeneity exists in the precision and accuracy with which economic agents form their medium-term inflation expectations based on the level of financial knowledge.

First, the difference between the expectation for the annual growth of prices 3-years-ahead and the inflation target of 2% set by the ECB is computed and it is considered the absolute value of the result. Then, a formal test similar to the one presented in Equation 2 is carried out, in which π_{it}^{e} is replaced by the absolute value of that difference. Again, it is also used a set of demographic controls to isolate the effect of financial knowledge.

	For all countries together			For Portugal		
	(1)	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
Constant	1.10***	1.06***	1.14***	1.20***	1.17***	1.07***
	(0.05)	(0.06)	(0.08)	(0.11)	(0.17)	(0.42)
Lagged Inf. Expectations	0.48***	0.47***	0.47***	0.48***	0.47***	0.47***
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
Inflation Perceptions	0.19***	0.20***	0.20***	0.18***	0.19***	0.18***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.12)	(0.01)
Financial Knowledge (omitted: Low Score)						
Medium Score	-0.54***	-0.53***	-0.44***	-0.82***	-0.80***	-0.65***
	(0.04)	(0.05)	(0.04)	(0.10)	(0.10)	(0.10)
High Score	-1.04***	-1.00***	-0.84***	-1.43***	-1.41***	-1.16***
	(0.05)	(0.06)	(0.45)	(0.14)	(0.14)	(0.13)
Observations	588,677	588,677	588,677	19,928	19,928	19,928
Adjusted R^2	0.49	0.50	0.49	0.49	0.49	0.49
Within R^2	0.49	0.45	0.49	0.49	0.48	0.49
Country- and time-fixed effects		✓			✓	
Demographic controls			✓			✓

Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are used in the estimations. Robust standard errors, clustered at the household and month level, are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, resp.

TABLE 4. Effect of financial knowledge on deviations of medium-term expectations from target

Table 4 shows that, as financial knowledge rises, the divergence of the medium-term expectations from the inflation target of 2% diminishes noticeably. Individuals with medium scores exhibit smaller differences compared to their counterparts, as evidenced by negative coefficients with statistical significance, even when controlling for systematic biases in inflation perceptions and other demographic controls. Moreover, those with a high score tend to have smaller deviations from target, highlighting the profound impact of financial education and its relevance for central banks. The results remain consistent when considering Portugal independently, reaffirming the robustness of the relationship. In this context, individuals with higher score have a even more negative coefficient than compared with the ones for all countries together.

Given the role of financial knowledge in shaping the inflation expectations formation process, it is also crucial for central banks to grasp its impact on the nexus between these expectations and economic decisions. Actually, expectations on future price changes are crucial for households' consumption allocation over time and they may lead to different reactions at the individual level in response to monetary policy. This study proceeds to explore the mechanism linking such expectations with choices.

4. Household Choices and Financial Knowledge

When households anticipate higher future prices, they are incentivised to buy more goods now while prices are now lower, lowering the expected spending growth rate.

This is described by the standard consumption Euler equation, a fundamental concept in macroeconomic models. Inflation expectations play a significant role in this equation, influencing consumption and saving decisions. Essentially, higher inflation expectations can stimulate the aggregate demand, thus potentially increasing inflation by reducing economic slack. This section follows Crump *et al.* (2022) to estimate the elasticity of intertemporal substitution of consumers in the euro area and in Portugal. It also assesses whether estimates change with the level of financial knowledge.

4.1. Theoretical Motivation

The theoretical motivation of this estimation approach lies in the intertemporal Euler equation, as explained in Crump *et al.* (2022). The equation characterises the optimal consumption and saving decisions of households that have the ability to borrow and lend at a known nominal rate of return, R_t. In its basic form, assuming separable isoelastic preferences, which can be interpreted as utility functions that exhibit a constant elasticity, this equilibrium condition can be expressed as:

$$1 = E_t^i \left[\beta_i \left(\frac{C_{t+1}^i}{C_t^i} \right)^{-\frac{1}{\sigma}} \left(\frac{R_t}{\prod_{t+1}} \right) \right], \tag{3}$$

where the discount factor β_i represents the household's time preference, and C_t^i denotes its consumption of a bundle of goods and services. It is important to note that the overall level of consumption can differ across households indexed by i, implying the absence of a representative consumer. However, the composition of the consumption bundle and its price index, $\prod_t$, is the same for all individuals in each country. The assumption of a "representative" price index, which is widely adopted in macroeconomics, aligns well with CES questions, designed to capture expectations of aggregate inflation rather than individual price changes, which might be more directly relevant to respondents.

Inflation expectations are allowed to vary across households, as observed in the data. This diversity in inflation expectations contributes to differences in the *"ex-ante"* real interest rates perceived by households over time, given a particular nominal interest rate. According to the Euler equation, these variations should correlate with disparities in planned consumption. The estimates of the intertemporal substitution elasticity, denoted by the σ, quantify the strength of this relationship. Taking a log-linear approximation of Equation 3 yields the following relationship:

$$E_t^i[\Delta c_{t+1}^i] = \sigma \log \beta_i + \sigma R_t - \sigma E_t^i[\pi_{t+1}] + o_{it}, \tag{4}$$

where lower case letters represent logs and $o_{i,t}$ is a remainder collecting second and higher order terms in the approximation. This simple linear equation is the starting point for the following regressions. Equation 4 is ubiquitous in macroeconomics, starting from the pioneering work of Hall (1978). Intuitively, an increase in expected inflation, $E_t^i[\pi_{t+1}]$, lowers the perceived real interest rate (for a fixed nominal interest rate, R_t), thereby reducing the incentive to save and raising current consumption relative to future consumption. This generates the negative relation in Equation 4.

4.2. Empirical Strategy

The strategy follows the methodology in Crump *et al.* (2022), relying on direct measures of euro area households' expectations of both inflation and their consumption growth from survey data. With these, Equation 4 can be estimated directly with a standard OLS regression model. The dependent variable is the expected real consumption growth computed as the difference between the expectation for the growth of spending on all goods and services during the next 12 months and the expectation for inflation over the same next 12 months. This approach allows for differences across households in their expectations of aggregate inflation, but not in the households' own price index.

4.3. Elasticity of Intertemporal Substitution

Table 5 presents the estimation results. Column (1) reports the regression coefficient on expected inflation, $-\hat{\sigma}$, in a specification without control variables. The absolute value of the coefficient can be interpreted as the elasticity of intertemporal substitution or, in other words, the response of expected consumption growth to changes in expected inflation. It also tested the inclusion of real expectations for income growth as one well-documented failure of the permanent income hypothesis (PIH) is the "excess sensitivity" of consumption growth to expected income changes. The PIH suggests that predictable changes in income shouldn't affect how consumption grows over time because people plan their consumption based on their expected lifetime income. However, studies often find that anticipated income growth does impact consumption growth, which contradicts the PIH.[12] Column (2) presents the estimation with this addition, confirming that this is a relevant variable. Column (3) shows results adding several demographic variables as controls.[13] Column (4) reports the results using other macroeconomic variables as controls, being one of them the expectation for the nominal interest rate to address the concern that if the interest rate the household faces is correlated with their inflation expectations this could be a source of bias. [14]

It is consistently found an elasticity of intertemporal substitution between 0.58 and 0.73 across various model specifications, for euro area consumers. These estimates, falling at the higher end of similar studies using data on consumption choices (Attanasio and Weber (2010)), are precisely determined with small robust standard errors.

Moreover, even in the simplest specification, it is accounted for approximately 35% of the variation in expected real spending growth over the sample period. All reported estimates are statistically significant, indicating a departure from a null hypothesis. As suggested by Crump *et al.* (2022), the rejection of an EIS of 0 strongly suggests that households' expectations align with a pronounced intertemporal substitution motive. In Portugal, statistically significant results are also observed across all specifications, with

12. See Jappelli and Pistaferri (2010) for a survey of this literature.

13. The demographic controls include: age, gender, income, education, housing type, size and partner.

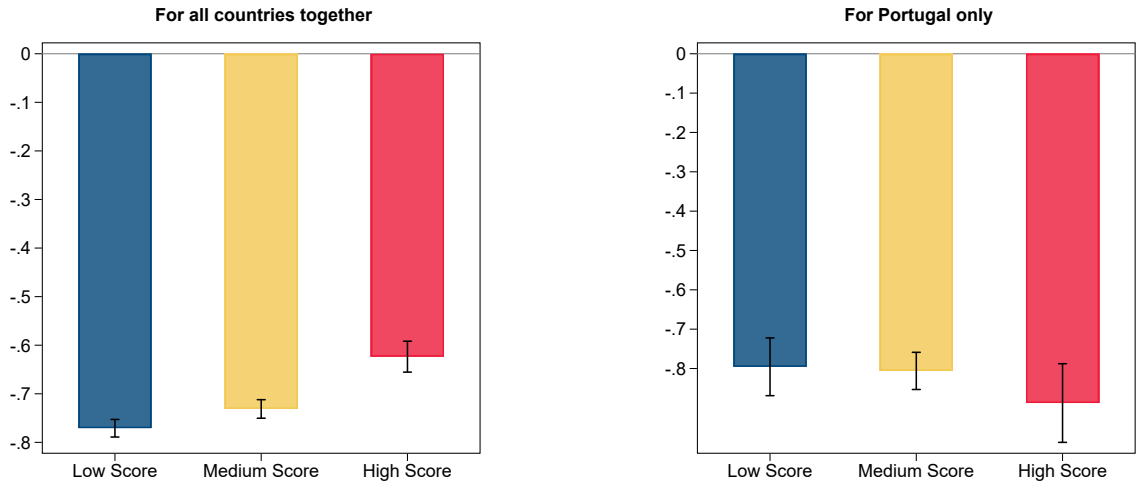
14. The macroeconomic controls include: past credit access, expectation for credit access, expectation about unemployment rate and expectation for interest rate on savings accounts.

a stronger elasticity ranging from 0.72 to 0.81. Notably, around 40% of the variation in expected real spending growth is explained in this context.[15]

	For all countries together				For Portugal			
	(1)	**(2)**	**(3)**	**(4)**	**(1)**	**(2)**	**(3)**	**(4)**
Expected Inflation	-0.81***	-0.73***	-0.58***	-0.60***	-0.76***	-0.81***	-0.72***	-0.75***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.03)
Real Exp. Inc. Growth		0.08***	0.05***	0.05***		-0.04***	-0.11***	-0.09***
		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)
Observations	590,807	590,807	613,844	573,494	20,947	20,947	22,532	22,532
Adjusted R^2	0.56	0.56	0.34	0.34	0.57	0.57	0.38	0.40
Within R^2	0.37	0.37	0.34	0.34	0.38	0.38	0.38	0.40
Household-fixed effects		✓				✓		
Demographic controls			✓				✓	
Macroeconomic controls				✓				✓

Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are used in the estimations. Robust standard errors, clustered at the household and month level, are reported in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, resp.

TABLE 5. Elasticity of intertemporal substitution



Notes: The euro area sample includes from April 2022 onwards data from the five new countries. Weights are used in the estimations. The black lines represent the 95% confidence intervals.

FIGURE 4: Elasticity of intertemporal substitution by level of financial knowledge

Figure 4 presents the estimated coefficient, $-\sigma$, splitting the sample for each level of financial knowledge. It is used the specification from Column (3) of Table 5. Using all countries, it is shown remarkable differences for the elasticities of intertemporal

15. The negative coefficient for the real expected income growth emerges as a result of the sample window available for Portugal. The estimated coefficients for the expected income growth concerning the euro area are similar to the ones shown in Crump *et al.* (2022). When using the data for the euro area after April 2022 (as for Portugal), the estimated coefficients also decrease to close to 0 or even negative values.

substitution. The consumers with a lower score are the ones with stronger reactions in expected spending when inflation expectations change. In contrast, consumers with higher financial knowledge exhibit lower estimates for the elasticity. When considering only households from Portugal, these differences are muted as it cannot be rejected the hypothesis that the coefficients are different across levels of financial knowledge.

5. Final Remarks

Understanding inflation expectations and household choices is important for economic research as well as for the design and evaluation of policies, being central to monetary policy. In this regard, survey data plays a pivotal role as it provides reliable information at a relatively high and timely frequency. It may help to assess the dynamic evolution of ongoing household sector developments, as well as the related policy responses, that often have heterogeneous effects on different population segments.

The CES fills this purpose by collecting individual-level data on consumers economic and financial behaviour in the euro area. This study starts by presenting the survey and its design, while evaluating the representativeness of the sample for the euro area and for Portugal. Then, it leverages the richness of the survey to explore heterogeneities of inflation expectations, focusing on the role of financial knowledge. Those with high scores employ more effort to answer survey on inflation expectations. They also have a perception of the past evolution closer to actual inflation and lower short-term expectations. This result aligns well with other heterogeneities already identified in the literature. Regarding medium-term expectations, those with more financial knowledge tend to report smaller deviation from the inflation target of 2% defined by the ECB.

When turning to household choices, a fundamental mechanism commonly found in macroeconomic models, the consumption Euler equation, is explored. Using variations in expected inflation, estimates for the elasticity of intertemporal substitution between 0.6 and 0.7 are obtained, consistent with results found in previous literature. The estimates for Portugal are slightly higher. When splitting the sample by level of financial knowledge, it is found that the response of expected real consumption growth to inflation expectations is weaker for the households with a higher financial knowledge. This result, however, is muted for Portugal as there is no measurable difference across groups, which may be also due to a smaller sample available.

Inflation expectations attract significant attention from researchers and central banks, in particular in times of turmoil such as the COVID-19 pandemic (Gomes *et al.* (2021)) and exceptionally rising prices. The recent surge in inflation in the euro area economy has raised concerns about the broader macroeconomic environment, including inflation expectations developments. This study provides further evidence on why promoting financial knowledge may be relevant for the conduct of monetary policy, helping them accomplish their mandates. First, it helps households to improve their perception about inflation. Then, it brings medium-term inflation expectations closer to the inflation target, one of the main objectives of central banks. Finally, it lowers the responsiveness of consumption plans in times of high inflation.

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