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FORMATION, HETEROGENEITY AND THEORY CONSISTENCY OF INFLATION EXPECTATIONS IN THE EURO AREA

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ABSTRACT

Using microdata from the European Consumer Survey (CES) for 11 European countries and 53 months, we investigate the formation and heterogeneity of inflation expectations as well as their theory consistency with the Phillips curve in the euro area, and across countries and demographic groups. We examine how individuals in the euro area form their inflation expectations. Our findings show that people place significant weight on their current perception of inflation. Past experiences with prices also play a role, though to a lesser extent. Importantly, the formation of expectations tends to be forward-looking rather than backward-looking. A similar pattern emerges when we analyze the consistency of these expectations and perceptions with the Phillips Curve theory. Individuals in the euro area generally do not hold theory-consistent expectations regarding inflation. We find notable variations across gender, age, income, education level, household size regarding the formation of inflation expectation.

***JEL**:* D84, E31
***Keywords**:* Expectations, Perceptions, Inflation, Phillips Curve, Consumer Survey

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1. Introduction

Expectations play a crucial role in economic decision-making since agents' views of future outcomes influence their current choices. Understanding how agents form their expectations is crucial for macroeconomic dynamics and policymaking. Macroeconomic expectations play a crucial role in influencing household behavior, saving and investment decisions, and firm economic choices (see e.g., Dräger and Nghiem, 2021; Crump et al., 2022; D'Acunto et al., 2023; Coibion et al., 2023; Armantier et al., 2015; Malmendier and Wellsjo, 2020; Coibion et al., 2020a,b). For example, in a typical AD-AS model an increase in inflation expectations shifts AS to the left, reducing output and raising inflation. In the same AD-AS context, a change in fiscal or monetary policy can lead to quite diverse policy outcomes depending on whether agents have adaptive or rational inflation expectations (see e.g., Gartner, 2016). Moreover, central banks also thoroughly examine whether the inflation expectations of market participants are compatible with the central banks' medium-term inflation targets. As pointed out by Bernanke (2007) the knowledge of monetary policy objectives and tactics by economic actors improves the efficiency of the monetary policy transmission channel. In the past, central banks tended to look primarily at inflation surveys of professional forecasters. However, workers, households in general and firms whose decisions are affected by inflation and in turn affect consumption, the labor market and investment do not possess as much specialized knowledge as professional forecasters. As a result, several central banks around the world have begun to conduct surveys of consumer and business expectations. These surveys are particularly useful when inflation is not at the low and stable level desired by monetary policy authorities.

Although surveys are commonly used to collect information on inflation expectations, there is limited study on how demographics influence inflation expectations (see e.g., Xu et al.,2018). Decision-theoretic models of perceptual choice suggest combining probable and current information to optimize decisions (Summerfiel and de Lange 2014). Moreover, the bulk of previous research has focused on professional forecaster expectations (Fendel et al.,2011; Rulke, 2012; Casey, 2020) or on U.S. households' inflation expectations (Kamdar, 2019; Candia et al, 2020; Weber, 2023).

Furthermore, according to recent literature (see e.g,, Fendel et al., 2011; Rülke, 2012; Casey, 2020; Clement, 2024) professional forecasters' inflation expectations are aligned with the Phillips curve. Whereas households' inflation expectations are not aligned with the economic theory (see e.g., Kamdar, 2019; Candia et al, 2020; Weber et al, 2023; Kipson and Staeh, 2024).

The purpose of this paper is to thoroughly examine inflation expectations in the euro area. To this end, we employ microdata from the ECB's Consumer Expectations survey (CES)[1], a high-frequency online panel survey that measures the expectations and behavior of consumers in the euro area, more specifically for six countries (Belgium, France, Germany, Italy, the Netherlands, and Spain) from April 2020 to October 2024, and another five Austria, Greece, Finland, Ireland and Portugal from April 2022 to October 2024.[2] The CES database has a lot of appealing features. First, we have statistical power to independently detect the impacts of interest because the survey is extensive. Second, we can track households over time because of the survey's panel format and frequent (monthly) administration.

In more detail, we examine the heterogeneity of inflation expectations and perceptions among demographic groups, as well as the heterogeneity of forecast and perception errors. Furthermore, we add to the existing literature by examining different models of expectation formation in order to determine which one best explains how individuals in the euro area form their expectations about future inflation. In doing so, we also examine the formation of inflation expectations by country and by demographic group. Moreover, building on Kirpson and Staehr (2024) we add to the existing literature by examining whether individuals' expectations of inflation and unemployment are in line with economic theory. Specifically, we examine various variations of the Phillips curve to determine whether the relationship between individuals' expectations and perceptions of inflation and unemployment is negative. By doing this we also examine the validity of the Phillips curve by country and by demographic group.

[1]https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/html/index.en.html

[2]At the pilot phase of the survey 2000 households have taken part monthly for Germany, Spain, France and Italy and 1000 for Belgium and Netherlands up until June 2021 where the number of households starts to increase reaching 3000 for Germany, Spain, France and Italy, with the total number of households taking part to be around 14000. From April 2022 up to March 2024 the CES includes Austria, Greece, Finland, Ireland and Portugal with 1000 monthly respondents making the total number of respondents to 19000.

When examining demographic differences in inflation expectations within the euro area, we observe notable variations across gender, age, income, education level, household size, and credit access expectations. Specifically, women, middle-aged individuals, those in larger households, and individuals who anticipate more difficult access to credit in the future tend to exhibit larger forecast errors regarding inflation. These groups also report higher inflation expectations for both the 1-year and 3-year horizons. Similar patterns are observed for inflation perception errors and perceptions. Additionally, older individuals, those with lower incomes, women, members of larger households, and those expecting tighter credit conditions are more likely to report higher inflation expectations.

After examining various models regarding the formation of short-term inflation expectation we find that the strongest influence comes from perceived inflation—that is, individuals' understanding of inflation based on their information and knowledge of current conditions. However, forward-looking conditions i.e., the long-term inflation expectations are also a relevant factor influencing short-term inflation expectations. Finally, we find no evidence that individuals' expectations and perceptions align with the Phillips Curve theory. Across countries and demographic groups, inflation expectations and perceptions are positively associated with unemployment expectations and perceptions—contrary to the negative relationship predicted by the Phillips Curve.

In section 2 we present the relevant literature. Section 3 discusses the key features of the CES database that are relevant for the present study. In section 4 we examine the heterogeneity of inflation expectations and perceptions among different demographic groups in the euro area. Section 5 examines the process of formation of inflation expectations, while section 6 examines whether individual expectations are aligned with the predictions of the Phillips curve. Section 7 concludes. A supplementary material appendix presents the estimations for each country, demographic group and various additional robustness checks.

2. Literature review

There is disagreement in the literature about the process by which inflation expectations are formed, although several alternative models have been proposed to ultimately explain how inflation expectations are formed.

In recent decades, full-information rational expectations (FIRE) have been the primary approach for modeling expectations. Full information rational expectations (FIRE) were the basic framework for examining the formation and modeling inflation expectations in the previous decades. However, the recent use of micro-survey data of individual expectations has revealed that FIRE deviates from actual expectations. Skepticism about survey-based expectations stems from criticisms of survey methodology (e.g., Machlup 1946) and findings that survey data are ineffective in predicting individual behavior (see e.g., National Bureau of Economic Research 1960; Juster, 1964). Some contend that only theories, not assumptions, can be experimentally validated. However, this viewpoint is becoming less prevalent. Zarnowitz (1984) and Lovell (1986) challenged the idea that assumptions should not be checked using micro data. According to Manski (2004), survey expectations can be used to evaluate theories of the expectation formation process given that there is insufficient evidence against the use of survey data.

However, it is widely acknowledged that there exist gender and age demographic biases. For example, females, non-white races, singles, less educated and low-income individuals report higher inflation expectations than male, white, married, high educated and high earners (see e.g., Bryan and Ventaku, 2001; de Bruin et al 2010; Madeira and Zafar, 2015). Females, low income and less educated individuals tend to demonstrate higher financial and numeracy illiteracy (see e.g., Palmqvist and Stroemberg, 2004; Armantier et al, 2015). The above-mentioned literature verifies that demographic characteristics have a direct effect on individuals' inflation expectations. Also, the forecast accuracy of inflation expectations is affected by demographic characteristics, more precisely it has been shown that specific demographic groups predict future inflation more systematically and significantly more accurately than others. In particular, young, low earners, females, and less educated individuals report higher expectation errors (Souleles 2004; Anderson 2008; Leung 2009; Pfajfar 2013; Madeira and Zafar 2015).In addition, financial literacy also affects the forecast error of inflation expectation (Lusardi and Mitchell 2011; de Bruin et al 2010).Binder and Rodriguez (2018) examine how economic agents' learning influence their inflation forecasts. After updating their understanding of Fed's objective and inflation performance, individuals alter their beliefs to align with the target and actual inflation rates. This demonstrates that enhancing the public's understanding of inflation and

central bank actions helps to improve long-term inflation expectations and reduces heterogeneity among respondents. Using a survey of Dutch households, Van der Cruijsen et al (2015) examined their knowledge of monetary policy and whether this knowledge affected their inflation expectations. They found that better knowledge about monetary policies is associated with lower inflation expectations. Rumler and Valderrama (2020) using data from an Austrian survey of 2000 households investigated whether differences in knowledge of the inflation process and central bank targets contribute to the observed heterogeneity in inflation expectations. According to their findings, households with good knowledge of the inflation process have lower and more accurate expectations in both the short run and the long run. At the same time, however, households that were more knowledgeable about inflation and central bank targets also expressed less certainty about their inflation expectations than those who were less literate about inflation. Furthermore, households with greater trust in the central bank's ability to maintain price stability tend to have lower inflation expectations. D'Acunto et al. (2023b) using IQ scores from Finish males during their military service showed that higher cognitive ability is linked with lower forecast error, while similar results were obtained for the euro area in D' Acunto et al (2024).

One strand of the literature attributes heterogeneity in inflation expectations to the use of different information sets. According to Mankiw and Reis's (2002) sticky information framework, individuals rarely update their information set, but when they do, they operate under FIRE. In the context of sticky information, Carroll (2003) suggested that information traveled to individuals from professional forecasters through news over time. Limitations in agents' ability to process information motivated an alternative approach known as nosy information or rational inattention. Information constraints refer to agents receiving noisy signals (observing the true values with some error) and ultimately deciding which information to pay attention to and which not to. In the sticky information context agents do not update their information set, which causes their forecasts to remain static and anchors the average forecast to the average forecast from the previous period. Due to signal noise, agents in noisy information update their forecasts slowly, anchoring their current expectations to past forecasts. The sticky information approach is adopted by Woodford (2002), while Sims (2003) and Macńkowiak and Wiederholt (2009) choose the rational inattention approach. Although

sticky information partially captures heterogeneity, it is unable to explain heterogeneity based on demographic characteristics (de Bruin et al., 2010).

Another strand of the literature explains the heterogeneity of expectations based on the theory of rational inattention. According to rational inattention models, heterogeneity of expectations is due to the fact that agents with certain demographic characteristics ignore certain information (Cavallo et al., 2014). However, studies of memory reveal that people are prone to include past experiences—especially the most dramatic ones—when making predictions about the future (Morewedge et al., 2005). Furthermore, according to Madeira and Zafar (2015), memories of price changes are nearly orthogonal to actual price changes. As a result, the memory of past inflation, which has been shown to be critical in the generation of inflation expectations, is ignored by both models with sticky information and rational inattention models (de Bruin et al., 2011; Malmendier and Nagel, 2015).According to Lanne et al. (2009) agents may base some of their expectations on forward-looking information (the inflation target, trend inflation, long-term expectation) as well as some backward-looking information (lagged inflation). In rational inattention models individuals integrate information only partially due to high costs and also learn from their personal perception (de Bruin et al., 2011; Malmendier and Nagel, 2015; Coibion and Gorodnichenko, 2015). Because some agents will not pay particular attention to the relevant variable, the current mean predictions in rational inattention models will be based on past mean predictions. These processes imply that mean projections will change gradually and that mean prediction errors will consequently be predictable.

Dräger et al. (2016) estimated how many consumers form expectations based on several economically relevant relationships such as the Fisher equation, the Taylor rule, and the Phillips curve trade-off. They demonstrated that having theory-consistent expectations enhances forecast accuracy, allowing agents to make more informed decisions. Furthermore, they showed that the proportion of agents who have theory-consistent expectations varies over time. For example, milestones in the Fed's central bank communication, such as the implementation of forward guidance on interest rates or the publication of the explicit inflation target, result in a greater proportion of consumer expectations being consistent with the Fisher equation.

Survey based professional inflation expectations and household expectations have been found to improve forecast of future inflation (see e.g., Ang et al. 2007).

Dovern and Weisser (2011) examining different forecasts for different variables in the G7 countries demonstrated that the degree of variation in forecast accuracy among forecasters varies greatly not only between countries but also between macroeconomic variables, in addition, professional forecasters tend to be more biased when forecasters need to gain knowledge about significant structural shocks or slow shifts in the trend of a variable. According to recent literature (see e.g., Fendel et al, 2011; Rülke, 2012; Casey, 2020; Clement, 2024) professional forecasters' inflation expectations are aligned with the Phillips curve. Coibion and Gorodnickeko (2012, 2015) showed that professional forecasters under-react when their expectations are revised in response to economic news. However, households' inflation expectations are not aligned with the economic theory (see e.g., Kamdar, 2019; Candia et al, 2020; Weber et al, 2023; Kipson and Staeh, 2024). Research focusing on individual inflation expectations uses mostly US data and their findings are not aligned with macroeconomic theories such as the Phillips curve. Kamdar (2019) and Candia et al. (2020) find a link between projected slack and higher inflation in advanced economies using individual survey data. Weber et al. (2023) find a strong correlation between inflation and unemployment expectations, both before and after the Covid-19 pandemic. Kirpson and Staehr (2024) using the ECB's CES examined whether individuals' expectations are consistent with the Phillips curve. Using a simple Phillips curve expectation model by regressing inflation expectation on unemployment expectation they show that individual expectations are not consistent with the Phillips curve in euro area countries. On the other hand, Sims (2010) argues that although professional forecasters and financial market participants are likely to pay close attention to even the slightest adjustment in the policy statement, the consequences for individuals of changing expectations can vary widely.

Professional forecasters' expectations have been the main source of survey-based data used by central banks; however, respondents may withhold their genuine opinions from these surveys for several reasons. This possibility has been theoretically and experimentally investigated in a few studies. For example, in the context of predictions, Ottaviani and Sørensen (2006) propose and examine a cheap debate game. The main conclusion is that telling the truth can be an unlikely equilibrium. According to a model proposed by Laster et al (1999), forecasters are fully aware of the actual probability distribution of outcomes, and the forecaster who makes the best prediction within a

specific time frame receives recognition from his company and a payment. The distribution of the forecasts will reflect both the actual probability distribution function and this trade-off as forecasters in this model are prepared to sacrifice accuracy in order to obtain attention.

However, households have less motivation to report false expectations in order to obtain financial gain (see Arnold et al.2014; Armantier et al.2015). Firms' inflation expectations are considerably more in line with those of households rather than with professional forecasters (see Coibion et al, 2015). An explanation for why business managers' forecasts are so similar to household forecasts is provided by Kumar et al. (2015), who note that the majority of business managers rely mainly on their own purchasing experiences to inform them about price changes and use their inflation expectations mainly for their personal decisions.

Household inflation expectations could influence how businesses set their prices. Rotemberg (2005,2010, 2011) and Eyster et al, (2015) based on the behavior of households, who are willing to "punish" firms that change their prices to changes in demand but at the same time consider price increases due to cost increases to be fair, showed that household expectations are used in setting prices as firms do not want to upset consumers when setting prices. Although the above shows that household expectations are a good proxy for business expectations, there are still significant differences between the two. The expectations of company managers are less sensitive to the language of the survey compared to the expectations of households, as the latter expect higher inflation and are more dispersed when asked about the "overall price change" and less so when asked about inflation rates (see e.g., de Bruin et al. 2010; Dräger and Fritsche 2013; Coibion et al. 2015).

Households' long-term expenditure allocation should be influenced by how quickly they anticipate future price increases. For example, families should buy more things in the present, while prices are still relatively cheap, because they expect much higher prices in the future ("intertemporal substitution"). Additionally, high inflation rates gradually reduce the value of sticky nominal pricing and wages, which are factors that businesses and workers use when setting prices and negotiating compensation increases, because nominal prices and profits fluctuate only rarely.Expectations about how much it will cost to repay loans in the future are also influenced by subjective expectations about inflation. These expectations are important for businesses making

investment decisions, which usually require external financing, as well as for households deciding how to pay for expensive purchases such as homes, vehicles, and other durable goods.

Even though subjective inflation expectations play an important role in theoretical models and policymakers' judgments, economists still do not fully understand how these expectations are formed or why they vary so much among agents who share comparable demographic characteristics. Indeed, there is ongoing debate in the literature about how to effectively elicit subjective inflation expectations (and macroeconomic expectations more generally) from a population of agents who often lack high expertise in economics, finance, or mathematics. However, some truths persist across time and place. For example, people's and businesses' inflation expectations are often higher than actual inflation, and the difference between them is orders of magnitude larger than that between experts' forecasts. A recently emerging body of scholarly work at the intersection of economics, psychology, marketing, and related disciplines has focused on understanding the causes and effects of these distortions in the views of ordinary individuals in relation to the inflation that occurs subsequently.

3. Data and descriptive analysis

We utilize the ECB's Consumer Expectations Survey[3] (CES) which covers six European countries, i.e., Belgium, Germany, Spain, Italy, Netherlands and France from April 2020 to October 2024, and another five Austria, Greece, Finland, Ireland and Portugal from April 2022 to October 2024.[4]The CES sample is a panel in which the same consumers answer to the poll many times. Regardless of sampling technique, most panel members complete their first monthly module during the same round as the background survey. Only a few panel members are inactive for one or more rounds before their initial full participation. To reduce the influence of conditioning and sample selection on the quality of CES data over time, the survey is set up as a rotating panel, with new members replacing those who leave. Panel rotation has been applied

[3]https://www.ecb.europa.eu/stats/ecb_surveys/consumer_exp_survey/html/index.en.html

[4]At the pilot phase of the survey 2000 households have taken part monthly for Germany, Spain, France and Italy and 1000 for Belgium and Netherlands up until June 2021 where the number of households starts to increase reaching 3000 for Germany, Spain, France and Italy, with the total number of households taking part to be around 14000. From April 2022 up to March 2024 the CES includes Austria, Greece, Finland, Ireland and Portugal with 1000 monthly respondents making the total number of respondents to 19000.

gradually. The maximum duration of participation in the CES is 24 completed survey rounds. The CES's panel retention is effective, since most members consistently complete their monthly survey duties. Except for the early sample construction phases, the percentage of new participants in each wave was around 10%. Georgarakos and Kenny (2022) provide a thorough explanation of the survey, whereas ECB (2021) provides a first assessment of the survey.

In this survey households provide their subjective inflation expectations for the next 12 months and the next 3 years, giving an open-ended percentage terms answer:

"*How much higher (lower) do you think prices in general will be 12 months from now in the country you currently live in?*"

"*By about what percentage do you expect prices in general in the country you currently live in to increase (decrease) over the 12-month period <between survey month year+2 and survey month year+3>?"*

From the answer that households provide to this question we have at our disposal the short- and long-term inflation expectations of households. Alongside inflation expectations households respond about their inflation perception of the past twelve months:

"*How much higher (lower) do you think prices in general are now compared with 12 months ago in the country you currently live in*?"

Respondents provide their short-term expectations and perceptions of unemployment:

"*What do you think is the current unemployment rate in the country you currently live in?"*

"*What do you think will be the unemployment rate 12 months from now in the country you currently live in?"*

There are more questions regarding their short-term expectations such as expectation for total net household income, expectation for mortgage interest rate and house prices. Observing Table 1 and 2 is clear that in the data there is a large number of outliers from the difference of median and mean, to counter the effect of outlier to the estimations all the percentages of expectations and perceptions are winsorized at the 2% level - 1% for each tail to avoid the impact of extreme observations and outliers and at 10% level – 5% for each tail for robustness checks. We also use the socio-demographic characteristics such as gender, education, income, number of household's members and expectation to credit.

We also utilize historical data for HICP and its subcomponents from the European Central Bank (ECB) – we use their annualized monthly growth rate (m-o-m). Moreover, we obtain the monthly unemployment rate from the ECB.

Table 1 presents the descriptive statistics for inflation expectations and inflation perceptions. Table 2 presents the descriptive statistics for unemployment expectations and unemployment perceptions[5].The average individual inflation expectation in the euro area is 5.092% and the average perceived inflation of individuals is 5.5%, while the medians are 3.5% and 5.5% respectively[6]. The sizeable difference between mean and median alongside the high standard deviations indicates the presence of outliers, especially at the high end. This is the reason why in the empirical analysis we winsorized the data to 2% and at 10%. Individuals perceive inflation to be higher at the present time and expect it to decrease in the future, as they report a higher perception of inflation than expected inflation. Men report on average lower expected and perceived inflation than women (by about 1.662% and 2.266%, respectively) and they have a lower standard deviation in these two indicators. Individuals that are between 35 to 49 years old are the more "pessimistic" followed by those that are between 50 to 70 years old as they report on average, both higher expected and perceived inflation. Elders have the lower perceived inflation and young have the lower expected inflation. Elders have the smallest standard deviation of expected and perceived inflation. Individuals with tertiary or higher education have smaller expected and perceived inflation.

[5]Summary statistics at the country level are presented in the supplementary material appendix.
[6]Notable is the high average inflation expectation in Greece which is around 15.27% and the average inflation perception which is around 25.87%. Moreover, Greece has the biggest standard deviations compared to other euro area countries for both inflation perceptions and expectations (21.14% and 18.36%, respectively). See supplementary material appendix.

Moreover, the expectations and perceptions of well-educated are tightly clustered round mean. Both expected and perceived inflation are on average negatively associated with income level. Moreover, the higher the income level the lower is in the standard deviation of expected and perceived inflation.

Similar results for how individuals expect and perceive unemployment in the euro area are reported in Table 2.[7] Specifically, we see that means are higher than medians; expected unemployment is lower for men, high incomes, and high educated and middle aged. The lowest perceived unemployment is recorded in the case of men, elderly, low educated and high earners.[8]

A striking difference between inflation and unemployment is that they expect unemployment to rise in the future relative to the currently perceived levels. The combination of these results provides an indication that expectations and perceptions of inflation and unemployment are compatible with the Phillips curve. That is, individuals perceive current inflation as high and expect it to decrease in the future, which will inevitably lead to a future increase in unemployment relative to its current estimated levels.[9]

Table 1
Summary statistics of inflation expectations and perceptions

	Inflation expectations				Inflation perceptions			
	Mean	Median	S.D.	Obs.	Mean	Median	S.D.	Obs.
All	5.092	3.5	10.41	887374	9.2	5.5	12.866	882227
Gender								
Male	5.08	3	8.878	438560	8.054	5	8.054	436072
Female	6.742	4	11.657	448814	10.32	6	13.957	446155
Age								
18 - 34	5.191	2.5	11.074	191091	8.275	5	13.478	189915
35 – 49	6.347	3.5	11.114	398263	9.899	6	13.496	339097
50 - 75	5.929	4	9.078	248650	9.111	6	11.13	247262
75+	5.26	3.6	7.599	49370	7.673	5.7	8.828	40125
Education								
Lower secondary	6.106	3	11.793	106971	8.495	5	13.413	106246
Higher secondary	6.529	4	11.446	291056	10.13	6.1	13.609	289468

[7]Compared to average unemployment expectations and perception of Euro area, Greece has again significant difference as the average unemployment expectation is around 22.8% and perception around 21.9% followed by Italy with average expectation 18.5% and perception 17.7%. See supplementary material appendix.
[8]Similar results hold across euro area countries.
[9]Additional information is presented in the supplementary material appendix. In more detail, the first chapter includes summary statistics for all demographic groups in 11 countries. Tables 1.1 and 1.2 present the summary statistics for inflation expectations and perceptions, and for unemployment expectations and perceptions, respectively, for each country. Tables 1.3 and 1.4 present the summary statistics by gender for inflation and unemployment, respectively. Tables 1.5 and 1.6 provide the summary statistics by age; Tables 1.7 and 1.8, by education; Tables 1.9 and 1.10, by income; and Tables 1.11 and 1.12, by credit access expectation group.

Tertiary or higher	5.519	3.2	9.445	489347	8.702	5.1	11.86	486513
Income quintiles								
Lowest	7.367	4	13.385	179404	10.879	6	15.429	178360
Second lowest	6.368	3.8	11.152	176419	9.653	5.7	13.41	175413
Mid	5.738	3.4	9.84	175780	9.027	5.2	12.344	174756
High	5.329	3.1	8.744	175911	8.556	5.2	11.288	174847
Highest	4.796	3	7.789	179860	7.87	5	9.946	178851

Source: CES survey ECB November 2024

Table 2

Summary statistics of unemployment expectations and perceptions

	Unemployment expectations				Unemployment perceptions			
	Mean	Median	S.D.	Obs.	Mean	Median	S.D.	Obs.
All	13.279	9.2	12.538	887400	12.741	9	11.98	887400
Gender								
Male	11.762	8.5	10.18	438574	11.082	8	9.684	438574
Female	15.001	10	14.267	448826	14.262	10	13.668	448826
Age								
18 - 34	14.151	9.8	14.091	191098	13.573	9	13.478	191098
35 – 49	13.885	10	12.856	398275	13.228	9.5	12.206	339275
50 - 75	12.225	8.8	11.097	248657	11.832	8	10.679	248657
75+	10.324	8	9.126	49370	10.174	7.5	8.812	49370
Education								
Lower secondary	15.201	10	15.071	106976	14.808	10	14.621	106976
Higher secondary	14.245	9.4	13.971	291068	13.565	9	13.357	291068
Tertiary or higher	12.285	9	10.815	489356	11.997	8.7	11.779	489356
Income quintiles								
Lowest	16.372	10	16.372	179404	15.669	10	15.794	179410
Second lowest	13.871	10	13.107	176426	13.293	9	12.481	176426
Mid	12.977	9.2	11.773	175789	12.442	9	11.21	175789
High	11.987	9	10.216	175913	11.549	8.5	9.775	175913
Highest	11.152	8.5	9.13	179862	10.737	8	8.712	179862

Source: CES survey ECB November 2024

4. Heterogeneity of inflation expectations

Building on Malmeider and Zafar (2015) we examine the heterogeneity of inflation expectation and perception among different demographic groups. To this end, we regress the winsorized at 2% (1% in each tail) inflation expectation for time t+12 formed in month t on a set of demographic data (age, income sex, household members and education level). Moreover, we control for the actual inflation in the month the survey was conducted (at time t) to show the effect that current inflation has on individuals when they form inflation expectations. In addition, we control for households' expectation in obtaining credit access. More specifically, if they anticipate having easier access to credit in the future, they anticipate that inflation will probably be under control so that monetary authorities will not have to raise interest rates. As a

consequence, inflation expectations will be lower. Hence, in the specification to be estimated we add as an explanatory variable the 1-year-ahead credit access expectations. To examine the heterogeneity of longer-term inflation expectations, we use a similar framework but as a dependent variable we now use the inflation expectations that individuals form in month t for the next 36 months (t+36), i.e., for the next three years.

In more detail, we estimate the following specifications (1) for short-term (t+12) and (2) for long-term (t+36) inflation expectations:

$$\pi^{E}_{it,t+12} = a + \beta_1 \chi + \beta_2 \pi_t + \varepsilon_{\iota t} \quad (1)$$

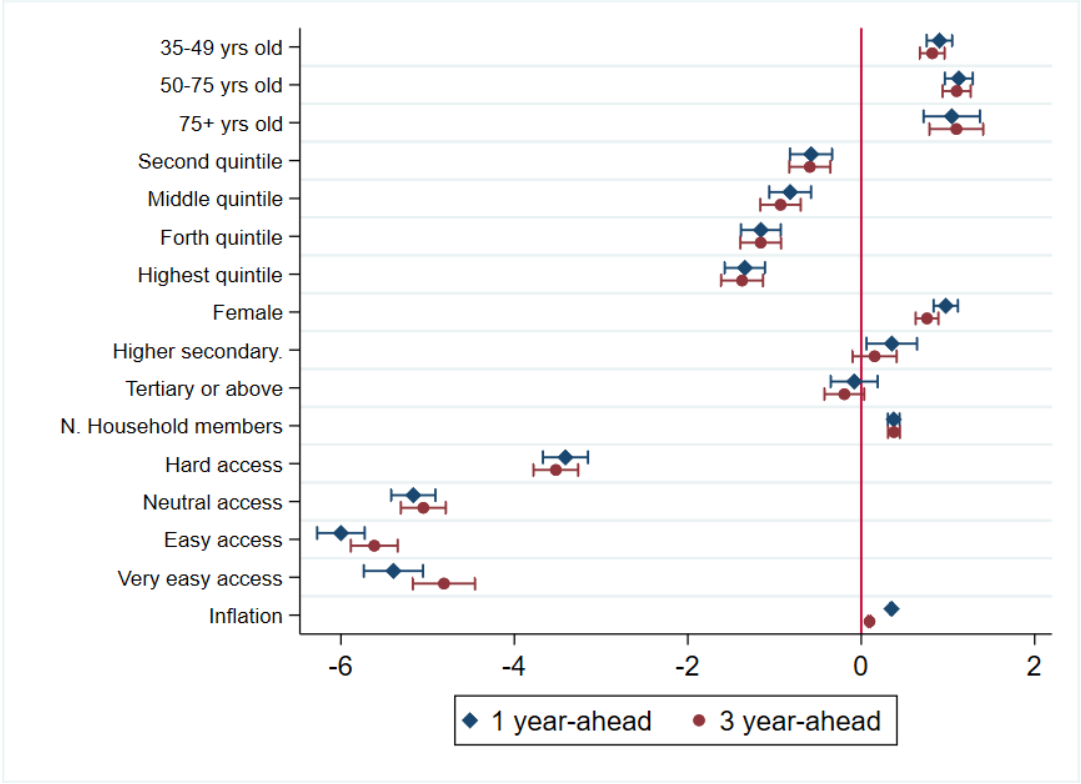
$$\pi^{E}_{it,t+36} = a + \beta_1 \chi + \beta_2 \pi_t + \varepsilon_{\iota t} \quad (2)$$

Where χ is the set of demographics (age, education,gender, income, number of household member and credit access expectation goup), π_t is the inflation rate at month t, $\pi^{E}_{it,t+12}$ and $\pi^{E}_{it,t+36}$ is the reported inflation expectation at month t for 1 and 3 year-ahead, respectively.

Observing the results in Table 3 column 1 and 2, as well as the coefficient plot comparing the results of short and long-term inflation expectations in Figure 1 we find that current inflation has a positive effect on inflation expectations. Female individuals on average tend to have higher inflation expectation than male individuals. Furthermore, keeping the poorest quintile as the reference group, it is clear that the higher the income quintile to which an individual belongs, the lower their expectation of inflation. These results are in line with earlier studies such as with Bryan and Ventaku (2001), de Bruin et al (2010) and Madeira and Zafar (2015). The age group of people aged 50 to 75 years reports on average higher inflation expectations, this is likely due to this group having more memories of price increases compared to the two younger age groups. The memory of higher prices in the past is likely to have led to high inflation expectations in the older age group as well. Individuals belonging to households with more members report higher inflation expectations on average, while the easier access to credit is expected to be in the coming year, the more "optimistic" individuals tend to be in their inflation forecasts. Similar conclusions are obtained in the case of the 3 year-ahead inflation expectations (see Figure 1, Table 3).

One important finding is that the effect of current inflation is much weaker on the 3 year-ahead expectation than on the 1 year-ahead inflation expectation. Nevertheless, the effect of current inflation on the long-term expectation is positive and statistically significant. This implies that households have unanchored inflation expectations and could be indicative of the possibility of low levels of trust in monetary authorities. The distrust of individuals towards central banks to contain inflation after an inflationary shock, the lack of financial literacy and individuals' limited understanding of inflation and monetary mechanisms (Van der Cruijsen et al., 2015; Binder and Rodrigue, 2018; Hayo and Neuenkirch, 2018) are the main drivers for unanchored expectations. These findings are consistent with earlier studies such as Rumler and Valderrama (2020), Brouwer and de Haan (2022b) and Christelis et al. (2020).[10]

Figure 1: Heterogeneity in 1 year-ahead and 3 year-ahead inflation expectations coefficient plot



Source: Notes: Authors calculations Source: CES survey ECB November 2024

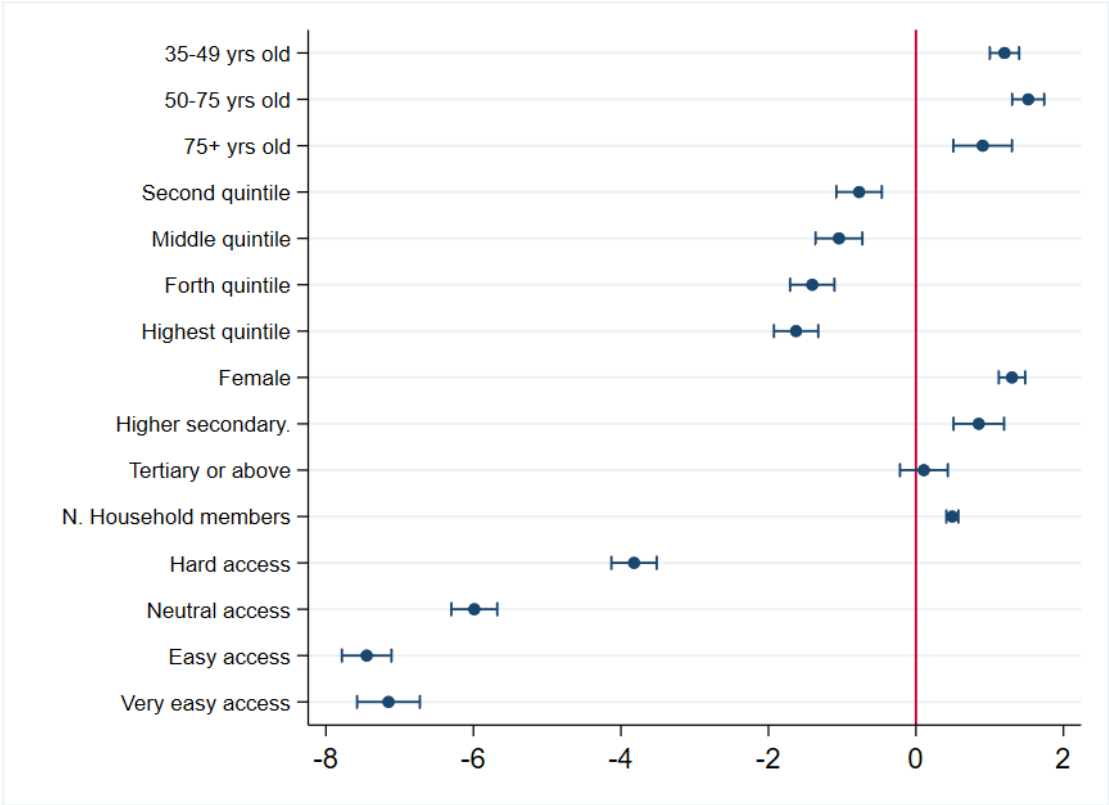
[10]Tables 2.1.1 and 2.1.2 in the supplementary appendix present country specific estimations on the heterogeneity of 1-year ahead inflation expectations, while Tables 2.2.1 and 2.2.2 present country specific estimations for the 3 year ahead inflation expectations.

In the third column of Table 3 we present the corresponding findings for the effect of demographic characteristics on the perception of inflation formed in month t compared to month t-12. Specifically, we estimate the following relationship:

$$\pi^{P}_{it,t-12} = a + \beta_1 \chi + \beta_2 \pi_t + \varepsilon_{it} \quad (3)$$

Where χ is the set of demographics, π_t is the inflation rate at month t, $\pi^{P}_{it,t-12}$. is the perceived inflation reported in month t by comparing the overall prices in month t with the prices in month t-12.

Figure 2: Heterogeneity in inflation perceptions coefficient plot



Notes: Authors calculations

Source: CES survey ECB November 2024

As before, we control for households' expectation in obtaining credit access. Figure 2 presents the heterogeneity between inflation perceptions for each demographic characteristic. The results obtained are qualitatively similar to those reported in Figure 1 and in columns 1 and 2 of Table 3. In more detail, perceived inflation is higher for females relative to males, individuals belonging to the 50 -75 age group report higher perceived inflation compared to other groups, and the poorest income quintile (reference group) report higher perceived inflation relative to the high- and highest-income quintiles that report on average the lowest perceived inflation. Finally, people

belonging to households with more members perceive current inflation to be higher compared to people living in households with fewer members. The more optimistic an individual is about future access to credit, the lower they perceive current inflation compared to individuals who anticipate difficult access to credit. The individual who expects very difficult access to credit in the future perceives current inflation higher compared to other groups.[11]

Columns 4 and 5 present the heterogeneity of absolute forecast and perception errors. More specifically, we regress the absolute difference of actual inflation minus the expectation that individuals reported for month t at month t-12 and the absolute difference of actual inflation minus the perceived inflation of individual at month t compared to the prices of month t-12 to a set of demographics and on households' expectation in obtaining credit access:

$$|\pi_t - \pi^E_{it-12,t}| = a + \beta_1\chi + \varepsilon_{it} \quad (4)$$

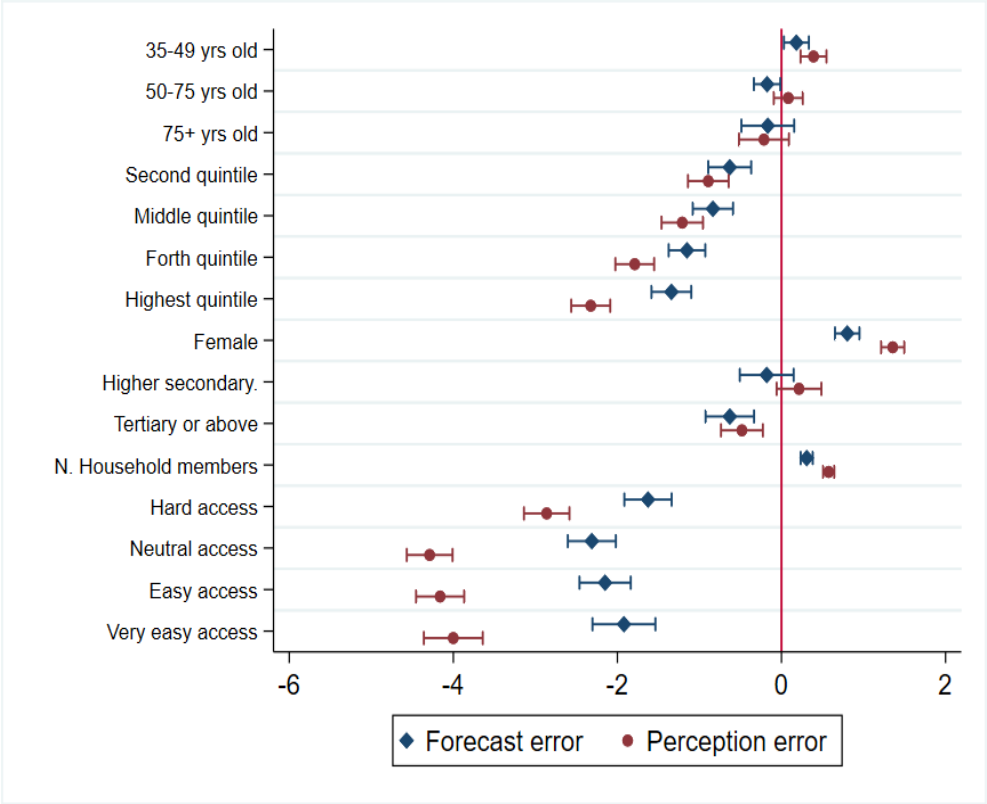
$$|\pi_t - \pi^P_{it,t-12}| = a + \beta_1\chi + \varepsilon_{it} \quad (5)$$

Equation (4) corresponds to column (4) and equation (5) corresponds to column (5) of Table 3, χ is the set of demographics, π_t is the inflation rate at month t, $\pi^E_{it-12,t}$is the reported inflation expectation at month t for 1 year-ahead and $\pi^P_{it,t-12}$is the perceived inflation reported in month t by comparing the overall prices in month t with the prices in month t-12. Figure 3 shows the heterogeneity of absolute forecast and perceived inflation errors. Females[12] and the lowest- and low-income quintiles have the higher absolute forecast and inflation errors. The same applies for the less educated and younger individuals. Households with fewer members and individuals that expect easier access to credit made smaller forecast errors compared to their counterparts. These results are consistent with evidence reported in previous studies such as Souleles (2004), Anderson (2008), Leung (2009), Pfajfar (2013) and Madeira and Zafar (2015). Similar results are obtained in the case of the absolute perception error. Interestingly, the difference between females and males is much bigger when considering the absolute perception

[11]Tables 2.3.1 and 2.3.2 in the supplementary material appendix present the results of heterogeneity in inflation perception for each country.
[12]There is no significant difference between males and females in Greece and Portugal, while in Germany males have higher absolute forecast error of inflation. See supplementary material appendix.

error relative to the forecast error. This implies that women experience current inflation more intensely than men, and as a result report higher inflation expectations due to their experiences (see e.g., Bryan and Ventaku, 2001; de Bruin et al, 2010; Madeira and Zafar, 2015).[13]

Figure 3: Heterogeneity on forecast and perception of 1 year-ahead inflation coefficient plot



Notes: Authors calculations

Source: CES survey ECB November 2024

The last column of Table 3 presents the role of demographics, present inflation and credit access expectations in affecting the probability of high inflation (>4%).

More specifically, in the survey, individuals are tasked with distributing 100 points between 8 and 12 beans, with each bean having a range of inflation rates (e.g. 0% - 2%), depending on the certainty that future inflation will be in that range. Excluding individuals who allocated a different sum than 100, we created a variable that indicates the probability that each individual believes that 1 year ahead inflation

[13]Tables 2.4.1 and 2.4.2 (Tables 2.5.1 and 2.5.2) in the supplementary material presented the results for the heterogeneity in forecast (perception) error of 1 year ahead inflation for each country.

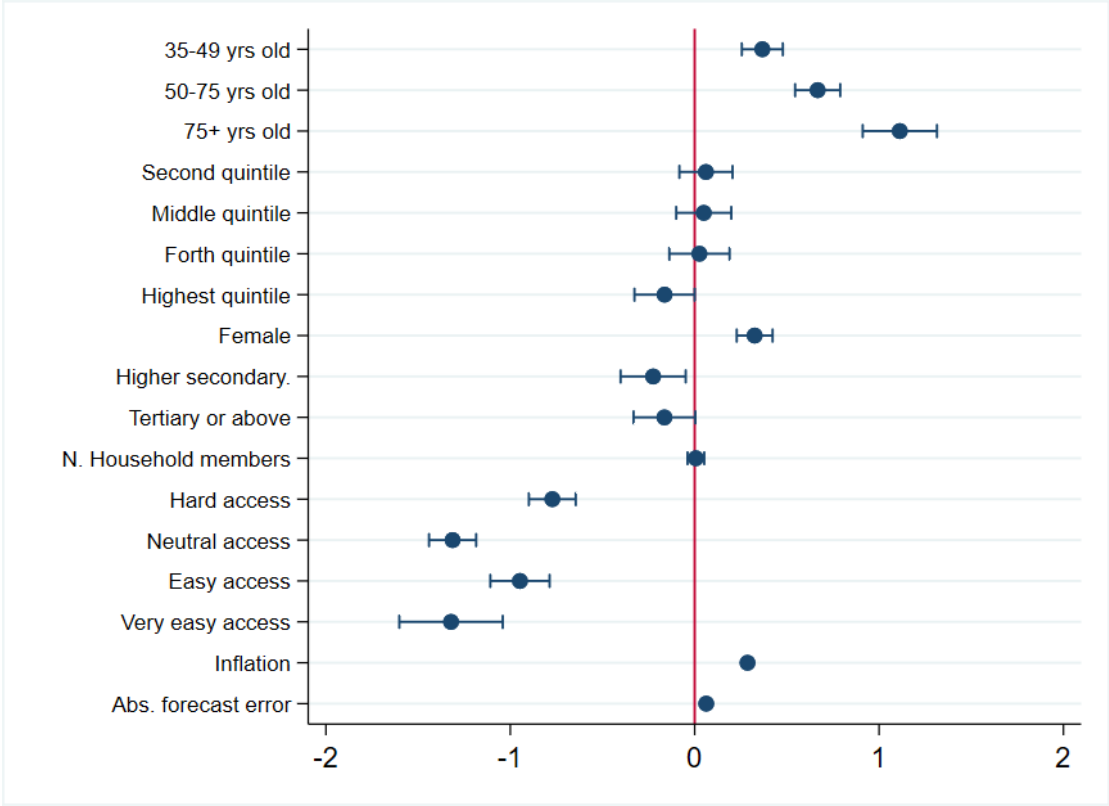
will be higher than 4% by making the sum of the bins 4% - 8%, higher than 8% (until June 2021), 8% - 12% and higher than 12% (July 2021 and beyond).Next we regress the probability of high inflation (above 4%) $Pr^{E}_{it,t+12}$to the following variables (see eq. 6): a set of demographics(χ) and the current inflationπ_t, to examine how individuals are affect from high current inflation. Moreover, we include as regressor the absolute forecast error $\left|\pi_t - \pi^{E}_{it-12,t}\right|$that individuals made when forecasting the present level of inflation in order to investigate if individuals with higher forecast errors are more likely to give higher probability for higher inflation compared to individuals with greater forecasting ability. The results are also presented in Figure 4.

$$Pr^{E}_{it,t+12} = a + \beta_1\chi + \beta_2\pi_t + \beta_3\left|\pi_t - \pi^{E}_{it-12,t}\right| + \varepsilon_{it} \quad (6)$$

People belonging to older age groups report on average a higher probability of future inflation being above 4%. Income does not affect the probability for high inflation expect for the richest quintile, which is impacted negatively. Females have greater certainty for higher future inflation compared to males. When inflation is high, individuals on average are more likely to have greater certainty for higher future inflation; this implies poor trust to monetary authorities. This finding is combined with the fact that individuals with higher forecast error have greater certainty about future inflation, as individuals with poor inflation knowledge are more likely to have less trust in monetary authorities[14].

[14]The results for each country regarding certainty for high future inflation are presented in Tables 2.6.1 and 2.6.2 in supplementary material appendix.

Figure 4: Heterogeneity in certainty for high future inflation coefficient plot



Notes: Authors calculations

Source: CES survey ECB November 2024

Table 3

Heterogeneity in inflation expectations and perceptions by demographics

	1 year ahead inflation expectation (1)	3 year ahead inflation expectation (2)	Inflation perception (3)	[a]Abs. forecast error (4)	[b]Abs. perception error (5)	Prob. of high inflation (<4%) (6)
35 – 49 years old	0.901***	0.819***	1.247***	0.181**	0.39***	0.367***
	(0.075)	(0.072)	(0.099)	(0.077)	(0.08)	(0.056)
50 – 75 years old	1.124***	1.099***	1.553***	-0.175**	0.082***	0.667***
	(0.082)	(0.082)	(0.108)	(0.082)	(0.09)	(0.062)
75+ years old	1.044***	1.097***	0.912***	-0.167	-0.213***	1.112***
	(0.165)	(0.158)	(0.199)	(0.164)	(0.155)	(0.102)
Low income quintile	-0.578***	-0.593***	-0.855***	-0.631***	-0.891***	0.061
	(0.124)	(0.12)	(0.154)	(0.133)	(0.126)	(0.073)
Middle income quintile	-0.82***	-0.931***	-1.094***	-0.835***	-1.209***	0.049
	(0.123)	(0.118)	(0.159)	(0.125)	(0.128)	(0.076)
High income quintile	-1.157***	-1.159***	-1.476***	-1.152***	-1.788***	0.025
	(0.117)	(0.119)	(0.15)	(0.113)	(0.12)	(0.083)
Highest income quintile	-1.342***	-1.374***	-1.749***	-1.341***	-2.325***	-0.163**
	(0.118)	(0.123)	(0.153)	(0.123)	(0.121)	(0.083)
Female	0.974***	0.78***	1.32***	0.307***	1.356***	0.325***
	(0.071)	(0.066)	(0.089)	(0.037)	(0.071)	(0.049)
Lower secondaryeducation	0.351**	0.154	0.699***	-0.18	0.213	-0.225**
	(0.148)	(0.129)	(0.173)	(0.167)	(0.139)	(0.09)
Tertiary or higher	-0.08	-0.194*	0.096	-0.629***	-0.482***	-0.164*
	(0.137)	(0.116)	(0.163)	(0.15)	(0.13)	(0.13)
Household members	0.373***	0.377***	0.524***	0.307***	0.575	0.006
	(0.034)	(0.034)	(0.04)	(0.037)	(0.034)	(0.023)
Hard credit access exp.	-3.441***	-3.552***	-3.622***	-1.627***	-2.861***	-0.772***
	(0.132)	(0.131)	(0.153)	(0.146)	(0.141)	(0.064)
Neutral credit access exp.	-5.165***	-5.049***	-5.714***	-2.311***	-4.288***	-1.313***
	(0.129)	(0.133)	(0.155)	(0.149)	(0.142)	(0.065)
Easy credit access exp.	-6***	-5.616***	-6.88***	-2.419***	-4.16***	-0.947***
	(0.139)	(0.137)	(0.169)	(0.159)	(0.149)	(0.081)
Very easy credit access exp.	-5.395***	-4.812***	-6.496***	-1.92***	-4***	-1.321***
	(0.174)	(0.182)	(0.211)	(0.195)	(0.183)	(0.143)
π_t	0.349***	0.095***	0.654***	-	-	0.286***
	(0.007)	(0.006)	(0.008)			(0.005)
Abs. forecast error	-	-	-	-	-	0.62***
						(0.002)
Constant	6.679***	6.894***	7.661***	7.815***	8.397***	4.27***
	(0.188)	(0.199)	(0.25)	(0.218)	(0.205)	(0.127)
Observations	881609	876463	876462	332320	876462	322320
R^2	0.085	0.058	0.059	0.032	0.054	0.095

NOTES: OLS estimates reported of a regression onto various demographics. Clustered standard errors in parentheses. ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively.

[a]Defined as |actual inflation in month t– expected inflation in month t at t-12|

[b]Defined as |actual inflation in month t–perceived inflation in month t|

5. Formation of inflation expectations

In this section we examine the process of formation of inflation expectations. Several models have been proposed to explain how agents form inflation expectations. The most widely recognized and influential among them is the rational expectations model, introduced by Muth (1961). However, a large body of the literature rejects the rational expectation hypothesis (see e.g., Forsells and Kenny, 2004; Mankiw et al., 2003).

Naive or static expectation formation (SE) models assume the naivety of individuals, that is, individuals assume that inflation in the future will be equal to the last actual inflation and will continue without changes and fluctuations, implying that inflation expectations are consistent across agents, with each having access to identical sets of information. The inflation expectation for the individual with a static formation process is given by the following equation:

$$\pi^{E}_{it,t+12} = \beta_1 \pi_{t-1} + a_i + \varepsilon_{it} \quad (7)$$

Where $\pi_{t-1}$is the actual inflation rate that was in effect at the time the survey was conducted in period t-1and $a_i$stands for the individual fixed effects.

Individuals do not really perceive the actual inflation rate, hence, the idiosyncratic static expectation model replaces the latest actual inflation rate with the one that individuals perceive. In the case of *idiosyncratic static expectations*, expected inflation is influenced by previous perceived inflation$\pi^{P}_{it-1,t-13}$. The inflation expectation under idiosyncratic static formation process is given by following equation:

$$\pi^{E}_{it,t+12} = \beta_1 \pi^{P}_{it-1,t-13} + a_i + \varepsilon_{it} \quad (8)$$

In *adaptive expectations models*, individuals take into account previous price memories as well as forecast errors made in the past. Individuals that follow the adaptive formation process for inflation expectation could be described by the following equation:

$$\pi^{E}_{it,t+12} = \beta_1 \pi_{t-1} + \beta_2 (\pi_{t-1} - \pi^{E}_{it-1,t-13}) + a_i + \varepsilon_{it} \quad (9)$$

Where π_{t-1} is inflation rate in month t-1 and $(\pi_{t-1} - \pi^{E}_{it-1,t-13})$ is the forecast error that individual made in month t-1 when expectations were formed in month t-13.

However, past inflation expectations and people's perceptions of current inflation can influence expectations of future inflation. That is, individuals may form future inflation expectations based either on past expectations (backward-looking) or on their unique experiences and memories. The *idiosyncratic adaptive expectation (IAE) model* proposed by Xu et al (2018) takes into account inattention and personal experiences in the formation of inflation expectations. In more detail the model is as follows:

$$\pi^{E}_{it,t+12} = \beta_1 \pi^{E}_{t-1,t+11} + \beta_2 \pi^{P}_{it,t-12} + \beta_3(\pi_t - \pi^{P}_{it,t-12}) + a_i + \varepsilon_{it} \quad (10)$$

Where $\pi^{E}_{t-1}$is inflation expectation individual formed at t-1 for t+11, $\pi^{P}_{it,t-12}$is the perceived inflation at time t, $(\pi_t - \pi^{P}_{it,t-12})$ is the perceived inflation error that individuals commit due to inconsistent knowledge and information about inflation.

To assess whether inflation expectations are forward- or backward-looking, we incorporate long-term inflation expectations ($\pi^{E}_{t,t+36}$) into our analysis. Additionally, we examine how the inability to accurately forecast future inflation influences the formation of expectations, including the associated expectation errors $(\pi_{t-1} - \pi^{E}_{it-1,t-13})$ in equation (11).

$$\pi^{E}_{it,t+12} = \beta_1 \pi^{E}_{t-1,t+11} + \beta_2 \pi^{P}_{it,t-12} + \beta_3(\pi_t - \pi^{P}_{it,t-12}) + \beta_4(\pi_{t-1} - \pi^{E}_{it-1,t-13}) + \beta_5 \pi^{E}_{t,t+36} + a_i + \varepsilon_{it} \quad (11)$$

The estimates for models (7)–(11) are presented in Table 5. Among the five models, the *augmented idiosyncratic adaptive expectations (AIAE) model* in column 5 (which corresponds to equation 11) best explains the formation of individuals' inflation expectations in the Euro Area, as indicated by its significantly higher R^2 compared to the other models.

Column 3 of Table 5 shows that, under the adaptive expectations framework, individuals place more weight on previous experiences and memories of prices and inflation than on forecast errors. In contrast, the results in column 5 of Table 5 and in

Figure 5 suggest that in the AIAE model, the strongest influence on inflation expectations comes from perceived inflation—that is, individuals' understanding of inflation based on their information and knowledge of current conditions. This factor outweighs the influence of both past inflation expectations and inflation perception errors. However, as shown in column 5 of Table 3 long-term inflation expectations is a relevant factor influencing short-term inflation expectations

When analyzing each euro area country individually, perceived inflation emerges as the most critical variable shaping short-term inflation expectations as for the euro area (see Figure 5). This influence is particularly strong in France, followed by Italy, Belgium, and the Netherlands. In Greece and Portugal, however, the dominant factor is not just perceived inflation but rather individuals' inability to accurately understand the current level of inflation. In these two countries, this lack of understanding has a greater impact on inflation expectations than forecast errors—unlike in Germany and Spain. Across all countries examined, individuals tend to follow a forward-looking process in forming inflation expectations.

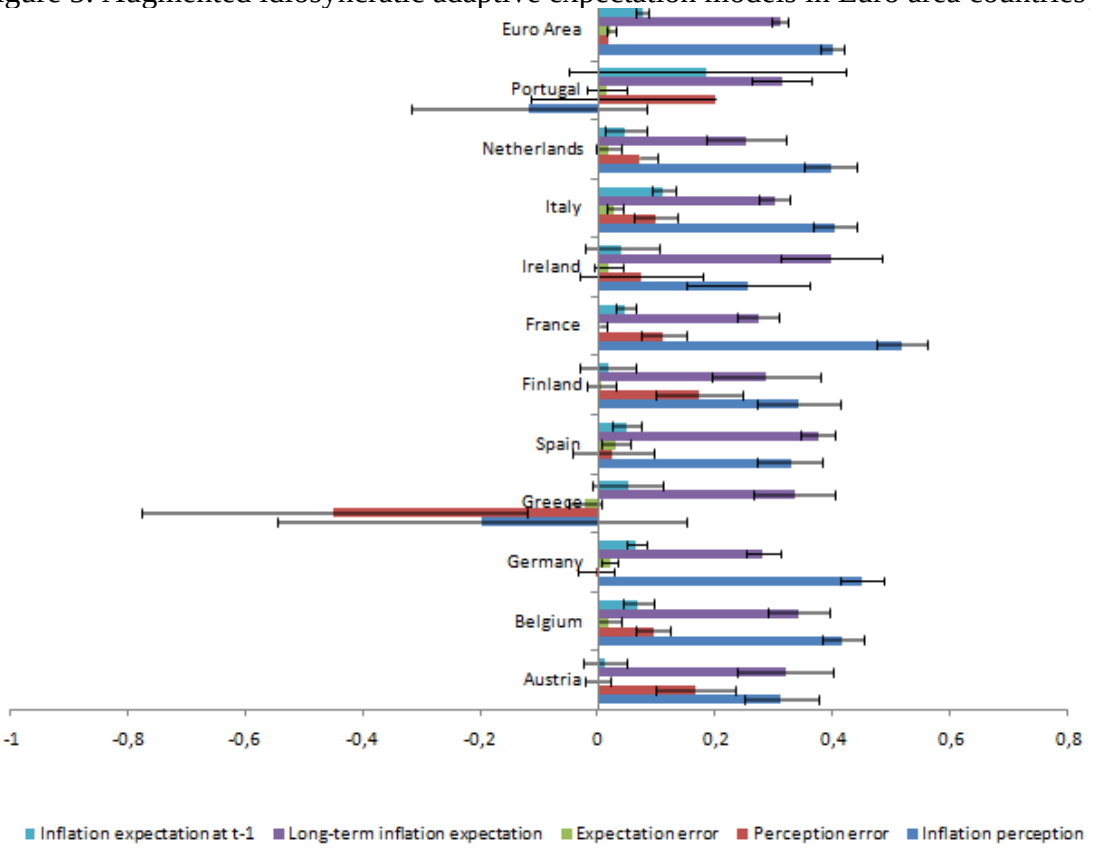
At the euro area level, individuals give more weight to the forward-looking component of inflation expectations than to the backward-looking component, particularly in contexts where other determinants of expectation formation show little variation. However, there exist notable cross-country differences. In particular, inflation expectations in Greece, Ireland, and Portugal appear largely unaffected by past inflation. For Greece and Portugal, expectations are primarily driven by the forward-looking component, while perceived inflation plays a minimal or negligible role.

Table 5
Inflation formation expectations models

	Static expectation (1)	Idiosyncratic static expectation (2)	Adaptive expectation (3)	Idiosyncratic adaptive expectation (4)	Augmented idiosyncrantic adaptive expectation (5)
$\pi^{P}_{t-1,t-13}$	-	0.168***	-	-	-
		(0.004)			
π_{t-1}	0.315***	-	0.326***	-	-
	(0.007)		(0.013)		
$\pi_{t-1} - \pi^{E}_{t-13,t-1}$	-	-	0.023***	-	0.022***
			(0.005)		(0.004)
$\pi^{E}_{t-1,t+11}$	-	-	-	0.123***	0.076***
				(0.003)	(0.005)
$\pi^{P}_{t,t-12}$	-	-	-	0.447***	0.399***
				(0.005)	(0.01)
$\pi_{t} - \pi^{P}_{t,t-12}$	-	-	-	0.056***	0.053***
				(0.005)	(0.009)
$\pi^{E}_{t,t+36}$	-	-	-	-	0.31***
					(0.007)
Constant	3.704***	3.768***	3.327***	1.273***	0.646***
	(0.03)	(0.03)	(0.069)	(0.035)	(0.059)
Observations	721982	717280	278367	717212	303071
R^2	0.542	0.548	0.589	0.655	0.717

Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Figure 5: Augmented idiosyncratic adaptive expectation models in Euro area countries



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

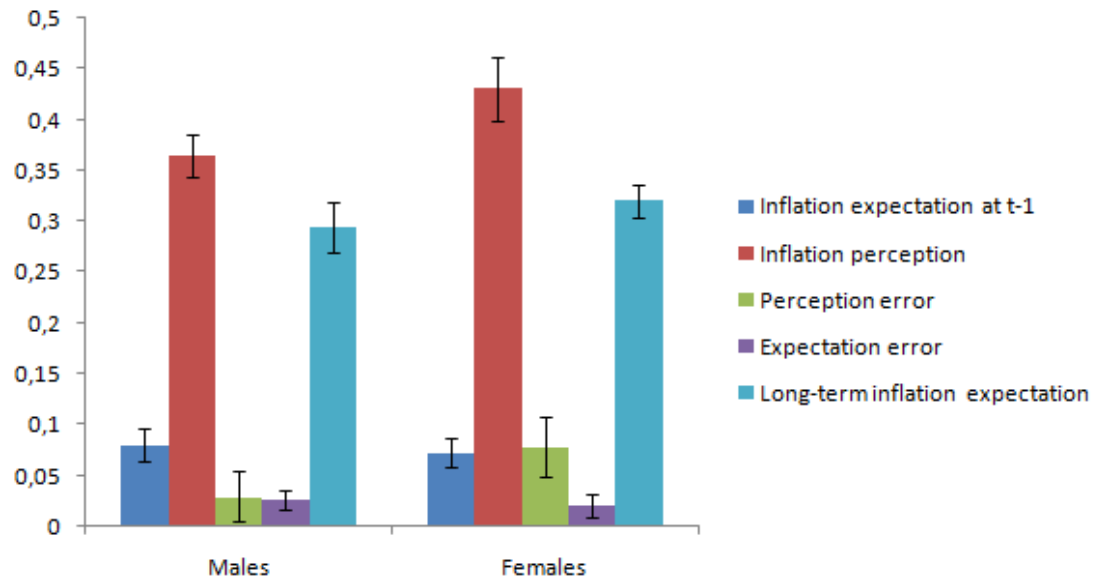
Next, to understand the impact of demographic characteristics, we examine the coefficient estimates of the AIAE model for the Euro Area across different demographic groups. As shown in Figure 6, the perception of inflation—and to a lesser extent, the perception error—is the primary factor explaining why female individuals report higher inflation expectations compared to males. Both genders exhibit a forward-looking process in forming expectations; however, males place slightly more weight on the backward-looking component, particularly on past experiences with prices.

Turning to age groups (Figure 7), inflation perceptions are again the key determinant of inflation expectations, with the strongest impact observed in individuals aged 71 and above, followed by those in the 35–49 age group. All four age groups are similarly influenced by past inflation expectations, with the 35–49 and 50–70 age groups being slightly more responsive than the youngest and oldest groups.

The perception error has the greatest influence on inflation expectations among those aged 50–70, followed by the 35–49 group. Despite these differences, individuals

across all age groups continue to exhibit a forward-looking approach to forming inflation expectations.

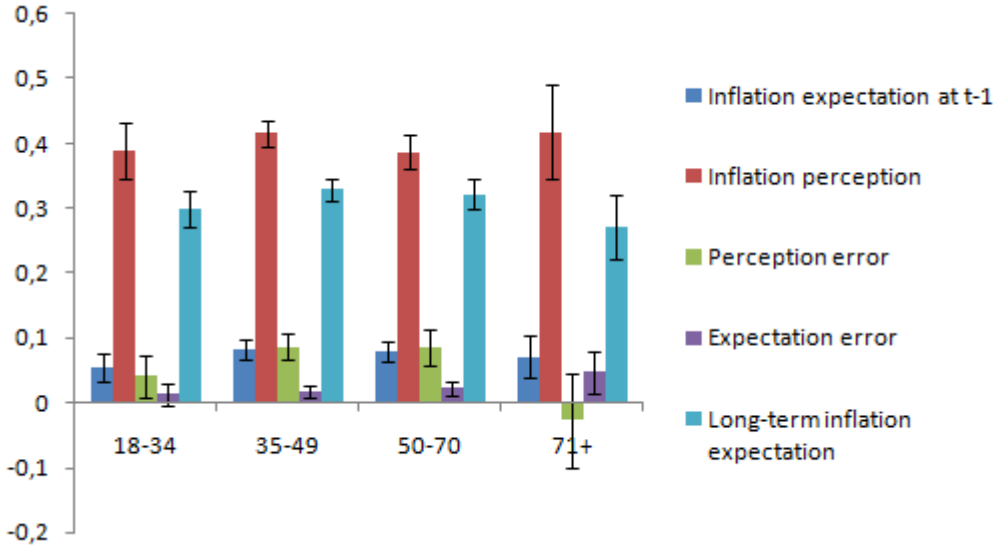
Figure 6: Augmented idiosyncratic adaptive expectation models in Euro area by gender



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 202

Figure 7: Augmented idiosyncratic adaptive expectation models in Euro area by age groups



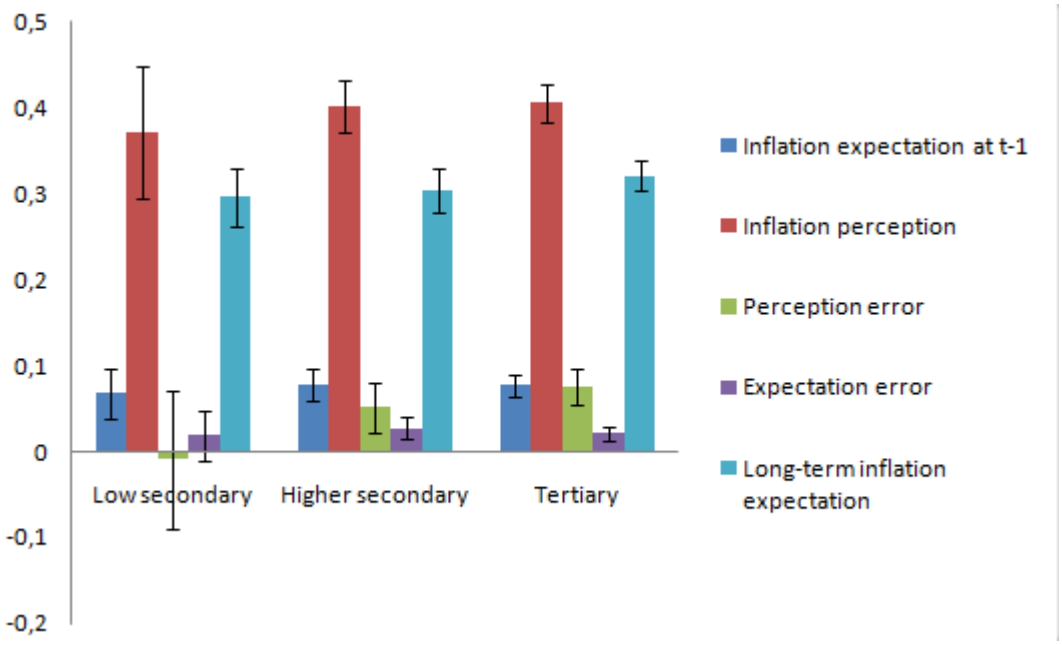
Notes: Authors calculations, 95% confidence bands. Source: CES survey ECB November 2024

Turning to education categories, Figure 8 shows that inflation perception is the key factor influencing inflation expectations across all groups. Individuals with lower levels of education have the strongest impact from inflation perceptions and the weakest

influence from perception errors. In contrast, past inflation expectations play a relatively larger role in the formation of inflation expectations for those with higher secondary and tertiary education. Nonetheless, the figure clearly indicates that individuals in all education categories form expectations in a forward-looking manner.

Inflation perception also emerges as the most important determinant of inflation expectations regardless of the income level. However, as shown in Figure 9, the strength of this impact is inversely related to income—lower-income individuals are more strongly influenced by their perceptions of inflation. Similarly, perception errors have a more pronounced effect on inflation expectations in the low-income group. Despite these differences, individuals across all income categories exhibit a forward-looking inflation expectations formation process, as shown in Figure 9.

Figure 8: Augmented idiosyncratic adaptive expectation models in Euro area by education



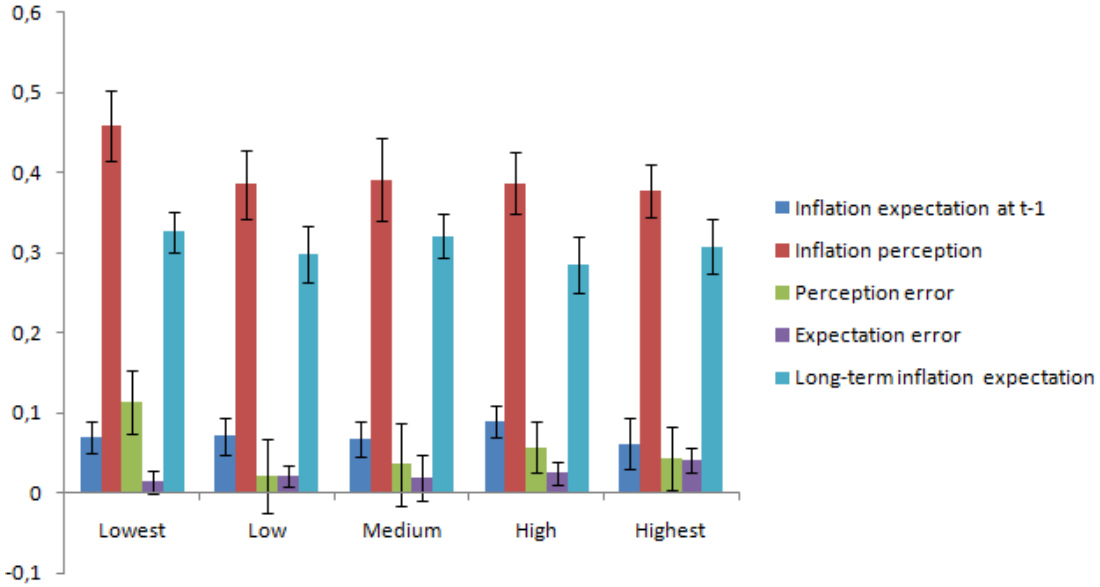
Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

Figure 10 presents the factors influencing the inflation expectations model across different credit access expectation groups. Inflation perceptions are the most significant determinant of inflation expectations in all groups. However, their impact is notably stronger among individuals who expect future access to credit to be very difficult. Similarly, perception errors have the largest effect on inflation expectations within this group. In contrast, individuals who anticipate easy or very easy access to credit in the

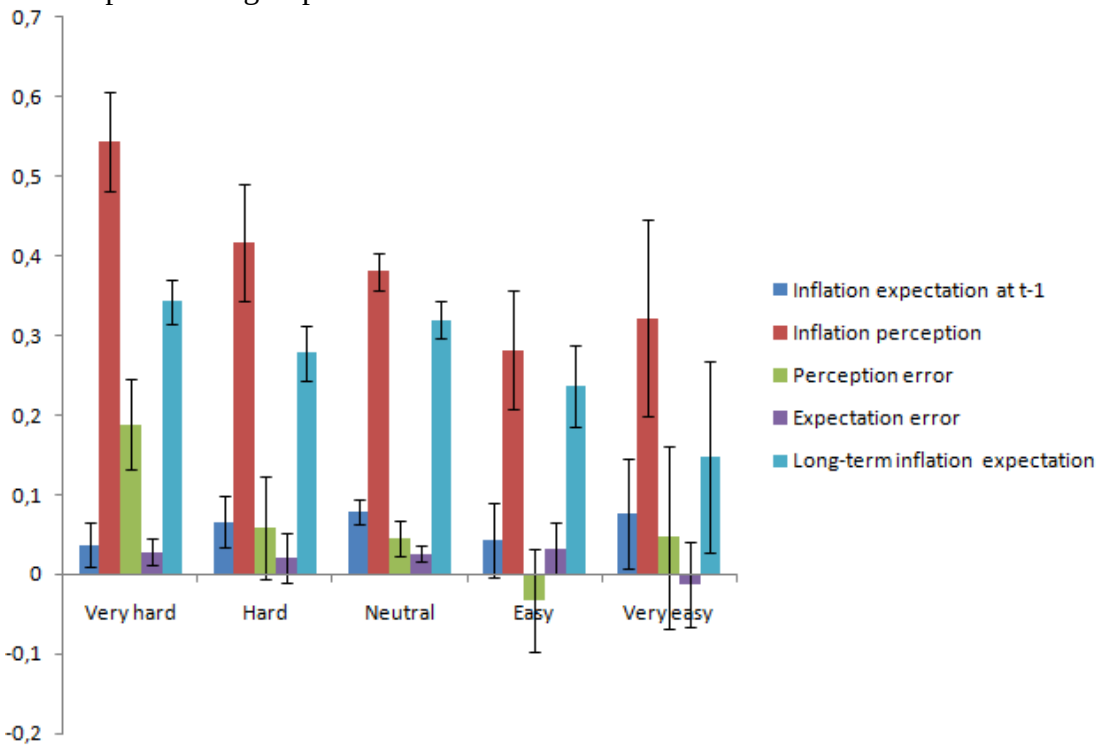
future do not appear to factor perception errors into the formation of their inflation expectations.

Figure 9: Augmented idiosyncratic adaptive expectation models in Euro area by income groups



Notes: Authors calculations, 95% confidence bands. Source: CES survey ECB November 2024

Figure 10: Augmented idiosyncratic adaptive expectation models in Euro area by credit access expectations groups



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

The estimations reported above remain valid when the data are winsorized at the 10% level (5% in each tail).[15]

6. Phillips curve and Inflation expectations

Central banks argue that knowledge of monetary policy objectives and tactics by economic actors improves the efficiency of the monetary policy transmission channel (Bernanke, 2007). In this section, we will examine whether individual expectations are aligned with economic theory and more specifically with the predictions of the Phillips curve. Previous research focusing on individual inflation expectations uses mostly US data and their findings are not aligned with macroeconomic theories such as the Phillips curve. Kamdar (2019) and Candia et al. (2020) find a link between projected slack and higher inflation in advanced economies using individual survey data. Weber et al. (2023) find a strong correlation between inflation and unemployment expectations, both before and after the Covid-19 pandemic.

First, building on Kirpson and Staehr (2024) we regress the 1 year-ahead inflation expectation formed at time t on the 1 year-ahead unemployment expectation formed at time t. This *simple Phillips curve expectation model (SPCE)* takes the following form:

$$\text{SPCE: } \pi^{E}_{it,t+12} = \beta_{PC} u^{E}_{it,t+12} + a_i + \varepsilon_{it} \quad (12)$$

Where $u^{E}_{it,t+12}$ is the 1 year-ahead unemployment expectation formed at time t, β_{PC} is the slope of the Phillips curve and a_i is the individual fixed effect. We consider a similar model for the *simple Phillips curve perception model (SPCP)*:

$$\text{SPCP: } \pi^{P}_{it,t-12} = \beta_{PC} u^{P}_{it,t-12} + a_i + \varepsilon_{it} \quad (13)$$

Where $u^{P}_{it,t-12}$ is the perceived unemployment at time t, β_{PC} is the slope of the Phillips curve and a_i is the individual fixed effect.

Next, we differentiate equations 11 and 12 to take into account forecast and perception errors in inflation and unemployment. For this reason, we estimate equation

[15]See chapter 5 in the supplementary material appendix.

13, a *forecast error Phillips curve expectation (FEPCE) model* and equation 14, *a perception error Phillips curve (PEPCE) model*:

$$\text{FEPCE:}\pi_t - \pi^E_{it-12,t} = \beta_{PC}(u_t - u^E_{it-12,t}) + a_i + \varepsilon_{it} \quad (14)$$

$$\text{PEPCE:}\pi_t - \pi^P_{it,t-12} = \beta_{PC}(u_t - u^P_{it,t-12}) + a_i + \varepsilon_{it} \quad (15)$$

As mentioned in section 2 expectations and perceptions regarding inflation and unemployment in CES appear to be consistent with the Phillips Curve. This is due to the fact that individuals perceive current inflation as high and expect it to decrease in the future, which will inevitably lead to a future increase in unemployment relative to its current perceived levels (see Tables 1 and 2). We formally test this by means of the following *internal error Phillips curve expectation model*:

$$\text{IEPCE: } \pi^E_{it,t+12} - \pi^P_{it,t-12} = \beta_{PC}(u^E_{it,t+12} - u^P_{it,t-12}) + a_i + \varepsilon_{it} \quad (16)$$

In equations (12) to (16) one would expect to find a negative Phillips curve coefficient.

Next, we consider a *hybrid Phillips curve expectations* model that will not only investigate whether individual expectations are consistent with Phillips curve theory but also whether expectations are more forward-looking or backward-looking. The *backward-looking* element is controlled for by including the lag of inflation expectations, while the *forward-looking* element is controlled for by including the long run (up to 36 months ahead) inflation expectation the individual has at time t. Coibion and Gorodnichenko (2015b) highlight the influence of oil prices in raising household and firm inflation expectations compared to those of professionals following the 2008–09 recession. More broadly, the growing recognition of inflation 'globalization' suggests that external inflationary pressures may be relevant. However, households tend to focus not on oil price fluctuations directly but rather on changes in their energy bills and, more significantly, shifts in their overall consumption basket. Therefore, in our Phillips Curve (PC) specifications, we incorporate *lagged changes in energy and*

food inflation instead. Including the change in the HICP for food and energy at time t−1 had minimal impact on the unemployment rate coefficients.

$$HPCE: \pi^{E}_{it,t+12} = \beta_B \pi^{E}_{t-13,t} + \beta_F \pi^{E}_{t,t+36} + \beta_{PC} u^{E}_{t,t+12} + a_i + \varepsilon_{it} \quad (17)$$

$$HPCE: \pi^{E}_{it,t+12} = \beta_B \pi^{E}_{t-13,t} + \beta_F \pi^{E}_{t,t+36} + \beta_{PC} u^{E}_{t,t+12} + \beta_c \pi^{energy}_{t-1} + a_i + \varepsilon_{it} \quad (18)$$

$$HPCE: \pi^{E}_{it,t+12} = \beta_B \pi^{E}_{t-13,t} + \beta_F \pi^{E}_{t,t+36} + \beta_{PC} u^{E}_{t,t+12} + \beta_c \pi^{food}_{t-1} + a_i + \varepsilon_{it} \quad (19)$$

For expectations or perceptions to be consistent with the Phillips curve, β_{PC}must be statistically significant and have a negative sign.Observing the results presented in the first row of Table 6 for the SPCE (column 1), SPCP (column 2) and hybrid expectations models (columns 6 7 8) it is clear that expectations and perceptions of economic actors regarding inflation and unemployment are not consistent with the Phillips curve theory. Similarly, the findings regarding the prediction error model (column 3), perception error (column 4) and internal Phillips curve (column 5) are still inconsistent with the Phillips curve theory as the estimated coefficients are positive.

A key finding that emerges from the estimates presented in columns 6-8 of Table 6 and Figure 11 is that individuals, when forming their inflation expectations, give more weight to the future than to the past, as the forward-looking component has a larger coefficient than the lag of inflation expectations. It is noted that Clement (2024) examining the expectations of professional forecasters in the US finds that the forward component in the Phillips curve has a greater weight than the backward component. The results do not change even when we take into account the lag of energy inflation or food inflation in the HPCE model. However, the lag of food inflation has a higher impact on inflation expectations than energy inflation (see columns 7 and 8 of Table 6).[16]

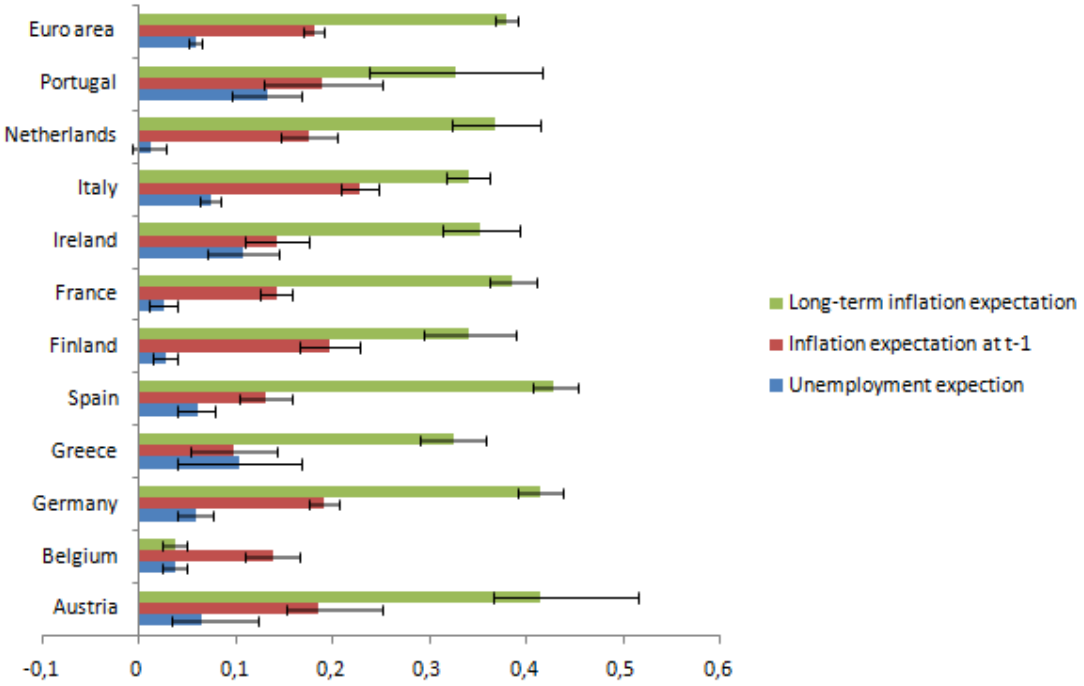
[16]In the supplementary appendix, chapter 4, we present the estimates of the Phillips curve expectation models for each euro area country and for each demographic group in the euro area. Moreover, in chapter 6 we present robustness checks for the Phillips curve expectations models where data are winsorized at the 10% level (5% of each tail). Moreover, in the supplementary material appendix (chapter ???) we present different coefficient plots for the Hybrid Phillips curve expectation model for each demographic group in the euro area as well as for each euro area country.

Table 6
Phillips curve expectation models

	SPCE (1)	SPCP (2)	FEPC (3)	PEPC (4)	IEPC (5)	HPCE (6)	HPCE (7)	HPCE (8)
$u^{e}_{t,t+12}$	0.119*** (0.003)	-	-	-	-	0.058*** (0.003)	0.064*** (0.003)	0.061*** (0.003)
$u^{P}_{t,t-12}$	-	0.119*** (0.004)	-	-	-	-	-	-
$\pi^{E}_{t-13,t-1}$	-	-	-	-	-	0.179*** (0.005)	0.167*** (0.004)	0.167*** (0.005)
$u_t - u^{E}_{t-12,t}$	-	-	0.145*** (0.006)	-	-	-	-	-
$u_t - u^{P}_{t,t-12}$	-	-	-	0.138*** (0.004)	-	-	-	-
$u^{E}_{t-12.t} - u^{P}_{t,t-12}$	-	-	-	-	0.03*** (0.003)	-	-	-
$\pi^{E}_{t,t+36}$	-	-	-	-	-	0.379*** (0.005)	0.374*** (0.005)	0.376*** (0.005)
π^{energy}_{t-1}	-	-	-	-	-	-	0.03*** (0.001)	-
π^{food}_{t-1}	-	-	-	-	-	-	-	0.125*** (0.003)
Constant	3.706*** (0.046)	6.213*** (0.054)	1.32*** (0.039)	2.829*** (0.018)	2.44*** (0.001)	1.896*** (0.044)	1.594*** (0.046)	1.195*** (0.05)
Observations	853507	848395	318949	848395	848394	717213	717213	717213
R^2	0.527	0.585	0.525	0.583	0.375	0.625	0.63	0.629

Note: Clustered standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 11: Hybrid Phillips curve expectation model by county



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

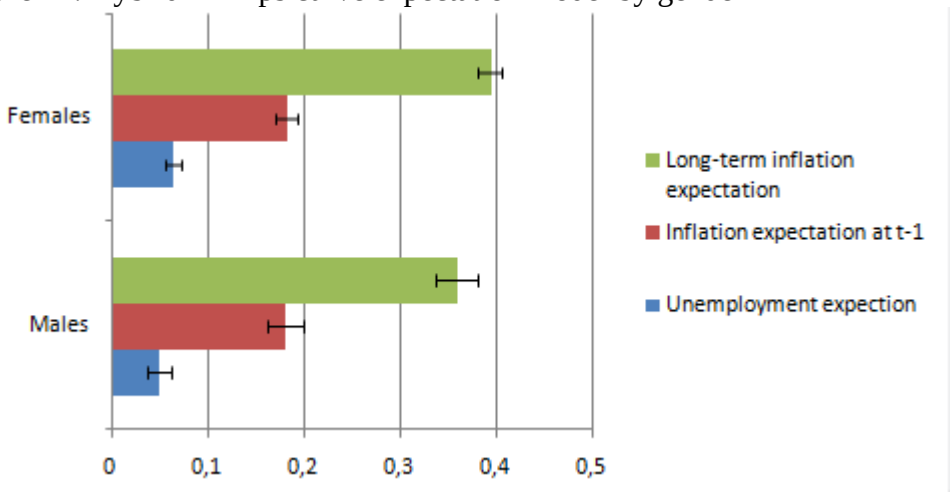
Observing the Figures 11 to 16, it is clear that even when individual euro area countries or euro area demographic groups are taken into account there is no theory consistency of inflation expectations as the estimated Phillips curve coefficient is positive and statistically significant. Only in the case of Netherlands and in the case of individuals that are expecting very easy access to credit in the future the Phillips curve coefficient is positive but not statistically significant.

Moreover, as reported in Figures 11 to 16, independent of the country and the demographic group, individuals when forming their inflation expectations, give more weight to the future than to the past, as the forward-looking component has a larger coefficient than the lag of inflation expectations. The long-term inflation expectations coefficient is more sizeable in Spain, Austria, Germany, and France while the past inflation expectations matter relatively more in Italy, Germany, Austria, Finland and Portugal.

There are no significant differences between genders (Figure 12), age groups (Figure 13), education (Figure 14), income (Figure 15) levels, credit access expectations groups (Figure 16). The coefficient estimate of the forward-looking component is slightly bigger in case of females, in case of low-income groups and substantially smaller in case of elder individuals (71+). Finally, as reported in Figure

16 individuals that are pessimistic about their future access to credit are more forward-looking compared to individuals that expect in the future easy or very easy access to credit.

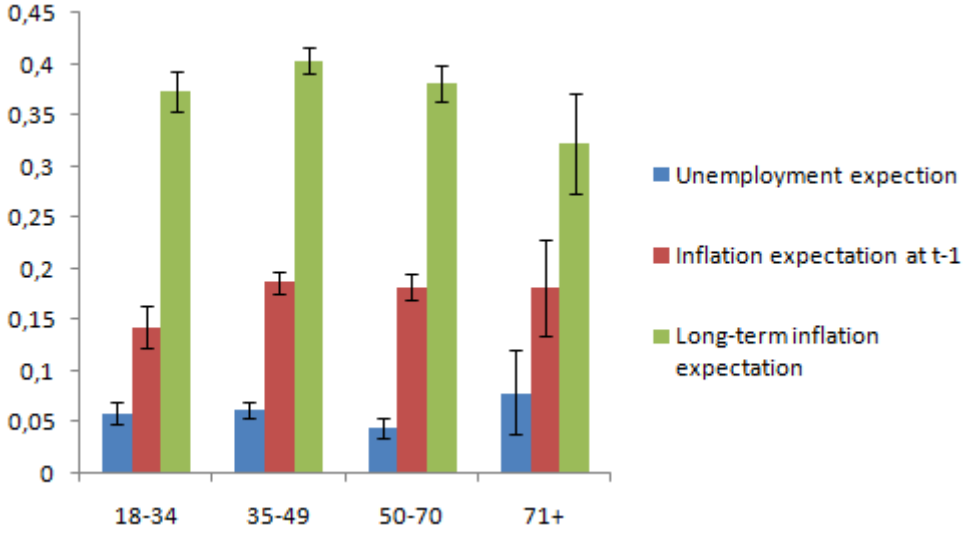
Figure 12: Hybrid Phillips curve expectation model by gender



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

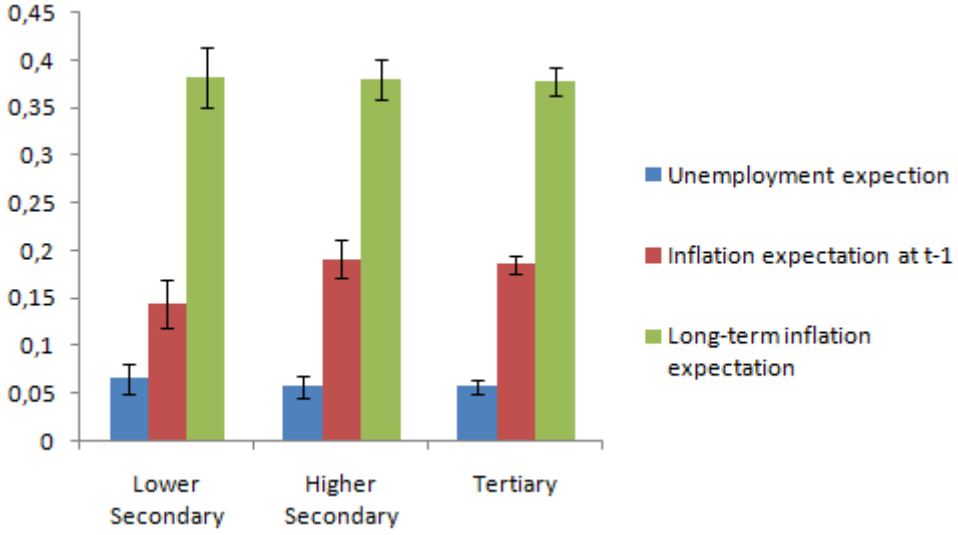
Figure 13: Hybrid Phillips curve expectation model by age groups



Notes: Authors calculations, 5% confidence bands

Source: CES survey ECB November 2024

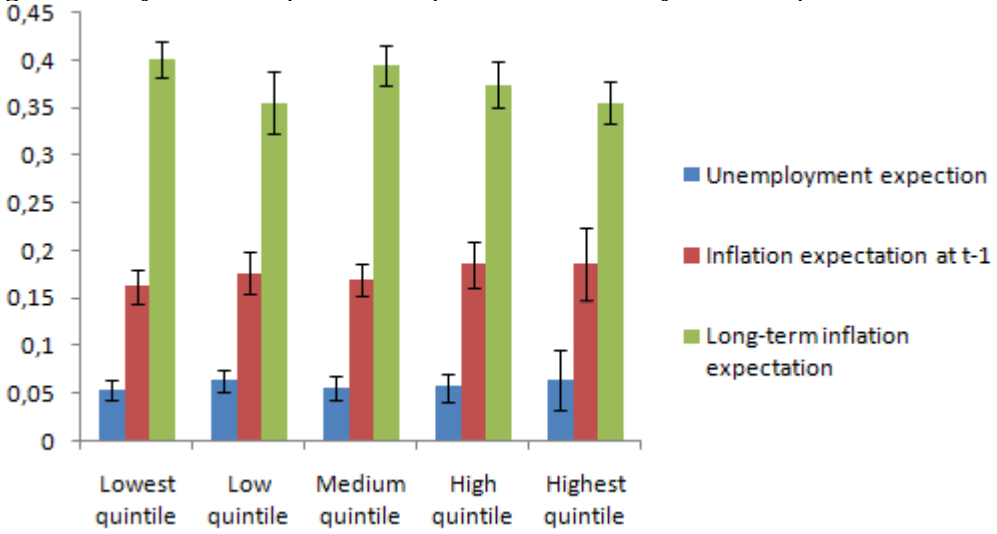
Figure 14: Hybrid Phillips curve expectation model by education level



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

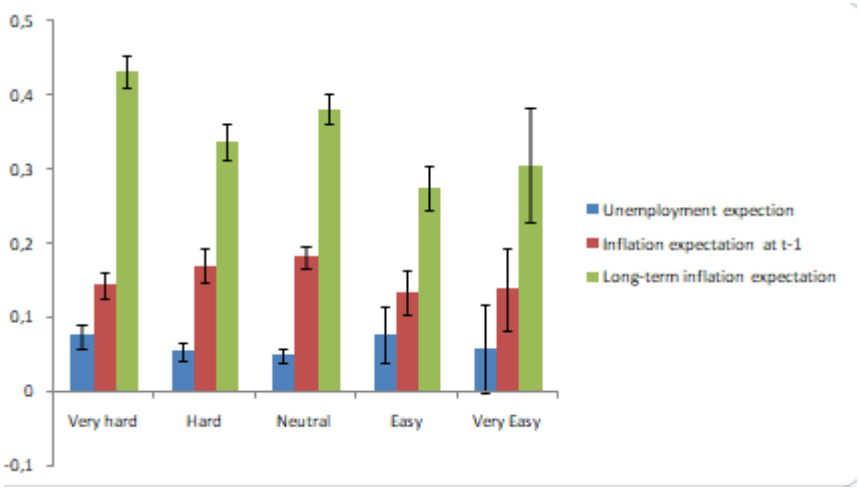
Figure 15: Hybrid Phillips curve expectation model by income quintiles



Notes: Authors calculations, 95% confidence bands

Source: CES survey ECB November 2024

Figure 16: Hybrid Phillips curve expectation model by credit access expectation groups



Notes: Authors calculations, confidence bands

Source: CES survey ECB November 2024

7. Conclusions

Understanding how agents form their expectations is crucial for macroeconomic dynamics and policymaking. In a typical AD-AS model an increase in inflation expectations shifts AS to the left, reducing output and raising inflation. In the same AD-AS context, a change in fiscal or monetary policy can lead to quite diverse policy outcomes depending on whether agents have adaptive or rational inflation expectations (see e.g., Gartner, 2016). Moreover, central banks also thoroughly examine whether the inflation expectations of market participants are compatible with the central banks' medium-term inflation targets. Households tend to adjust their inflation expectations slowly in response to monetary policy shocks. Relevant research highlights that central bank communication can play a key role in shaping these expectations more directly. However, reaching consumers is a challenge. Central banks must make a significant effort to engage the public, competing for attention with more immediate personal and social issues. A crucial conclusion is the value of clearly communicating the central bank's price stability objective. Doing so can help align consumer expectations with the central bank's inflation target, providing an important anchoring effect. This alignment is particularly beneficial for ensuring the effectiveness of monetary policy, as it can help reduce economic impacts, such as output losses following inflationary or cost-push shocks.

Motivated by the theoretical importance of household inflation expectations, we examine three critical aspects of expectations: heterogeneity, formation, and theoretical consistency. This is achieved using the ECB's Consumer Expectations Survey. The main focus of the analysis is on the euro area, but we also examine the formation of inflation expectations in each country separately. Building on Xu et al (2018), we examine different factors that influence the process of inflation expectation formation. However, our analysis extends to a broader dataset of countries and demographic groups in the euro area. Beyond the influence of inflation perceptions and the influence of memories of previous price levels on the expectation-forming mechanism, we also highlighted the importance of long-term forward-looking inflation expectations in the euro area. We then extended the analysis of Kirpson and Staehr (2024), who examined the consistency of inflation expectations with Phillips curve theory. Specifically, we examined additional models such as a hybrid Phillips curve expectations model that examines whether individual expectations are consistent with the Phillips curve theory but also whether expectations are more forward-looking or backward-looking. The backward-looking element is controlled for by including the lag of inflation expectations, while the forward-looking element is controlled for by including the long run (up to 36 months ahead) inflation expectation the individual has at time t.

Regarding heterogeneity, we examine the importance of various demographic characteristics (such as age, income level, education, gender) and access to credit on one- and three-year inflation expectations, inflation perceptions, absolute perception and forecast error, and the probability of expecting high inflation. The findings align with those reported in earlier studies, including Souleles (2004), Anderson (2008), Leung (2009), Pfajfar (2013), and Madeira and Zafar (2015). In more detail, females, low-income individuals, households with a large number of members, and those with a pessimistic outlook on credit access tend to have higher inflation expectations compared to other demographic groups. These same groups also exhibit larger errors in forecasting inflation. On average, females and individuals in the lowest income quintile not only expect higher inflation but also perceive current inflation to be higher than others do. They also tend to make greater forecasting and perception errors and express stronger certainty about future high inflation.

Moreover, one notable finding of this study is that current inflation has a significantly weaker influence on three-year-ahead inflation expectations compared to

one-year-ahead expectations. Nevertheless, the effect of current inflation on longer-term expectations remains positive and statistically significant. This pattern suggests that households' inflation expectations are not well anchored. Moreover, in periods of elevated inflation, individuals are more likely to report higher long-term inflation expectations. This suggests that expectations are not well-anchored and reflects a lack of confidence in monetary authorities' ability to control inflation following a positive inflationary shock. This may stem from limited public understanding of inflation dynamics and monetary policy mechanisms.

Building on the literature suggesting that agents form expectations based on both their prior perceptions of inflation and their actual inflation experiences (Cavallo et al., 2014) and that individuals tend to place greater emphasis on their inflation perceptions—which are more accessible and less cognitively demanding—than on actual inflation data, which require more effort to obtain and interpret, in line with the theory of rational inattention (Sims, 2003; Cavallo et al., 2014), we examine an augmented idiosyncratic adaptive expectations (AIAE) model for the euro area. We find that inflation perception is the dominant driver of inflation expectations, particularly among females, who report higher expectations than males primarily due to their stronger perceptions of inflation. While both genders rely on forward-looking behavior, males place slightly more emphasis on backward-looking elements, especially past price experiences. Across age groups, inflation perceptions again play a central role, with the strongest effects observed among individuals aged 71 and above, followed by those aged 35–49. Although all age groups demonstrate forward-looking behavior, the 35–49 and 50–70 cohorts respond more actively to past expectations, with perception errors influencing expectations most strongly among those aged 50–70. Educational level also differentiates the factors influencing inflation expectations: people with lower educational levels are more influenced by inflation perceptions and less by perception errors, while people with upper secondary and tertiary education give greater weight to past expectations. Nonetheless, forward-looking behavior is consistently observed across all education groups. A similar pattern emerges across income categories, where inflation perception remains the primary factor, but its impact diminishes as income rises. Lower-income individuals are more affected by both inflation perceptions and perception errors. Lastly, when considering credit access expectations, individuals anticipating very difficult future access to credit show a

heightened sensitivity to both inflation perceptions and perception errors, in contrast to those expecting easy access, who seem unaffected by perception errors. Despite these demographic variations, the analysis consistently reveals that individuals across all groups form inflation expectations in a predominantly forward-looking manner.

Given that the primary objective of monetary policy in the euro area is to maintain price stability (Mallick and Sousa, 2013a, 2013b), a deeper understanding of the role that both actual and perceived inflation play in shaping inflation expectations can enhance the effectiveness of monetary policy. By managing expectations more effectively and with minimal disruption to the real economy, central banks can better achieve their policy objectives (Lee and Yoon, 2016).

Moreover, we find that expectations for inflation and unemployment are inconsistent with the Phillips curve theory. The same conclusion emerges when we examine perceptions of unemployment and inflation in the eurozone. Examining various hybrid Phillips curve models, the conclusion is that individuals in the eurozone are more forward-looking than backward-looking. The backward-looking element is controlled for by including the lag of inflation expectations, while the forward-looking element is controlled for by including the long run (up to 36 months ahead) inflation expectation the individual has at time t. The study's findings also suggest that a food price shock has a larger impact on consumers' price expectations than an energy price shock.

Overall, the findings of the study highlight the importance of understanding how households' inflation expectations are shaped in the euro area. Although there are no systematic differences between countries and between demographic groups, some variations do exist and deserve further examination. This is particularly important for understanding households' economic decisions and how monetary authorities can influence them through the common monetary policy.

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