Heterogeneity in Euro Area Consumers' Inflation Expectations: Some Stylized Facts and Implications

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Aggregate measures of inflation expectations mask heterogeneity among consumers. According to the theoretical and empirical literature, expectations may differ due to different information sets and "models" used by individuals. European Commission Consumer Survey data confirm considerable heterogeneity in inflation expectations over time, across countries and across demographic groups. Consistent with findings according to which financial literacy is an important determinant of inflation expectations heterogeneity, our econometric estimates show that education and income seem to play a more important role than age and gender. However, their effect on heterogeneity is nonlinear. We also find evidence of strong country-specific idiosyncrasies in the formation of inflation expectations. Overall, while showing some common tendencies, inflation expectations in the euro area continue to vary across countries and demographic groups as regards their level, driving factors and evolution over time. Employing "targeted" or "multi-tiered" communication strategies for different demographic groups and within the various euro area countries might indeed help "focus," or "anchor," inflation expectations around a level in line with the Eurosystem's definition of price stability.

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Expectations are important for economic decisions. Inflation expectations feed not only into consumption and investment decisions but also into price and wage setting, which are particularly important for monetary policy: inflation expectations are a major determinant of inflation itself, and stable and low inflation expectations are therefore a prerequisite for lasting price stability. It is thus not surprising that inflation expectations feature frequently and prominently in the ECB's Governing Council's assessment of the inflation outlook, which underlies its monetary policy decisions. Furthermore, inflation expectations influence the term structure of interest rates and thus ultimately affect both financing conditions and the sustainability of public finances.

Most macroeconomic models assume that economic agents' inflation expectations are identical. The reasoning is that even if expectations differed at certain times, they would converge through various mechanisms. Moreover, the assumption of homogeneous expectations allows important simplifications in economic models.

Recently, a small but growing body of literature has focused on the heterogeneity of inflation expectations of different economic agents. This literature addresses three issues. First, it provides a rationale why heterogeneity in inflation expectations is important for researchers and policymakers and why it should not simply be assumed away. Second, it offers several theoretical explanations of why inflation expectations could persistently differ among economic agents and over time. Third, it studies empirically what factors might explain heterogeneity in inflation expectations.

This study takes stock of existing knowledge on the first two aspects (sections 1 and 2). Then it describes

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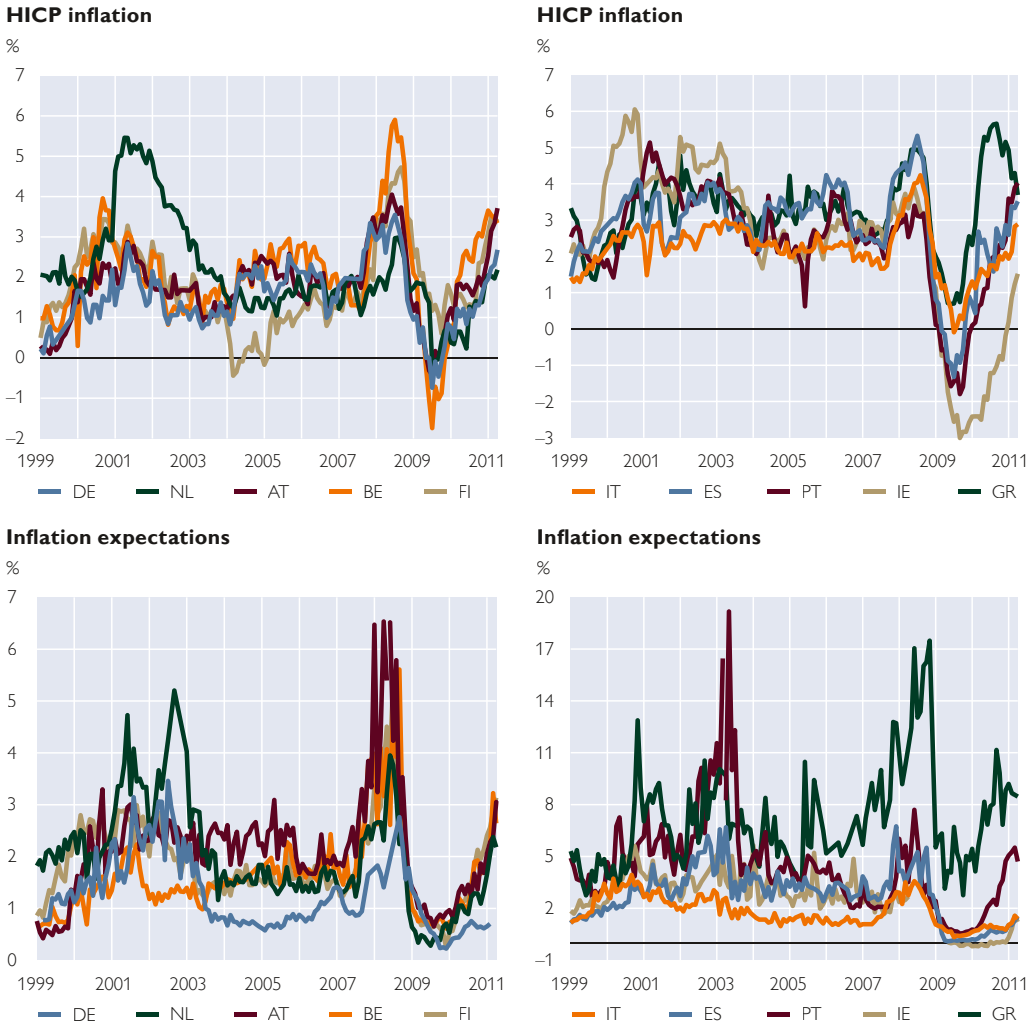
available data sources and explores how to measure heterogeneity in the inflation expectations of euro area consumers (section 3). Section 4 provides some interesting stylized facts about this heterogeneity and section 5 offers an econometric analysis of the factors that drive heterogeneity in inflation expectations in various countries and among various demographic groups in the euro area. Section 6 concludes.

1 Why is Heterogeneity in Inflation Expectations Important?

Economists and policymakers should be concerned with heterogeneity in inflation expectations for several reasons. Three aspects seem relevant here: (1) Is heterogeneity in inflation expectations empirically observable? (2) How might the heterogeneity of inflation expectations theoretically affect the behavior of

Chart 1A

HICP Inflation and Consumer Inflation Expectations over the Next 12 Months[1]
A: By country



Source: OeNB, European Commission.

[1] Consumer inflation expectations are calculated using the method developed by Berk (1999).

Note: We use linear interpolation in case of missing values for inflation expectations.

economic agents and what might be the consequences for economic welfare and economic policy? (3) Do heterogeneous inflation expectations empirically lead to different economic behavior?

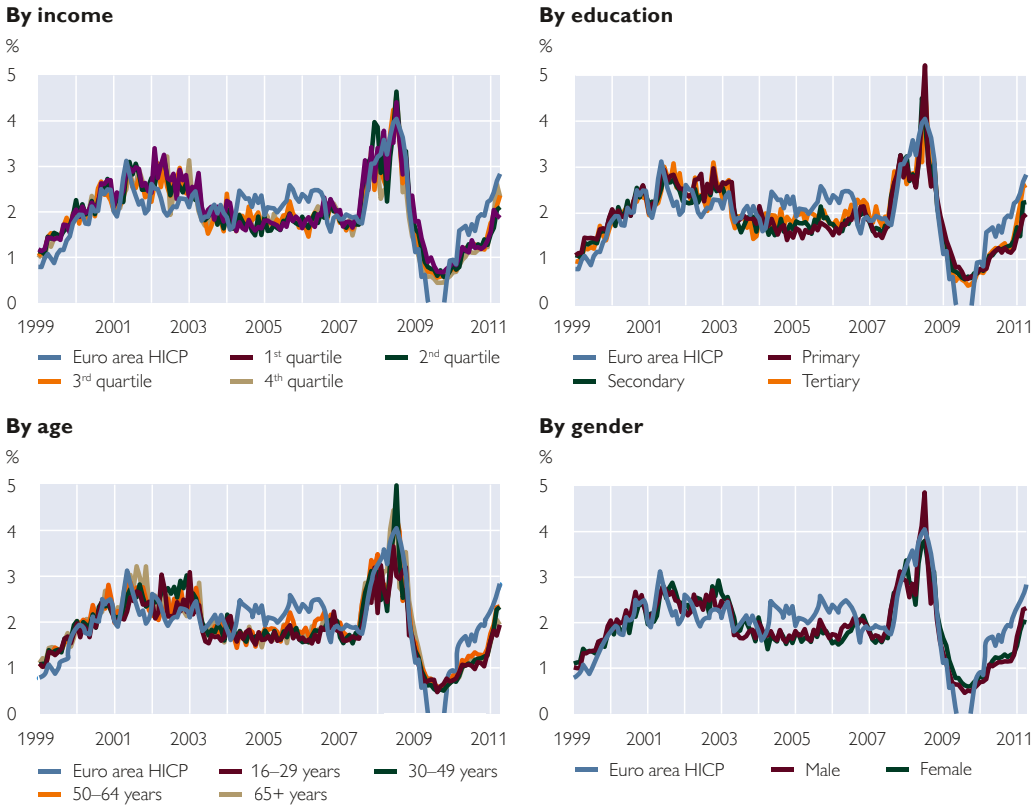
Regarding the first aspect, survey measures of inflation expectations indeed exhibit substantial heterogeneity among respondents: Thus, this topic is empirically relevant.

Concerning the second aspect, heterogeneity in inflation expectations might affect the behavior of economic agents and become relevant for economic welfare and policy through a number of channels.

– Disagreement among economic agents about future inflation may be crucial to understand macroeconomic dynamics (Mankiw et al., 2003; Townsend, 1983). Using models of imperfect information, Phelps (1970), Lucas (1973), Sims (2003) and Woodford (2002) show that the real costs of nominal movements may be related to heterogeneity in inflation expectations. Acemoglu et al. (2007) show that if inflation expectations do not converge, outcomes in various game-theoretical and asset market models are strongly altered. Mankiw and Reis (2006) show that a model featuring staggered updating on the part of consumers, workers and firms is able to reproduce empirical

Chart 1B

HICP Inflation and Consumer Inflation Expectations over the Next 12 Months[1]
B: Euro area average by demographic groups



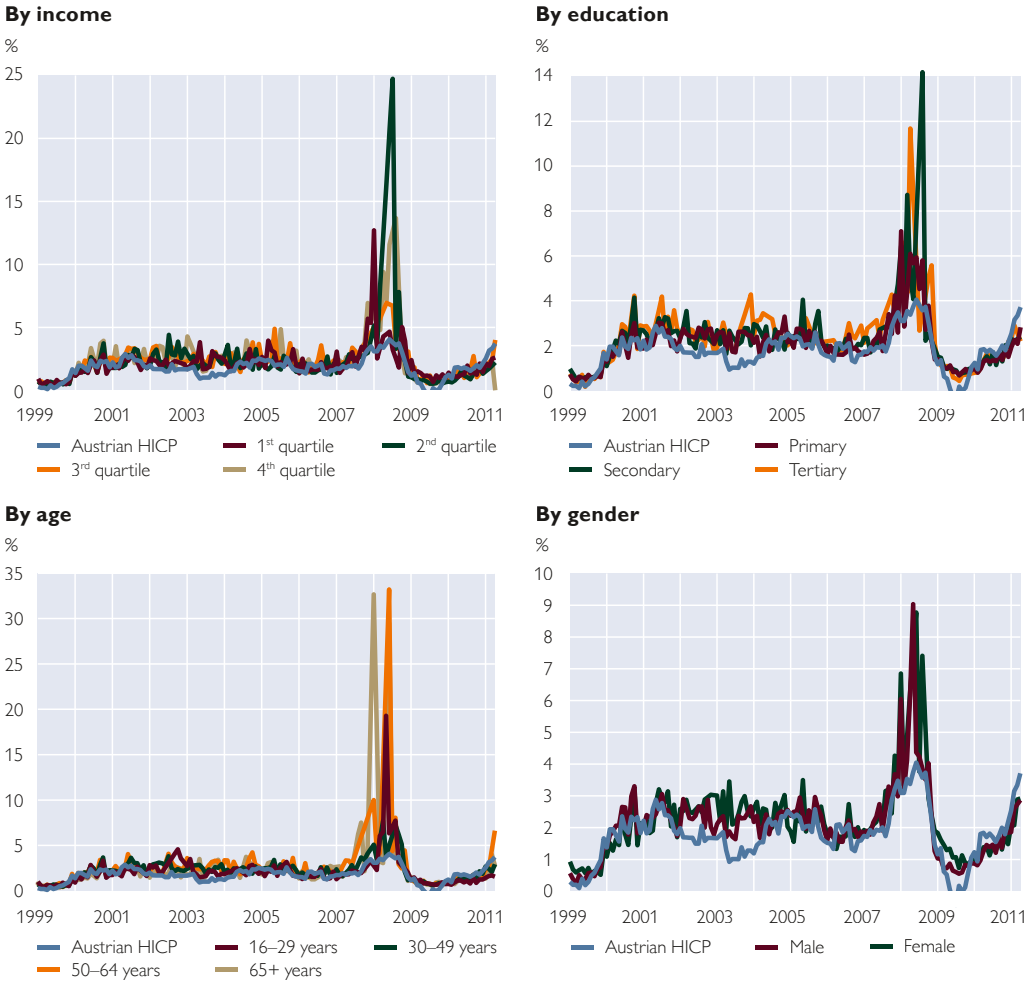
Source: OeNB, European Commission.

[1] Consumer inflation expectations are calculated using the method developed by Berk (1999).

Note: We use linear interpolation in case of missing values for inflation expectations.

Chart 1C

HICP Inflation and Consumer Inflation Expectations over the Next 12 Months[1]
C: Austrian average by demographic groups



Source: OeNB, European Commission.

[1] Consumer inflation expectations are calculated using the method developed by Berk (1999).

Note: We use linear interpolation in case of missing values for inflation expectations.

patterns such as the acceleration phenomenon and real wage smoothness. Sims (2009) argues that heterogeneous views about future inflation and interest rates can lead agents to bet against each other, thus potentially generating overinvestment in real assets and speculative excesses in asset prices, while potentially delaying and distorting monetary policy action.

– "Anchoring" and "focusing" inflation expectations is a core element of many monetary policy strategies. Some studies have for instance evaluated the success of inflation targeting by measuring its effects on the dispersion of inflation expectations (Capistrán and Ramos-Francia, 2010). Thus, central banks need to understand how agents form their inflation expectations, what drives potential heterogeneity and how to influence expectations formation. To the extent that the "learning mechanisms" of economic agents

might differ, optimal communication strategies might differ as well. Burke and Manz (2010) argue that central banks should take into account insights learnt about the expectations formation process from demographic variation. It is against this background that Sims (2009) and Anderson et al. (2010) propose "multi-tiered" communication strategies which specifically target various demographic groups. Heterogeneity and thus nonrationality can also have implications for central banks' optimal reaction functions: Orphanides and Williams (2005) show that under learning, monetary policy should respond more decisively to inflation and focus more on inflation stabilization since tight inflation control speeds up learning and guides inflation expectations more effectively.

– Furthermore, the heterogeneity of inflation expectations may also be regarded as an indicator of perceived uncertainty (Bomberger, 1996; Lahiri and Sheng, 2010; Gnan et al., 2010), thereby influencing risk taking, leverage and vulnerability at the individual as well as at the systemic levels.
– To the extent that inflation expectations may, according e.g. to the New-Keynesian Phillips curve, influence current inflation, monitoring the heterogeneity of inflation expectations may give an indication about the convergence or divergence of inflation, for instance, among different euro area countries.
– Finally, the heterogeneity of inflation expectations might also affect the distribution of income and wealth: If some agents systematically perform worse in forecasting inflation, they are at a disadvantage by making less optimal decisions. So, it is interesting to identify, for instance, whether specific demographic groups are subject to larger expectation dispersion and errors and, if necessary, invest more effort in financial education.

The third aspect mentioned above, namely how inflation expectations indeed empirically affect the behavior of economic agents, has so far been little studied at the micro level and is thus not well understood. One experimental study (Armantier et al., 2010) suggests that survey results on inflation expectations are consistent with agents' financial decisions under experimental conditions under the assumption of risk neutrality. However, the authors emphasize that their experimental result does not prove that everyday behavior is also influenced by beliefs about future inflation.

2 Why Might Inflation Expectations Differ among Economic Agents? Taking Stock of the Literature

There are by now a number of explanations of why inflation expectations among consumers may differ.[2] Several authors provide summaries of relevant research, in particular Döpke et al. (2007), who study professional forecasters' inflation expectations heterogeneity, Ranyard et al. (2008), who study consumers' inflation perceptions from a psychological perspective, Badarinza and Buchmann (2009) as well as Maag (2010), who survey the recent literature with respect to the ability to generate theoretically, and explain empirically, heterogeneous consumer inflation expectations. We propose an encompassing conceptual

[2] *For a survey of the literature on nonrational inflation expectations formation under uncertainty, see Gnan et al. (2010).*

framework which summarizes and integrates the various explanations for heterogeneity in consumers' inflation expectations formation.

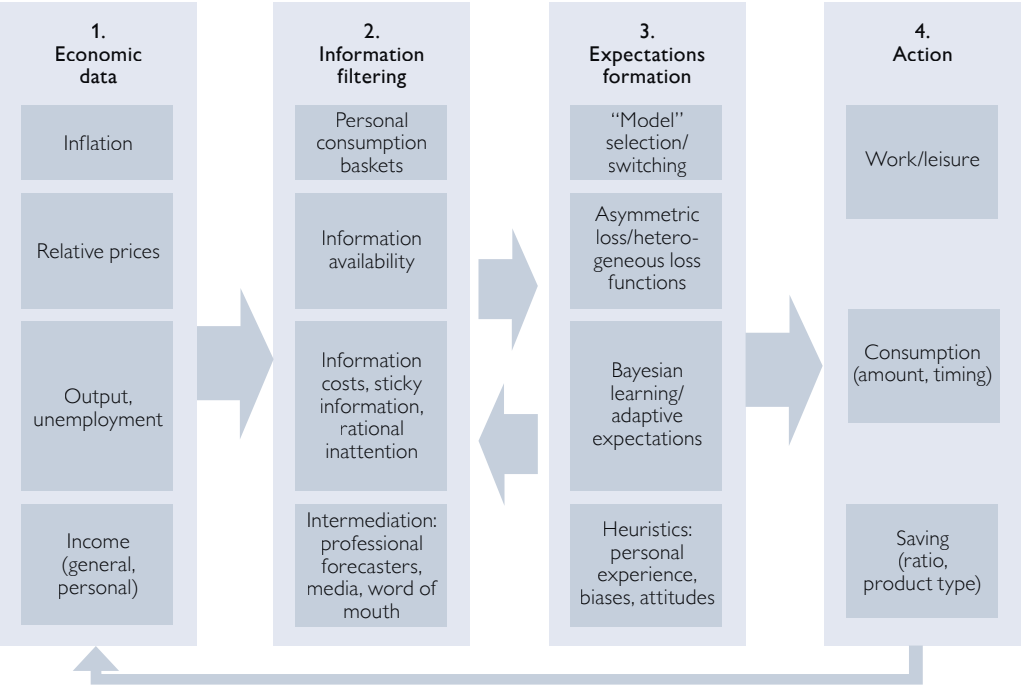
Our framework distinguishes three stages during which heterogeneity might arise, and integrates the possible feedback from the resulting behavior in a fourth stage (chart 2). The process starts from economic fundamentals, i.e. available "objective" data. The second stage describes which information actually reaches, or is actually used by, individuals to form their expectations. The third stage is where the information is processed, i.e. where the actual expectations formation takes place. The resulting expectations will then in a fourth stage influence the behavior of economic agents, which in turn can affect economic fundamentals. Therefore, there are many possible links and feedback loops between these stages which blur the clear distinction between them, but we still believe that for expositional purposes such a conceptual framework may be useful. In the following, we focus on the first three stages of this framework.

Stage 1: Differences in Macroeconomic Data

Let us start with the first stage, in which "objective" information that potentially drives future inflation and inflation expectations becomes available. On the one hand, *macro fundamentals* – such as current inflation, the output gap and unemployment rate as well as the relevance of prices for imported goods like oil or intermediate goods – may differ across countries or regions, thus generating different inflation expectations across countries or regions. These differences in macro fundamentals may be accentuated during periods of large

Chart 2

Heterogeneity of Consumers' Inflation Expectations: Stylized Framework



Source: OeNB.

shocks, such as oil and commodity price shocks, or periods of financial and economic crises.

Objective economic data also comprise information on income developments – both in *aggregate* (e.g. for a country as a whole) and in *relative* terms (individual or group incomes relative to the aggregate). Similarly, data on price developments may refer to an average consumption basket used to generate official statistics, or to developments in prices for individual goods in absolute or relative terms (e.g. gasoline or food prices).

The available empirical evidence on the effect of various macroeconomic variables on inflation expectations heterogeneity tends to confirm that inflation expectations heterogeneity varies over time with the level of inflation, inflation variability, and with relative price variability (e.g. Mankiw et al., 2003).

Stage 2: Information Filtering

The second and third stages, information filtering and processing, are closely interrelated and sometimes difficult to disentangle. In fact, several of the models on inflation expectations formation are actually models of information selection and filtering.

A first issue in the context of *information filtering* is which data out of the universe of available economic information are indeed *relevant* for an individual's inflation expectations formation. For instance, the personal income and cost of living of an employee in Vienna will be different from that of a farmer in Carinthia. Thus, it seems obvious that the relevant prices as well as other economic data will differ across individuals, which means that heterogeneity in inflation expectations may simply arise on the basis of differences in the relevant data, without any "irrational" filtering taking place.

In addition, information *availability* may differ across individuals. Even in the internet age, not everyone has access to online information; moreover, information on some international data might only be available in a foreign language and therefore specific data might, for all practical purposes, still be inaccessible for considerable parts of the population, thus generating information asymmetry. This becomes all the more obvious when information costs (search costs, etc.) are considered, which may differ vastly across individuals.

The recent interest in the heterogeneity of inflation expectations was triggered by Mankiw and Reis' (2002, 2006) *sticky information model*. In their model, economic agents update information sets only in a staggered way. Economic agents who actively acquire information update their forecasts rationally, whereas all others "stick" to their outdated expectations. The sticky information model generates heterogeneous inflation expectations since staggered information updating has the effect that different information sets are used to form expectations. The sticky information model also predicts that higher inflation volatility will increase expectations heterogeneity, since it affects the differences across individuals arising from the timeliness and frequency of information acquisition. This prediction is empirically confirmed by Mankiw and Reis (2002) and subsequently by authors such as Badarinza and Buchmann (2009).

Investing only limited resources into information search and acquisition may be entirely rational from the individual's perspective: Under Sims' (2003) model of *rational inattention* individuals have only limited information acquiring and processing capacity and may weigh the costs of acquiring additional information against the benefits. In this

setting, heterogeneous inflation expectations result from heterogeneous objective functions (not all data are, equally useful to everyone), heterogeneous information processing constraints and heterogeneous errors.

Macroeconomic fundamentals may influence expectations differently, depending on how this information reaches economic agents. In *epidemiological models,* information spreads throughout the population like an epidemic (e.g. Carroll, 2003). Since new information reaches individuals at different points in time, the resulting inflation expectations will differ among individuals as well.

The *media* play a vital role in the spreading of information. Different media cover economic topics, such as inflation, to different degrees, so depending on the use of different media, different individuals are likely to receive different information (quantity, detail, bias/tone) on current and future inflation (Maag and Lamla, 2009; Lamla and Lein, 2008). This media filter alone might account for differences in inflation expectations formation across the euro area countries and across different demographic groups. Also, other forms of social amplification, such as *word of mouth,* may play a role.

Empirical research confirms notions of salience, rational inattention and the role of the media in influencing inflation expectations heterogeneity. Badarinza and Buchmann (2009) show that higher inflation is associated with higher agreement on inflation perceptions and expectations. More news on inflation helps reduce expectation errors on average and increases agreement, thus "densifying" perceptions and expectations.

Stage 3: Information Processing: "Models" of Inflation Expectations Formation

Turning to the third stage, various suggestions have been made to model the inflation expectations formation process. They can broadly be grouped into two categories: theoretical economic approaches and psychologically inspired explanations.

Branch's (2007) model of *rationally heterogeneous expectations* provides for agents to rationally choose between different forecasting models each period by evaluating their associated costs and benefits. Expectations heterogeneity arises because the costs and benefits associated with various predictors may differ among agents. With this model, under several model selection rules, the author is able to generate disagreement and time variation in disagreement.

Capistrán and Timmermann (2009) propose a formal model which explains heterogeneity in inflation expectations on the basis of *asymmetric loss* (the cost of over- and underpredicting inflation may be different, prompting a bias in agents' inflation expectations) and *heterogeneity in agents' loss functions* (which would lead to heterogeneous biases in inflation forecasts).

Maag and Lamla (2009) use a *Bayesian learning* model according to which news on inflation influences forecast disagreement by affecting both the information sets and the choice of predictor. Since news is noisy, consumers face a signal extraction problem, which they address by updating their information sets. The authors find that both higher volume and lower heterogeneity of media coverage on inflation reduce forecast disagreement, since agents converge to the same information set.

Regarding psychologically based explanations of simplified inflation forecasting behavior, a first idea is that

agents may use personal *experience,* rather than official statistical information, to form their views on future price developments. Given differences in individual consumption baskets, individuals' expectations about future changes in their personal consumption baskets can also be expected to differ (Bryan and Venkatu, 2001; Ranyard et al., 2008). Thus, higher *relative price variability* should raise inflation expectations heterogeneity, since it introduces additional heterogeneity in the information sets used by households to form individual inflation forecasts (Maag and Lamla, 2009).

While the differences in actual personal inflation rates that are generated by differences in consumption baskets are, empirically, rather small (see e.g. Fritzer and Glatzer, 2009), the *psychological effects of inflation perception (exaggeration* of extreme price movements, *biased* memory, attitudes, *availability* heuristics, *salience, reference prices* etc. – see e.g. Ranyard et al., 2008; Fluch and Stix, 2005; Morewedge et al., 2005; Gnan et al., 2010) may amplify differences in inflation perceptions and, as a consequence, also in inflation expectations. Several surveys (Benford and Driver, 2008; Maag, 2010) provide empirical evidence that inflation perceptions play an important role in the formation of inflation expectations.

Frameworks which *combine several explanations* are conceivable as well. Along this line, Maag and Lamla (2009) argue that inflation expectations heterogeneity might be related to inflation and relative price changes in a nonlinear way. On the one hand, if media coverage on inflation becomes more salient (which would likely be the case in periods of high and rising inflation and in periods of sharp changes in relative prices), individuals invest more effort in the formation of inflation expectations, leading to a convergence of consumers' inflation expectations to those of professional forecasters. On the other hand, if inflation exceeds a certain threshold or if exceptional developments occur (e.g. a change in the monetary policy regime, a sharp economic crisis or a massive oil price shock), the uncertainty about the adequate forecasting model might increase, professional forecasters might need to revise their inflation forecasts more frequently and sharply and, as a result, the heterogeneity of consumers' inflation expectations might increase.

A considerable body of literature explicitly studies the *influence of demographic factors on inflation expectations heterogeneity* (see Burke and Manz, 2010, for a comprehensive survey). The results by Bruine de Bruin et al. (2010) are representative of the general thrust of the literature: They find that female, poorer, single and less educated individuals consistently expect inflation to be higher. They explain this result by two factors: first, the need to focus on how to cover future expenses and, second, financial literacy. This is consistent with Anderson et al.'s (2010) empirical finding that socioeconomic characteristics are statistically highly significant in explaining differences in adaptive learning processes. However, Burke and Manz (2010) show by means of experiments that much of the empirically observed demographic differences in inflation expectations can ultimately be traced back to financial and economic literacy, with differences in the general educational level, income and gender playing a comparatively minor role. According to these authors' experiments, economically literate individuals tend to know better which economic data are most predictive of inflation (i.e. the data filtering and selection described above is more effective) and they also

use a given data set more effectively (i.e. they employ better models to form expectations).

The question arises as to what extent heterogeneous inflation expectations are *persistent or converge* over time. Models of learning assume that agents with bounded rationality continuously adjust their views in light of new information. In principle, this allows for the possibility of long-run expectations convergence, for instance to the inflation target as set by the central bank. Ranyard et al. (2008) summarize the psychological empirical literature in the sense that consumers use rather simple heuristics involving past inflation as well as current actual or perceived inflation to form their inflation expectations. Weber (2007) shows that households update their information sets less frequently than professional forecasters, which slows down such convergence. This finding is in line with the notion that households find updating information more costly than professional forecasters. Weber also shows that agents in countries with higher inflation update information sets more frequently, which is in line with theories of salience and rational inattention. As a result, and contrary to professional forecasters, euro area households' inflation expectations have not yet converged to the ECB's definition of price stability. In this context, Sims (2009) argues that in the face of unprecedented economic developments and policy measures, a convergence of views among agents will likely happen more slowly and less completely.

3 Data Sources and Measurement

3.1 Data Sources for Inflation Expectations Heterogeneity

Inflation expectations can be derived either from financial market data or from surveys. Only the latter offer information on the heterogeneity of expectations. Information from surveys on inflation expectations can, in turn, be grouped according to different characteristics:

a) Type of respondent: The respondents of available surveys are either professional forecasters (ECB Survey of Professional Forecasters and Consensus Economics) or randomly selected citizens (Consumer Survey of the European Commission).
b) Time horizon: The time horizon of the inflation forecast may vary from short term (e.g. over the next 12 months) to medium and long term (5 years, 10 years).
c) Type of information: The survey may provide quantitative information on respondents' expectations in terms of concrete figures, or the information may be qualitative (e.g. increase, remain unchanged, fall). There are several methods to transform qualitative information into quantitative inflation expectations figures; they all have their limitations and caveats, however (e.g. Maag, 2010). Conversely, recent research (e.g. Bruine de Bruin et al., 2011) shows that survey data on direct quantitative inflation expectations need to be used very cautiously as replies depend on the framing of questions (e.g. open questions on quantitative inflation expectations versus choosing among given ranges of future inflation) and differences in the interpretation of survey questions may generate statistical artifacts of heterogeneity in inflation expectations.
d) Type of indicator: The information collected may relate to the price level or to the inflation rate, i.e. an expected change in the price level. Experiments show that the way a question is posed may influence

responses (Van der Klaauw et al., 2008; Maag, 2010). The difference between the price level and changes thereof is not always fully understood and may be interpreted ambiguously by respondents. These caveats must also be borne in mind.

e) Demographic information: Survey respondents may belong to different categories. In the case of consumer surveys, the relevant categories are country of origin and demographic details such as age, gender, income and education/profession.

f) Level of aggregation: The available data may be micro data or aggregate distributions of inflation expectations for given demographic categorie only.

For the purpose of this paper, we would ideally look for monthly micro data that cover a long time span extending from at least the beginning of EMU (or better yet, a couple of years earlier) and provide quantitative medium-term inflation expectations of consumers across all euro area countries, including individual demographic information on age, gender, income and education/profession.

For practical purposes, the choice of data is limited by availability. For our study, we are interested in demographic and country differences, so a natural choice is the European Commission's Consumer Survey. In this survey, question 6 inquires about expected changes in the price level over the coming 12 months. We do not use the existing experimental time series on quantitative inflation expectations collected in a number of euro area countries since 2003, since the series are too short for our purposes, the data still seem quite unreliable and subject to a considerable question bias (Biau et al., 2010) and they have so far not been freely available for all euro area countries. The European Commission's Consumer Survey provides comparable monthly data for most euro area countries since 1991 (except for Austria, Finland, Slovakia and Slovenia, for which data are available from 1995 or 1997). Micro data in the sense of individual responses are not available. But the balance of the qualitative responses as well as the distribution among the five different response possibilities is available for various demographic groups in individual countries.

With these data, it is possible to analyze two things: a) the heterogeneity of expectations regarding inflation developments over the next 12 months across countries and/or demographic groups, and b) differences among various countries and/or demographic groups with regard to the heterogeneity of inflation expectations within a country and/or demographic group. In the remainder of this study, we focus on the latter aspect.

3.2 Measurement of Inflation Expectations Heterogeneity

A number of methods have been proposed in the literature to infer measures of heterogeneity of inflation expectations from the European Commission's qualitative survey data. For a survey of such methods, see Maag (2010, chapter 2.4.2). Following Badarinza and Buchmann (2009), in this paper we use the d^2 index of ordinal variation proposed by Lacy (2006), which for reasons of simplicity we call the "Lacy measure."

$$\textit{Lacy measure} = \sum_{i=1}^{K-1} F^i \, (1 - F^i)$$

where $K = 5$ is the number of response categories in the question on inflation expectations in the European Commission's Consumer Survey and F^i is the cumulative response share in category i,

e.g. $F^3 = s^1 + s^2 + s^3$. The Lacy measure attains its minimum of 0 if all answers lie in the same response category. It reaches its maximum when the distribution is polarized, i.e. if $s^1 = s^5 = 0.5$. Note that the fifth category of survey questions is not included in the above formula because F^5 by definition of the measure equals 1 and therefore does not contain additional information on the distribution of response shares. Note also that the measure is ordinal, i.e. it is not necessary to assume that the distance between categories is equal (Maag, 2010; Badarinza and Buchmann, 2009; Lacy, 2006).

The database we use includes the Lacy measure of disagreement for 12 euro area countries[3] as well as for the euro area total, for the period between 1991 and end-2010. The data are quarterly[4] and split across the demographic categories of income, education, age and gender.

4 Some Stylized Facts for the Euro Area and Its Member Countries

To start with, let us consider the development of inflation expectations heterogeneity across demographic groups for the euro area as a whole (chart 3). Disagreement about inflation over the next 12 months increased continuously from the beginning of the 1990s until the beginning of Stage Three of EMU in 1999. Thereafter, it declined until 2001 and remained at this lower level until 2006. During 2007, disagreement fell strongly and remained low until the third quarter of 2008. From the fourth quarter of 2008 onward, disagreement increased again to levels comparable to, or even slightly above, those prevailing at the start of Stage Three of EMU. For the euro area as a whole, there are some differences across demographic groups, but these differences seem rather small.

However, the euro area total masks important differences across individual euro area countries. To illustrate this, we consider first the development of inflation expectations disagreement for the total population by euro area countries (chart 4). There seems to be no obvious joint pattern across euro area countries in the behavior of disagreement over time, except for an obvious brief period of convergence of disagreement during the financial and economic crisis. Thereafter, disagreement increased again across countries.

Chart 3 exhibited only minor differences in inflation expectations heterogeneity across demographic groups for the euro area total. This changes if we consider developments in individual countries. In this context, three types of countries can be distinguished. In the first group of countries, divergence across demographic groups is rather small (Germany, France and Slovakia). A second group of countries (including Austria and Belgium) shows larger dispersion across various demographic groups. Finally, a third group of countries shows generally low dispersion but either much larger or much smaller heterogeneity for some demographic groups (Italy, the Netherlands, Portugal, Slovenia, and Spain). For reasons of space, we only show the series for Austria in chart 5.[5]

[3] *Cyprus, Greece, Luxembourg and Malta are not included due to lack of data.*

[4] *These are averages of the original monthly data.*

[5] *Charts for other countries are available upon request.*

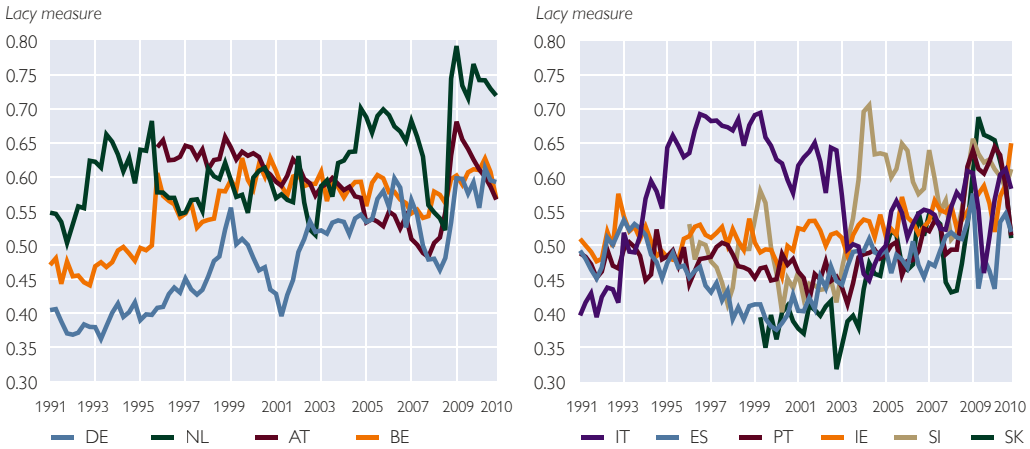
Chart 3

Inflation Expectations Heterogeneity across Demographic Groups in the Euro Area

Source: European Commission, authors' calculations.

Chart 4

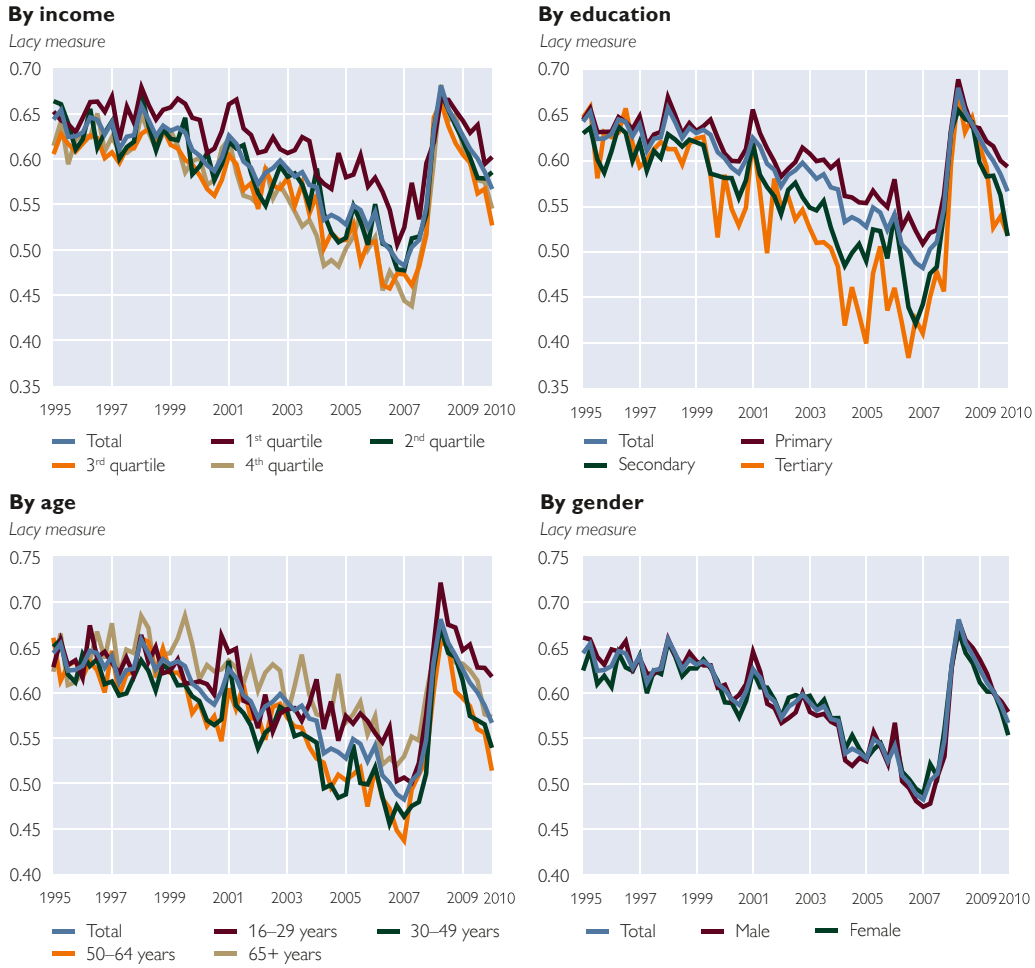
Inflation Expectations Heterogeneity across Euro Area Countries



Source: European Commission, authors' calculations.

Chart 5

Inflation Expectations Heterogeneity across Demographic Groups in Austria



Source: European Commission, authors' calculations.

5 What Drives Heterogeneity in Euro Area Consumers' Inflation Expectations: An Econometric Analysis

In this section, we use the data set from the Consumer Survey of the European Commission to investigate what drives differences in inflation expectations heterogeneity across demographic groups (differentiated by income, education, age and gender) and across countries. Our hypothesis is that besides country specific effects, variables such as the output gap[6], the level of inflation[7] and relative price variability[8], will explain the variation in levels of inflation expectations heterogeneity across countries and across demographic groups.

In past studies (see sections 1 and 2), it has been argued that different demographic groups process information differently. In particular, it was found that the level of education, which should be highly correlated with the level of income, explains differences in inflation expectations and inflation perceptions *across* demographic groups. Based on these past results, our hypothesis is that such factors (education, income, gender and age) may also help explain the heterogeneity of inflation expectations *within* various demographic groups.

In particular, we are interested in how the different demographic groups use the available information and how this information determines the level of heterogeneity within a group. More specifically, we hypothesize that heterogeneity is explained by the level of inflation, relative price variability and the phase of the business cycle captured by the output gap in each country. Because by construction, and also in theory, these series are highly persistent we include a lag of the dependent variable.[9]

5.1 Results by Demographic Groups

Table 1 summarizes the estimation results by demographic groups, using data for 12 euro area countries. In general, we find that the coefficient for inflation is always significant and always negative, while the coefficient of the output gap is significant for more than half of the groups, and it is also always negative. Relative price variability is always positive and almost always significant.[10]

The fact that the effect of the level of inflation on that of inflation expectations heterogeneity is always negative and significant implies that at higher levels of inflation, the heterogeneity of inflation expectations decreases, which would be consistent with models in

[6] *The output gap was obtained by applying a Hodrick-Prescott filter to quarterly real GDP data for each country.*

[7] *Measured as the year-on-year growth rate of the HICP.*

[8] *Relative price variability is the weighted standard deviation of the inflation rate in HICP components. Our measure is based on 12 HICP components for each country in our sample.*

[9] *Despite the fact that we use a lagged dependent variable in our regressions, we use the within-estimator because, for one thing, we are interested in fixed effects, and, for another, we have a long panel with 12 countries and about 79 quarters per country (for a total of around 830 observations). The bias introduced by the lagged dependent variable should therefore be small. Moreover, we are not particularly interested in the size of the lagged coefficient but rather in the effects of other variables on inflation disagreement. (Indeed, estimations carried out with one- and two-step GMM yielded very similar results for the coefficients we are interested in.) The advantage of using the within-estimator is that we can compare the results to OLS estimations carried out at the country level. We estimated different specifications in which either inflation or relative price variability or both were excluded. We find that our results are robust to the specifications used. In the following, we report only results achieved with the full specification (inflation, relative price variability and output gap).*

[10] *In some initial regressions the squared change in annual inflation was used as well, as in Mankiw et al. (2003), but this was not significant.*

which the cost of making forecast errors increases with the level of inflation or with heuristics such as salience, and which confirms the findings of Badarinza and Buchmann (2009) for the euro area.[11] The coefficient of the effect varies between –0.098 and –0.044, and it is the largest effect we find using our three explanatory variables.

The effect of the level of inflation on inflation expectations heterogeneity differs across demographic groups but, as can be seen in the annex, these differences do not seem to be statistically significant.[12] We find, however, interesting patterns in the differences of the coefficients. For example, the coefficient for respondents aged 65 years or older is –0.061, while for respondents aged 16 to 29 years the coefficient is –0.098. The lowest effect, however, is found for consumers aged between 50 and 64, and this is almost identical to the effect found for the group of consumers aged 30 to 49. Thus, we find that the effect of age on the way heterogeneity reacts to inflation is nonlinear. This would suggest that models according to which consumers invest more time on forecasting inflation when the level of inflation rises, which leads to a decline in heterogeneity, seem to be more relevant for either very young or very old consumers.

We also find a similar nonlinear effect of education: inflation expectations heterogeneity among consumers with only primary education on the one hand and with tertiary education on the other responds more strongly to the level of inflation than heterogeneity among consumers with secondary education.

Splitting the sample by income classes shows, however, a linear effect. The smallest effect is found for the lowest level of income and the highest effect for the richest segment of the population. This result is puzzling given the large effect found for the youngest group of the population. We also see that, although not statistically significant, the reaction of women to inflation is less pronounced than that of men. This would be in line with the linear effect found when considering income categories, if we assume that women are more strongly represented in the lower income quartiles.

The effect of relative price variability on inflation expectations heterogeneity is, as expected, positive and almost always significant. This confirms the hypothesis that when certain prices which are more salient increase by more than the general price level, heterogeneity goes up as well. In terms of size, the effect is only slightly smaller than that found for the level of inflation, but we see less variation across demographic groups. Also, as was the case for inflation, these differences among demographic groups are not statistically significant. We also find that when the sample is split by age and education, the effect of age and education is not linear. In particular, compared to the results for the level of inflation we see that with respect to relative price variability, results for the youngest segment of the population do not differ as strongly. In this case, we

[11] *Note that this result differs from the findings by Mankiw et al. (2003) for the United States and by Maag and Lamla (2009) for Germany: The former authors found a positive relation between the level of inflation and inflation expectations heterogeneity, while the latter found no relationship between the amount of news coverage on inflation and inflation expectations heterogeneity.*

[12] *Determining the statistical significance of these differences is no trivial task, since we compare regressions carried out with different dependent variables and identical regressors in a panel data context. Thus, as a way of approximating this significance, we look at confidence intervals.*

also find that the level of income is nonlinear, but for the last two quartiles of the population its effect is not significant. This implies that for groups with higher income, relative price variability does not constitute relevant information for the inflation expectations formation process.

The output gap is used as a proxy for the business cycle and thus the general economic situation that should be taken into account by consumers. We find that the effect of the output gap on heterogeneity is smaller than that of inflation, always negative, but for some groups not significant. The negative sign implies that dispersion of beliefs increases in bad times and decreases in good times. This behavior could be associated with a general increase in uncertainty during bad times. The fact that this effect is smaller and less often significant than the effect found for inflation and relative price variability confirms the hypothesis that people would take into account information that is more relevant or more accessible to them. While information on the inflation level and relative price variability are more readily available and understandable, this may not be the case for the output gap, which is not observable. Moreover, what people actually observe are different indicators about the general situation, which in real-time, as is well established in the literature, can be very different from ex-post statistical output gap measures.

Although we do not see statistically significant differences based on confidence intervals (Annex chart 1A), there are some interesting patterns across demographic groups. First, there is basically no difference between men and women. Second, while very young people do not seem to include this information in their expectations formation process, older people do. Third,

Table 1

Effects[1] of Inflation, Relative Price Variability and Output Gap on the Heterogeneity of Inflation Expectations for Various Demographic Groups

Demographic group	Lag (1)	Inflation level	Relative price variability	Output gap	N	Adjusted R-squared	Durbin-Watson statistic
16–29 years	0.725***	–0.098***	0.050*	–0.020	820	0.61	2.095
30–49 years	0.818***	–0.057***	0.050**	–0.020	820	0.73	1.916
50–64 years	0.795***	–0.056***	0.047*	–0.033 **	820	0.70	2.058
65+ years	0.736***	–0.061 ***	0.055**	–0.036 **	820	0.62	2.119
Primary education	0.781 ***	–0.064***	0.065***	–0.016	820	0.69	2.097
Secondary education	0.826***	–0.048**	0.041*	–0.032 **	820	0.74	2.027
Tertiary education	0.768***	–0.068***	0.053*	–0.034 **	820	0.66	2.084
1st income quartile	0.791 ***	–0.052**	0.061**	–0.037 **	807	0.71	2.007
2nd income quartile	0.772***	–0.072***	0.055**	–0.027 *	807	0.67	2.083
3rd income quartile	0.777***	–0.078***	0.040	–0.018	807	0.67	2.069
4th income quartile	0.755 ***	–0.081***	0.047	–0.021	807	0.63	2.090
Female	0.830***	–0.044**	0.047**	–0.023 *	820	0.75	1.965
Male	0.820***	–0.058***	0.039*	–0.025 *	820	0.73	1.947
Total	0.821 ***	–0.057***	0.045*	–0.023 *	822	0.74	1.873

Source: Data: Eurostat; estimations: authors' calculations.

[1] Standardized beta coefficients.

**** 1% significance level, ** 5% significance level, * 10% significance level.*

Lag (1): one period-lagged value of the dependent variable. N: number of observations.

for people with higher education, the output gap affects inflation expectations heterogeneity more, while its influence falls as income increases.

5.2 Results by Country

As a supplement, we conducted country-level regressions for the level of heterogeneity among the entire population. Here, we additionally included the euro area as a whole as a benchmark. The results are summarized in table 2. For the euro area, 79 quarters are available, starting with the second quarter of 1991; the same applies for most euro area countries, while for Austria, Finland, Spain, Slovakia and Slovenia the sample is much shorter.

Regression results for individual countries show larger heterogeneity than across demographic groups. For example, in table 1 we saw that the coefficients vary somewhat across demographic groups, but their sizes and signs are quite similar and, based on confidence levels, there is basically no statistical difference among the different coefficients (Annex chart 1A). By contrast, at the country level (table 2), we do not find statistically significant coefficients as often as with the panel data. Furthermore, we find not only larger variation in the size of the coefficients but also in the sign, and judging from the confidence intervals (Annex chart 2A), the differences across countries are statistically significant. Moreover, the observed larger variation of the lagged dependent variable suggests that the persistence of inflation heterogeneity differs widely across countries.

Table 2 also shows that the euro area average masks large differences across countries. For the euro area, both the level of inflation and relative price variability have the expected signs but are not significant, while the output gap has a significant negative effect. Regarding individual euro area countries, the inflation level has a significant effect on inflation expectations heterogeneity in Belgium, Finland, Ireland,

Table 2

Effects[1] of Inflation, Relative Price Variability and Output Gap on the Heterogeneity of Inflation Expectations in Individual Euro Area Countries

Country	Lag (1)	Inflation level	Relative price variability	Output gap	N	Adjusted R-squared	Durbin-Watson statistic
Euro area	0.681 ***	–0.161	0.046	–0.124 **	79	0.80	1.840
Austria	0.915 ***	0.024	–0.023	–0.009	60	0.82	1.451
Belgium	0.805 ***	–0.108 *	0.168 ***	0.003	76	0.81	2.294
Germany	0.830 ***	–0.048	0.108 **	–0.082 **	79	0.90	2.060
Spain	0.731 ***	0.119	0.128	0.006	64	0.59	2.455
Finland	0.703 ***	0.278 ***	–0.253 **	–0.341 ***	60	0.78	1.747
France	0.873 ***	–0.044	–0.054	0.016	79	0.80	2.040
Ireland	0.338 ***	–0.396 ***	0.250 ***	0.178 *	74	0.48	2.005
Italy	0.899 ***	–0.016	–0.072	0.021	79	0.84	1.780
Netherlands	0.571 ***	–0.158 **	0.219 ***	–0.141 *	79	0.70	1.963
Portugal	0.811 ***	–0.068	0.055	–0.017	79	0.75	1.781
Slovenia	0.576 ***	–0.412 ***	–0.064	–0.020	59	0.85	1.440
Slovakia	0.731 ***	–0.264	0.160	–0.068	46	0.82	1.535

Source: Data: Eurostat; estimations: authors' calculations.

[1] Standardized beta coefficients.

**** 1% significance level, ** 5% significance level, * 10% significance level.*

Lag (1): one period-lagged value of the dependent variable. N: number of observations.

the Netherlands and Slovenia. This effect is, as expected, negative in all countries except Finland. Relative price variability is significant in Belgium, Finland, Germany, Ireland and the Netherlands. Its effect is, as expected, positive in all countries except Finland once again. While in the panel regressions the output gap was significant in most cases, we rarely find significant effects at the country level. For those countries for which the effect is significant, we see some variation in size but the effect is always negative, except for Ireland.

These results imply that besides the differences across demographic groups, there are strong country-specific effects that explain inflation expectations heterogeneity in individual countries differently. The results obtained from the panel data across demographic groups average out these effects as they concentrate on the effects of demographic differences. The differences found across countries may reflect the cultural or institutional characteristics of these countries which influence the use of information. Further research might make a comparison across countries for each demographic group, but this is not pursued further here due to space constraints.

6 Conclusions

Inflation expectations are an important element of monetary policy strategies and implementation. The respective communication polices are generally aimed at "anchoring" inflation expectations at a level consistent with the inflation target or with the definition of price stability. However, aggregate measures of inflation expectations mask the fact that individual consumers may have very different inflation expectations in mind.

In this paper we first surveyed different explanations of why expectations are not identical across economic agents and, more specifically, consumers. A review of the relevant economic literature reveals two different explanations: a) information sets: heterogeneity occurs because consumers collect information differently; b) "models" of inflation expectations formation: consumers process a given set of information differently.

Second, using data from the European Commission's Consumer Survey, we showed that for the euro area as a whole and for individual member countries[13], there is indeed considerable heterogeneity among consumers in their expectations of inflation over the next 12 months. Moreover, we show that inflation expectations heterogeneity varies over time, across countries and across demographic groups.

In the empirical part, we investigated the effect of information proxied by macroeconomic variables on inflation expectations heterogeneity within various demographic groups and in a large number of euro area countries. Our results seem consistent with the findings by other researchers that financial literacy may play an important role in explaining heterogeneity. The reasons for this conclusion are, first, that the pattern of differences among demographic groups is more robust and consistent than that of differences across countries. Second, when country-specific effects are taken into account, the most significant differences among demographic groups are driven by education and income. Age, by contrast, does play a role but the differences are

[13] *Except Cyprus, Greece, Luxembourg and Malta, which were not covered by the data.*

quite small, and gender differences are found to be negligible.

However, we do not find a linear effect of education or income on inflation expectations heterogeneity. While we see that the effects of macroeconomic variables differ across different levels of income and education, we do not find that the effects are smallest for the richest or most educated, as some theory would predict. There seems to be a threshold effect which might warrant more thorough investigation.

With respect to different countries, we see much larger heterogeneity not only regarding the level of inflation expectations but also on how macroeconomic variables affect heterogeneity, pointing to strong country-specific idiosyncrasies in expectations formation.

Overall, the paper finds that regarding their level, their driving factors and their evolution over time, inflation expectations in the euro area, while showing some common tendencies, are still quite diverse across both countries and demographic groups. To the extent that a stronger "focusing" or "anchoring" of inflation expectations around the Eurosystem's definition of price stability is deemed desirable, "targeted" or "multi-tiered" communication strategies for different demographic groups and in the various euro area countries (including further investment in economic education), as proposed by Sims (2009) and Anderson et al. (2010), may indeed be worth exploring.

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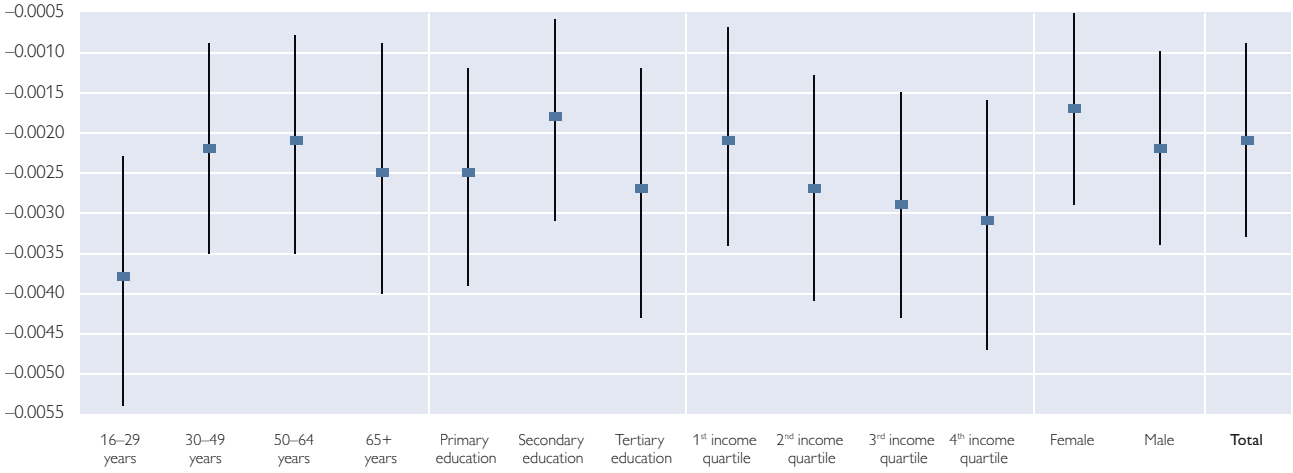
Annex

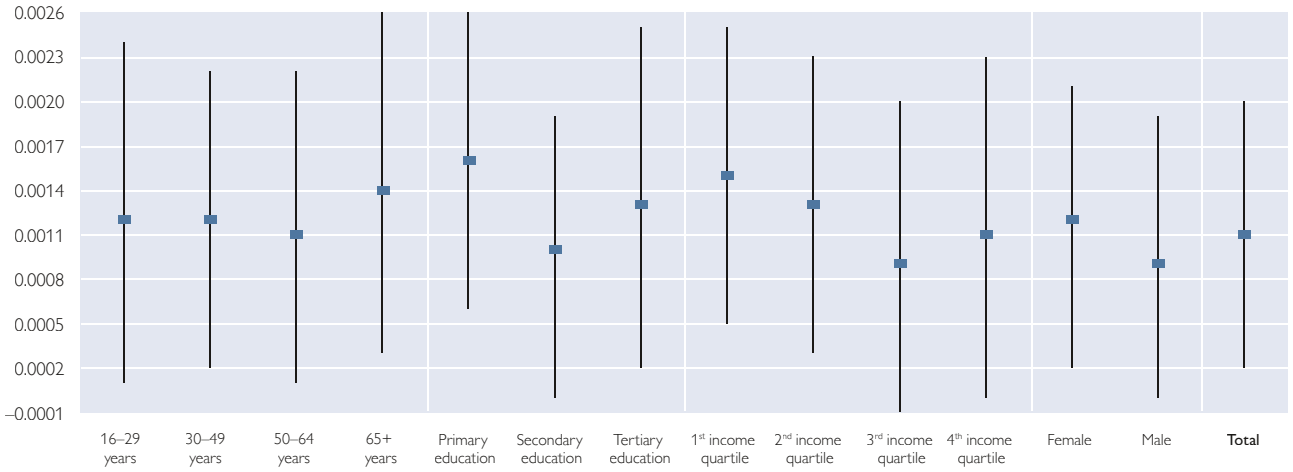
Chart 1A

Effects on Inflation Expectations Heterogeneity for Various Demographic Groups
Point Estimates and 90% Confidence Intervals

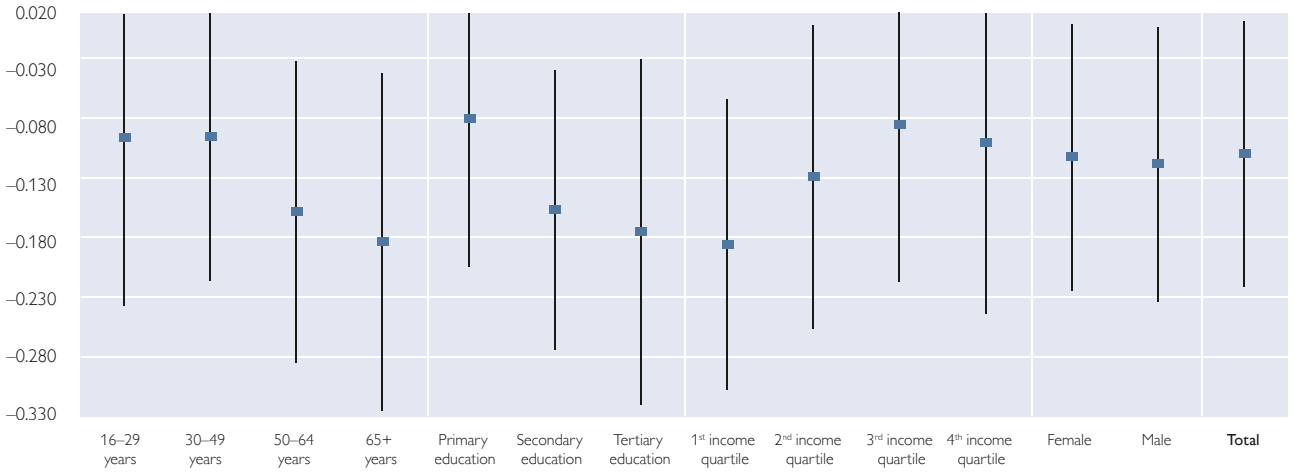
Inflation



Relative price variability



Output gap



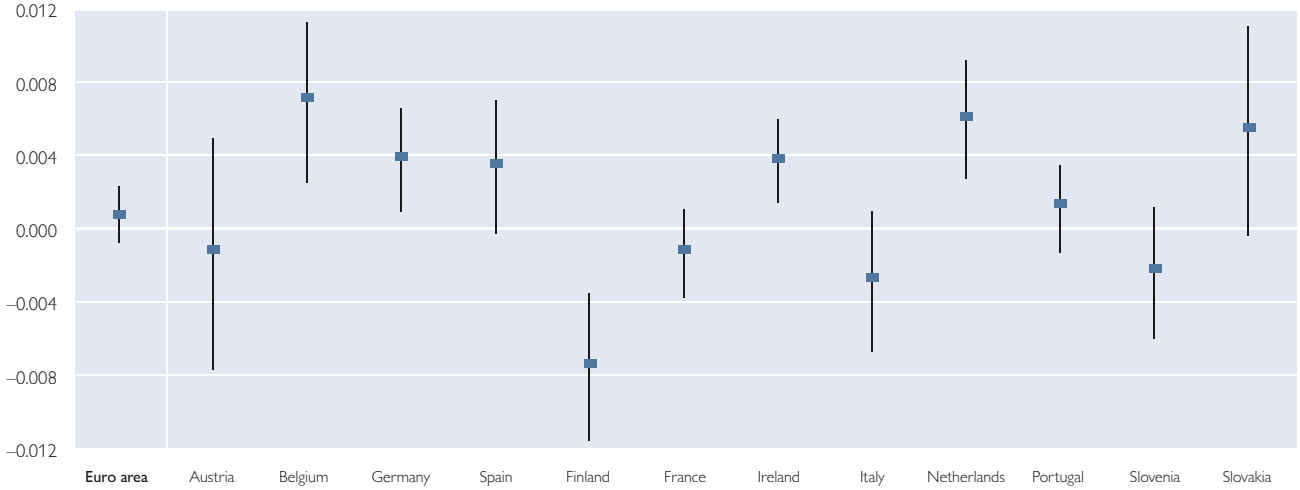
Source: Authors' calculations.

Chart 2A

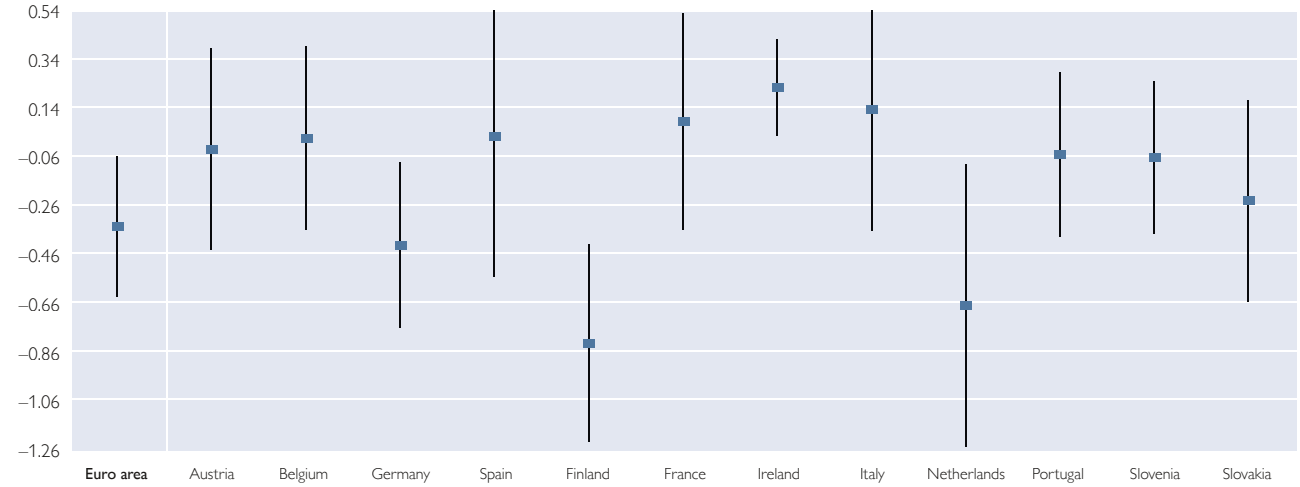
Effects on Inflation Expectations Heterogeneity for the Countries of the Euro Area
Point Estimates with 90% Confidence Intervals

Inflation

Relative price variability



Output gap



Source: Authors' calculations.