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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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The effect of information on consumer inflation expectations

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Abstract

This paper examines how information provision affects consumers' inflation expectations. Using data from a representative Dutch household survey, we document that providing information about current and past inflation rates, as well as the ECB's inflation target, brings inflation expectations closer to the target and reduces the upward bias typically found in the literature. The beneficial effect of information holds across various types of inflation expectations and time horizons. We also find that consumers' reactions to information are heterogeneous, with women, respondents with low levels of education and income, and renters showing stronger reactions to information provision. Finally, we observe that the effect of information provision on inflation expectations in times of normal economic activity is similar to its effects during periods of large economic shocks such the start of the Covid-19 pandemic, the Ukraine war and the start in 2022 of the monetary tightening cycle following a strong increase in inflation.

Keywords: inflation expectations, shocks, information acquisition, monetary policy.

JEL Classifications: D10, D84, D90, E31, E52.

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1 Introduction

This paper examines the impact of information on inflation expectations of households, and how it depends on socio-economic characteristics of households and the presence of large shocks in the economy. We use data from a representative Dutch household survey of short- and long-term inflation expectations, which has been conducted at monthly frequency since December 2019. In this survey, half of respondents receive information about the ECB's inflation target, as well as current and past realised inflation.

Our paper relates to the growing literature that tries to explain the drivers of inflation expectations held by households. A rich body of evidence has documented the overestimation of inflation perceptions by households, leading to an upward bias in inflation expectations (see Reiche and Meyler, 2022 for an overview). Evidence has been reported among others for the United States (e.g. Ehrmann et al., 2017; D'Acunto et al., 2021a), the euro area (Arioli et al., 2016; Cecchetti et al., 2021) and individual European countries (e.g. Denmark, see Albidgren and Kuchler, 2021, or Italy, see Rondinelli and Zizza, 2020). The upward bias in consumers' inflation perceptions has been explained by inattention to inflation – particularly during periods of low inflation (Carroll, 2003; Bracha and Tang, 2022; Powell, 2022), socio-economic characteristics and economic uncertainty. The upward bias has also been linked to the way households' expectations are gathered, and in particular in terms of wording of the questions, sample design and interview methodology (Airoli et al., 2016). For example, Rondinelli and Zizza (2020) show that the bias is lower when inflation expectations are collected using probabilistic questions rather than questions for a point estimate.

There is also evidence of significant heterogeneity of expectations across households, which has been found to be systematically correlated with some socio-demographic characteristics, in particular age, gender, education and income.¹ Income has for instance been found to matter for consumers' inflation expectations in studies by Jonung (1981) and Dräger et al. (2014).

Various studies have shown that gender matters for both the upward bias of household expectations and their heterogeneity.² Using data on households from Sweden, Jonung (1981) documents that female survey respondents report higher levels of perceived inflation, while levels of inflation expectations tend to decline with age. D'Acunto et al. (2021b) present evidence of systematic differences in inflation expectations across genders in the United States, which they relate to traditional gender roles in grocery shopping.

Malmendier and Nagel (2015) provide evidence that cross-sectional variation in inflation expectations can be explained by age, to the extent that cohorts differ in their average inflation expectations because they learn from their different lifetime inflation experiences. Conrad et al. (2022) find evidence for a role of information channels and lifetime experience in households'

¹ For a recent survey on heterogeneous expectations among professional forecasters see Conrad and Lahiri (2023).

² See Di Nino et al. (2022) for an overview.

inflation expectations. They show that the information channels which households use to inform themselves about monetary policy are closely related to their socioeconomic characteristics, and influence the level and uncertainty of perceived past and expected future inflation. They also find that the expected future change in inflation and the unemployment rate is also influenced by individual experience of these variables. They conclude that while households obtain inflation numbers from the media, their ‘economic model’ is shaped by experience.

There is evidence that large shocks have an impact on the formation mechanism of inflation expectations by households. Goldfayn-Frank and Wohlfart (2020) document that inflation expectations by East Germans households exceed those of households from West Germans even decades after reunification, even though actual inflation rates in East and West Germany converged by 1994, five years after the fall of the Berlin Wall. The authors argue that these differences reflect a persistent effect of the inflation shock in East Germany that occurred in the years after German reunification. They conclude that large shocks and changes in the economic environment may have permanent effects on households’ expectations. Dräger et al. (2022a) find that the large shock of the invasion of Ukraine in 2022 affected German households’ short-term inflation expectations, but less so than those of professionals. Detmers et al. (2022) find for the New York Fed Survey of Consumer Expectations survey that policies aimed at containing the Covid pandemic led to higher inflation expectations and inflation uncertainty, with some heterogeneity in the effect for different demographic groups.

Reiche and Meyler (2022) provide a detailed analysis of the link between overestimation of inflation by households, heterogeneity of expectations across households, and perceived uncertainty. They argue that in surveys of household expectations, uncertain respondents tend to have higher perceptions of current inflation and higher expectations of future inflation, because they tend to round their answers to multiples of 5 or 10. In turn, inflation uncertainty also depends systematically on socio-demographic characteristics (gender, age, income and education). A negative economic shock that increases individual inflation uncertainty would then also lead to higher inflation perceptions and higher inflation expectations.

A related finding of the literature is that inflation perceptions and inflation expectations can be related to economic sentiment. In particular, households with negative economic sentiment tend to report higher perceived inflation and higher inflation expectations compared to households with positive attitudes about the economic situation (Kamdar, 2019; Binder, 2020; Candia et al., 2020; Reiche and Meyler, 2022).

Recent papers studying the effect of information provision on households’ inflation expectations include Nghiem et al. (2024), who find in a survey experiment for German households at the height of the inflation surge in early 2023 that the provision of information about the ECB’s inflation target and projections could better anchor their medium-term inflation expectations, with the effect being largest for respondents with high financial literacy and high trust in the central bank.³ Coibion et al. (2022) and Dräger et al. (2022b) find that information

³ A related strand of the literature using market-based or professionals’ survey inflation expectations studies the effect of regular macroeconomic news on inflation expectations, see eg Nautz et al. (2017) and Apokoritis

about current or projected inflation in both low and high inflation regimes significantly affects consumers' inflation expectations. Weber et al. (2023) find that as inflation rose in advanced economies, households became more attentive and informed about inflation, leading them to respond less to exogenously provided information about inflation and monetary policy, suggesting that inattention is endogenous and depends on the economic environment. When the same agents were repeatedly provided information in low- and high inflation environments, Weber et al. (2023) found a negative relationship between the level of inflation and the magnitude of the inflation treatment effects.⁴

The features of the DNB Household Survey allow us to study the effects of information on inflation expected in the Netherlands as well as in the euro area one year and ten years ahead. Three important results emerge from our empirical analysis. Our main finding is that providing information about current and past inflation as well as the ECB's target brings inflation expectations closer to the target and reduces the upward bias. We document this effect of information provision on both short- and long-term inflation expectations. The paper also finds heterogeneous reactions of consumers to information. In particular, the groups that initially have higher inflation expectations (women, individuals with low levels of education and low income, renters) react more strongly to the provision of information. Finally, we find that the effects of information are the same in times of large economic shocks as in normal times. In both environments, information about the current and past level of inflation brings inflation expectations closer to the ECB's target.

The remainder of this paper is organized as follows. Section 2 describes our data, in particular the annual DNB Household Survey (DHS) and the monthly DHS satellite survey on inflation expectations of consumers in the Netherlands. Section 3 presents the empirical methodology and the main results on inflation perceptions and expectations and the effect of information provision. Section 4 discusses the effect of large economic shocks (the start of the Covid-19 pandemic, the Ukraine war and the start in July 2022 of the monetary tightening cycle following a strong increase in inflation) for inflation perceptions and expectations, and Section 5 elaborates on the role of information provision in these periods. Finally, Section 6 concludes.

2 Data

In this paper, we use data from a satellite survey of the DHS, a longitudinal database of economic and psychological aspects of financial behaviour of Dutch households, which started in 1993.⁵ The monthly DHS satellite survey has been conducted since December 2019.⁶ In this survey household members in the DHS panel for the Netherlands are asked quantitative questions on the level and probability distribution of short-term (one-year ahead) and long-term (ten-years ahead) inflation

et al. (2024). Born et al. (2022) and Born et al. (2023) find that macroeconomic news is incorporated into survey inflation expectations of firms in a way which violates the full-information rational expectations assumption.

⁴ See the recent survey on consumers' inflation expectations of Dräger and Lamla (2023) for more references.

⁵ A detailed description of the DHS can be found in Teppa and Vis (2012).

⁶ For more details on the special satellite survey see Galati et al. (2021, 2023).

expectations, as well as a question on perceived inflation over the last twelve months. The questions on inflation levels are posed monthly, while probabilistic expectations appear in the survey every quarter.

The paper uses data from December 2019 until September 2023. More than 2000 respondents participate every month, and the majority of them continue to be present in the survey in subsequent waves, thus allowing a substantial panel dimension with a total of around 100,000 observations. In September 2023, for example, 3179 households received the questionnaire, of which 2326 (73,2% of all participants) provided complete survey responses and 35 (1,1% of all participants) incomplete survey responses. Response rates have remained stable over the whole sample period and are comparable to those of consumer surveys in other countries.

The monthly frequency of the DHS satellite survey is high compared to many existing household surveys, and allows studying the dynamics of short- and long-term inflation expectations around large economic shocks that have occurred during our sample period.

Respondents in this survey are randomly assigned to four distinct groups (see Figure 1 for a schematic representation). The first two groups are asked about inflation in the Netherlands, while the third and fourth groups receive questions about inflation in the euro area. Participants from the first group do not receive any background information and are asked also about their perception of current inflation. Participants from the second group receive information about past and current inflation in the Netherlands (including a time series plot of inflation in the Netherlands since 1999) and the ECB's inflation target. Similarly, participants in the fourth group are provided with information about past and current inflation in the euro area (including a time series plot of euro area inflation since 1999) as well as the ECB's inflation target. Participants in the third group do not receive background information and are asked to report their perceived current inflation in the euro area.

The main variables of interest for this paper are consumers' inflation perceptions and inflation expectations. There is one question on inflation perceptions in the monthly DHS satellite survey, which asks participants the following: "What do you think inflation currently is in the Netherlands/euro area?". There are several questions that elicit consumers' inflation expectations. First, the survey has a quantitative question on one-year ahead inflation expectations, which is worded in the following way: "What do you think the rate of inflation will be over the next twelve months?". Second, there is a quantitative question about long-term inflation expectations which is elicited as follows: "What do you think the rate of inflation will be 10 years in the future?". These two questions are included in the monthly questionnaire.⁷ In addition, once every quarter probabilistic questions are fielded about one-year ahead and ten-year ahead inflation expectations, which ask the respondents to allocate probabilities to 10 bins of potential future inflation values.⁸

The standard DHS survey elicits information on a rich set of socio-economic characteristics of

⁷ The exact wording of this question is provided in Appendix A.

⁸ The exact wording of this question is provided in Appendix A.

the respondents, including gender, age, education, household income, region of residence and whether the respondent has a partner. We use this information to control for individual factors that may be important for inflation expectation formation.

3 The effect of information: Empirical method and results

In this paper we analyse the responses to the DHS satellite survey together with information on socio-economic characteristics of survey participants to shed new light on the role of information for the formation of inflation expectations. In this section we first study how information provision about the current and past level of inflation as well as the ECB’s inflation target affects consumers’ inflation expectations. Second, we examine the heterogeneity of information effects and to what extent it reflects socio-economic characteristics of the respondents, specifically gender, income, education and home ownership. Furthermore, we test whether the impact of information decreases when it is provided repeatedly. In Section 4 we go on to investigate whether household inflation expectations differ between periods of normal economic activity and periods in which large shocks occur, such as the Covid-19 pandemic, the Ukraine war and the start of monetary tightening in response to surging inflation. Finally, in Section 5 we investigate whether the role of information is different during periods of large shocks compared to tranquil periods.

3.1 The effect of information about past and current inflation

Before analysing the role of information provision, it is important to establish how informed consumers are about inflation. In line with the finding of the literature that consumers’ inflation perceptions tend to be higher than actual inflation (Reiche and Meyler, 2022), survey responses in our data set also reveal that inflation perceived by consumers is different from actual HICP statistics (Figure 2). The gap is especially large during the period of low and stable inflation before mid-2021, and again when inflation declined from its peak at end-2022. This wider gap during periods of low inflation is in line with papers that highlight that households tend to be particularly inattentive during periods of low inflation (Carroll, 2003; Bracha and Tang, 2022; Powell, 2022).

If households do not know the actual current inflation rate, does providing them with information affect their inflation expectations? To study how information provision about the current and past levels of inflation as well as the ECB’s inflation target affects consumers’ inflation expectations, we estimate the following regressions,

$$E[\pi_{i,t+12} | I_{i,t}] = \alpha + \beta_1 Info_i + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $E[\pi_{i,t+12} | I_{i,t}]$ refers to expectations of individual i about inflation over the next 12 months elicited in period t , $I_{i,t}$ denotes the information set that household i has in period t , $Info_i$ is a time-invariant dummy variable equal to 1 if a consumer was provided with information, and zero

otherwise, and $X_{i,t}$ is a vector of socio-economic characteristics of household i at time t , namely gender, age, education, household income, region of residence and whether the respondent has a partner. Here and in all the other regressions in the paper, we estimate the regressions using OLS and robust standard errors (Eicker-White standard errors). We estimate equation (1) separately for inflation expectations in the euro area and in the Netherlands. We also estimate the regression of equation (1) when replacing consumers' short-term inflation expectations one year ahead with their long-term inflation expectations ten years ahead.

The DHS satellite survey elicits probabilistic short-term and long-term inflation expectations, and we can therefore test the effect of information provision on the probability assigned to the highest inflation bin as well as on the probability that inflation is going to be close to the ECB's target. Equation 2 shows the OLS regression that tests for the effects of information provision on the elicited subjective probabilities,

$$SP_{i,t} = \alpha + \beta_1 Info_i + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (2)$$

where $SP_{i,t}$ refers to the subjective probability attached by individual i at time t to inflation 1 year ahead being higher than or equal to 4%. We estimate equation (2) separately for subjective probabilities of expected inflation in the euro area and in the Netherlands. We also estimate the regression of equation (2) when replacing consumers' subjective probabilities of inflation one year ahead with those of inflation ten years ahead.

Table 1 shows that providing information about current and past inflation significantly decreases short-term (one-year ahead) and long-term (ten-year ahead) inflation expectations of consumers, both for expected inflation in the Netherlands and in the euro area. The effect is stronger for expected inflation in the euro area. Moreover, the information provision decreases the probability that individuals attach to future inflation being higher than 4% (Table 2). The weight consumers put on the highest inflation bin is 3-6 percentage points lower than in the control group that does not receive information. The largest effect is observed for long-term inflation expectations.

Next, we estimate equation (2) when replacing the left-hand side variable by the subjective probability attached by individual i at time t to inflation 1 year ahead being close to the ECB's target, with closeness being defined as 1% or higher but less than 3%. We also estimate the corresponding regression for the expected probability of inflation 10 years ahead being close to the ECB's target. We again find that information provision pushes inflation expectations of households in the direction of the ECB's target (Table 3). Thus, when consumers are provided with information, they reallocate some probability mass from the highest inflation bin towards bins closer to 2%.

Moreover, we estimate equation (2) when replacing the left-hand side variable by the variance derived from the subjective probability distribution of future inflation. This variance also decreases in response to information (Table 4). We interpret this variance as a measure of consumers' uncertainty about future inflation. However, this effect is observed only for uncertainty about future inflation in the Netherlands.

Finding 1 (*Information provision affects all types of inflation expectations*). Providing households with information about past and current inflation as well as the inflation target decreases their inflation expectations both 12 months ahead and 10 years ahead. The probability attached to the highest values of future inflation also drops, while the expected probability that inflation is going to stay around the ECB’s target increases. The results apply both to expected inflation in the Netherlands and in the euro area.

3.2 Heterogeneity in the information effects and socio-economic characteristics

To examine the heterogeneity of information effects and to what extent it reflects socio-economic characteristics of the respondents, we run regressions of the following form,

$$E[\pi_{i,t+12}|I_{i,t}] = \alpha + \beta_1 Info_i + \beta_2 Group_i + \beta_3 Group_i \cdot Info_i + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (3)$$

where $Group_i$ refers to a dummy variable equal to 1 if an individual i belongs to a specific socio-economic group and 0 otherwise. In particular, we focus on gender, income, education and home ownership. We estimate equation (3) separately for inflation expectations in the euro area and in the Netherlands. We also estimate equation (3) when replacing consumers’ inflation expectations one year ahead with those ten years ahead.

Among socio-economic characteristics, gender has been found to matter for inflation expectations of households. Higher households’ inflation expectations of women compared to men are an established finding by inter alia Jonung (1981) and D’Acunto et al. (2021a,b).⁹ Our results confirm these findings, as Table 5 documents that women have higher short-term and long-term inflation expectations. Moreover, the wedge between inflation expectations of women and men is larger for long-term expectations. Importantly, there are also differences across genders in the effect of information provision on inflation expectations. The impact of information is stronger for women.

Next, we test whether income affects consumers’ inflation expectations, as e.g. in Jonung (1981) and Dräger et al. (2014). We find that low-income individuals have higher short-term and long-term expectations of inflation in the Netherlands, but we find no difference for expectations of euro area inflation (Table 6). Both low-income and higher-income consumers adjust their expectations of inflation in the Netherlands downward in response to information, but low-income individuals react more. Low-income consumers respond to information about inflation in the euro area in the same way as higher-income individuals.

We support the findings of the previous literature on the importance of education for inflation expectations (Table 7). We define a high level of education as either finishing higher vocational

⁹ For professionals, by contrast, Apokoritis et al. (2024) find that inflation expectations of women were better anchored than those of men during a long period of low inflation.

education (HBO) or scientific/academic education (WO), and find that highly educated individuals expect lower inflation in the Netherlands. As for income, we find no differences for expected inflation in the euro area. Moreover, individuals with low education react to the provided information about inflation in the Netherlands more. The effect of information is larger for long-term inflation expectations.

We are not aware of any research papers that specifically examine differences in inflation expectations between homeowners and renters. However, the existing literature on the impact of monetary policy on households' expectations does consider the role of household heterogeneity in its effectiveness. Research on US data, for example, shows that homeowners revise down their near-term inflation expectations in response to a rise in mortgage rates, while renters are less likely to do so (Ahn et al., 2022). We document differences between inflation expectations of renters and homeowners in general (Table 8). Homeowners have lower expectations for short- and for long-term inflation expectations both for the Netherlands and the euro area. Renters adjust their short-term and long-term expectations downward when provided with information. Owners adjust their short-term expectations less than renters (with the exception of long-term inflation expectations in the Netherlands). One interpretation of this result is that against the background of persistent increases in house prices, homeowners tend to overweight their house price expectations in forming their inflation expectations. Using the Survey of Consumer Expectations by the Federal Reserve Bank of New York and the Survey of Consumers by the University of Michigan, Dhamija et al. (2023) find evidence for this link for US households.

Finding 2 (Heterogeneous Effects of Information Provision). *Women, individuals with low level of education and low income, as well as renters have higher short-term and long-term inflation expectations. These groups react more strongly to information provision.*

3.3 High and low inflation regimes

Next, we verify whether the finding of previous research that when inflation is high consumers tend to be more informed (e.g. Carroll, 2003; Bracha and Tang, 2022) also holds for our dataset. Recent randomised control trial survey experiments also established that information provision is much less effective during periods of high inflation (Weber et al., 2023). The data from the DHS satellite survey is particularly well-suited for studying whether information effects are the same during periods of high and low inflation. The survey started in December 2019, a period characterised by low and stable inflation. It continued through 2022 and 2023, during which the Netherlands and the euro area experienced the largest inflation increases in decades. We construct a dummy variable to differentiate between a low inflation period and a high inflation period, with the high inflation period lasting from November 2021 until August 2023. Then we run the following regressions,

$$E[\pi_{i,t+12}|I_{i,t}] = \alpha + \beta_1 Info_i + \beta_2 High\ inflation_t + \beta_3 High\ inflation_t \cdot Info_i + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (4)$$

where $High\ inflation_t$ is introduced to capture the difference between low and high inflation regimes, and refers to a dummy variable equal to 1 if a survey wave is in the period between December 2019 and October 2021 and 0 otherwise. We estimate equation (4) separately for inflation expectations in the euro area and in the Netherlands, and also estimate it when replacing consumers' inflation expectations one year ahead with those ten years ahead.

Table 9 shows that in a period of high inflation consumers report higher one-year ahead expected inflation. This is consistent with inflation being persistent in the short run and with short-term inflation expectations being dependent on perceptions of current inflation. This result for short-term expectations is consistent with the result of Galati et al. (2022). For 10-year ahead inflation expectations, however, we do not find significant differences between the low inflation period and the high inflation period. Thus, according to these results, the high-inflation dummy variable has no impact on long-term inflation expectations, which is a surprising result in view of the results by Galati et al. (2022). This difference could partly arise since Galati et al. (2022) use panel mean group robust estimation which downweights outliers and the tails of the distribution, and has greater flexibility by allowing estimated coefficients to vary by respondents. Their method is therefore more flexible, and less sensitive to outliers and the tails of the distribution. Moreover, they consider the group with and without information separately. By contrast, we use pooled OLS, which is more sensitive to the tails of the distribution, and assume homogenous coefficients across respondents. We pool the groups with and without information, adding a dummy variable for information provision.

As before, the information treatment leads to lower short-term and long-term inflation expectations for Dutch as well as euro area expected inflation. The information effect is comparable across the low and high inflation periods, except that the information treatment reduces short-term euro area inflation expectations more in the period of high inflation than in the period of low inflation.

3.4 The effect of repeated information

Since the DHS satellite survey is a panel dataset, it is particularly well suited to investigate whether repeated information provision is more or less effective compared to a one-off information treatment. In the literature there is evidence of panel conditioning – i.e. the influence of participation in previous survey rounds on respondents' answers to questions in later rounds – in surveys of household inflation expectations (Bańkowska et al., 2021; Weber et al., 2022; Kim and Binder, 2023). Using a dummy variable for respondents occurring in the survey for the first time, we can split the observations into those referring to the first participation of a respondent and all subsequent occurrences.

Table 10 shows that households tend to have higher inflation expectations when they first appear in the survey. The reaction of inflation expectations in the Netherlands to information provision is not significantly different for first occurrences and for subsequent occurrences. Euro area inflation

expectations, however, are reduced more as a result of informing respondents about current and past inflation and the ECB's inflation target when respondents participate in the inflation survey for the first time, compared with participations in follow-up surveys. In a period of rising inflation, this is consistent with the finding of Weber et al. (2023) that when the same agents are repeatedly provided information, there is a negative relationship between the level of inflation and the magnitude of the inflation treatment effects. This different result for Dutch inflation expectations and euro area inflation expectations may reflect that respondents are more familiar with Dutch prices and price increases than with those in the euro area as a whole. An alternative explanation is that individuals form beliefs relying on processes that differ from the standard rational-inattention framework, and hence call for enriching such a framework to explain the set of facts we document (D'Acunto et al., 2021a). For instance, research in cognitive psychology such as Watanabe et al. (2001) and Seitz and Watanabe (2005) documents that frequent stimuli affect perceptual learning irrespective of individuals' attention to such stimuli.

3.5 Outliers

A common feature of consumer inflation surveys is the presence of outliers. Roughly 1.5-2% of households in each survey wave have inflation expectations that are higher than 30% or lower than -5%. Most of the extreme observations are of very high inflation rather than of high deflation. There is evidence that cognitive abilities are an important determinant of extreme responses. Using data from a survey of men serving in the Finnish military and the Consumer Survey of Statistics Finland from 2001 to 2015, D'Acunto et al. (2022) document that forecast errors for one-year ahead inflation are substantially higher for individuals with mid-to-low IQ levels compared to those of participants with high IQ levels. Other important socio-economic characteristics established by previous research which are associated with higher inflation expectations and therefore may drive outliers include gender, income, education and age (Weber et al., 2022).

We look at "information" and "no information" groups separately, because they potentially contain different types of households. In the "information" group, consumers who report extreme values for inflation expectations while being provided with the numbers for current inflation either did not take it into account or react to it differently. In contrast, in the "no information" group, consumers who were uninformed stay uninformed.

We run linear probability models with a dummy equal to 1 if a household has inflation expectations higher than 30% or lower than -5% as the dependent variable, and various socio-economic characteristics as independent variables, controlling for time fixed effects. Table 11 shows that renters, younger individuals, households with lower income and a lower level of education are more likely to have extremely high or extremely low inflation perceptions and expectations. The same socio-economic groups are more likely to report outliers for expected inflation if they receive information about current and past inflation (Table 12).

4 The effect of shocks on inflation expectations

In section 3.2 we established that certain socio-economic groups react to information provision more. A second potential dimension of heterogeneity is whether inflation expectations are formed differently in periods of large economic shocks or in times of normal economic activity. This question is relevant for monetary policy because in times of turmoil policymakers are especially interested in managing inflation expectations.

Reiche and Meyler (2022) introduce the (un)certainty channel as a means to shed light on some of the more puzzling aspects of reported quantitative inflation perceptions and expectations. These include the apparent overestimation of inflation by consumers, as well as the negative correlation observed between the economic outlook and household inflation expectations, as documented by Candia et al. (2020). Reiche and Meyler (2022) also show that the uncertainty framework fits with some of the stylised facts of consumers' inflation expectations, such as their correlation with socio-demographic characteristics and economic sentiment.

The sample period of the DHS survey allows to study the effects of several shocks. We focus on three events: the first Covid-19 lockdown in the Netherlands, the onset of the war in Ukraine, and the first ECB policy rate increase since 2011. First, we study the effect of these shocks on inflation expectations and then, in section 5, we look into the question of whether the effects of information provision on inflation expectations are different in times of shocks.

4.1 Empirical methodology

As was highlighted above, the shocks we choose to study are the first Covid-19 lockdown, the start of the war in Ukraine and the ECB rate increase in July 2022. Where relevant, we use the time of announcement of the event as the time of the shock. The first Covid-19 lockdown in the Netherlands was announced on 20 March 2020. The war in Ukraine began on 24 February 2022. The first ECB rate hike since 2011 as inflation surged was announced on 21 July 2022. All these events were largely unexpected by economic agents. Moreover, they capture different types of shocks.

We apply an event study methodology and study the change in inflation perceptions and expectations in the narrow window around a shock. Based on the number of observations, we chose a window of 30 days in the following equation,¹⁰

$$E[\pi_{i,t+12}|I_{i,t}] = \alpha + \beta_1 Shock_t + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (5)$$

where $Shock_t$ is a dummy variable equal to 1 for the period of 30 days after a shock and equal to 0 for 30 days before a shock. We estimate equation (5) separately for inflation expectations in the euro area and in the Netherlands, and also estimate it when replacing consumers' inflation expectations one year ahead with those ten years ahead.

¹⁰ This particular time window allows to have roughly 1,000 observations before and after an event.

4.2 Results

The Ukraine war shock is associated with an increase in short-term inflation expectations, both for the Netherlands and the euro area (Table 13). The expectations of inflation in the Netherlands and the euro area 10 years ahead also increase, but for the euro area the effect is statistically not significant. Perceived inflation does not move in response to the war shock, most likely because the strong upward effect of the Ukraine war on energy and food prices did not materialise yet in the time frame that we study.

We observe a different reaction to the Covid lockdown announcement (Table 14). While this event has no statistically significant impact on short-term inflation expectations, we do observe a reaction of long-term inflation expectations. In particular, expected long-term inflation in the Netherlands and the euro area moves downward. As was the case with the start of the Ukraine war, we do not observe a response of inflation perceptions to the start of the lockdown.

This is different for the first ECB rate increase, which is associated with higher inflation perceptions (Table 15). Short-term inflation expectations for both the Netherlands and the euro area are also higher directly following the announcement of the first interest rate hike of the ECB, whereas there is no effect on long-term inflation expectations.

These three cases illustrate that the reaction of household inflation perceptions and expectations depends on the nature of the economic shock. The onset of the Ukraine war led consumers to raise short-term inflation expectations, which makes sense in case they foresaw supply constraints as a result of the war, while the impact on long-term inflation expectations are mixed, perhaps related to uncertainty about the length of the war and its long-term effects. The Covid lockdown effect of reducing long-term inflation expectations may also be related to uncertainty about the future and its long-term economic consequences.

Higher perceived inflation after the announcement of the ECB's interest rate hike might be attributed to the information channel of monetary policy. If the ECB rate hike reveals to consumers that current inflation is actually higher than they thought, a positive reaction of their inflation perceptions can be observed.¹¹ For the start of the Ukraine war or the Covid lockdown, such an effect on inflation perceptions is not to be expected. Higher short-term inflation expectations directly after the announcement of the interest rate hike are consistent with the information channel as well. The absence of the effect on long-term inflation expectations may suggest that consumers are confident that the higher inflation is short-lived.

Finding 3 (Differential Effects of Shocks on Perceptions and Expectations). *The reaction of inflation perceptions and expectations to shocks depends on the nature of the shock. The war in Ukraine led to higher short-term and long-term expectations. The Covid lockdown had a negative*

¹¹ Alternatively, higher inflation perceptions can be explained by price movements during this period in the Netherlands and the euro area. July 2022 was the month of extremely high inflation and also a substantial inflation jump relative to the previous months.

effect only on long-term inflation expectations. The first ECB rate hike shifted short-term perceptions and expectations upwards.

5 The effect of information during shocks

5.1 Empirical methodology

Finally, we study whether information provision affects inflation expectations differently during the time of big shocks, by adding an interaction term in the following equation,

$$E[\pi_{i,t+12}|I_{i,t}] = \alpha + \beta_1 Info_i + \beta_2 Shock_t + \beta_3 Shock_t \cdot Info_i + \gamma^T X_{i,t} + \varepsilon_{i,t} \quad (6)$$

which we estimate separately for inflation expectations in the euro area and in the Netherlands, and also estimate when replacing consumers' inflation expectations one year ahead with those ten years ahead.

5.2 Results

Tables 16 to 18 show that the effects of information provision are the same during normal economic times and when shocks hit. The only exception is the downward revision of short-term euro area inflation expectations around the start of the war in Ukraine, which is mitigated by the provision of information about past and current inflation rates and the ECB's inflation target.

6 Conclusions

This paper examined how information provision affects consumers' inflation expectations. Using data from a representative Dutch household survey, we documented that providing information about current and past inflation rates, as well as the ECB's inflation target, brings inflation expectations closer to the target and reduces the upward bias typically found in the literature. The beneficial effect of information holds across various types of inflation expectations and time horizons, for short-term and long-term inflation expectations, as well as both for the Netherlands and the euro area. Moreover, we found that there is no difference in the effect of the first and subsequent provision of information.

We also found that consumers' reactions to information are heterogeneous, with women, individuals with low levels of education and income, and renters showing stronger reactions to information provision. The finding about renters is novel in the literature. Moreover, we found that some consumers, whose inflation expectations are outliers in the probability distribution of expected inflation, especially in the group provided with information, do not react to information in the same way as the consumers whose inflation expectations are not outliers. This suggests that the communication strategy of central banks should be tailored to the audience.

Finally, we observed that the effect of information provision on inflation expectations in times of normal economic activity is similar to its effects during periods of large economic shocks such as the start of the Covid-19 pandemic, the Ukraine war and the start in 2022 of the ECB's monetary tightening cycle following a strong increase in inflation. This is the case even though the reaction of inflation perceptions and expectations to shocks depends on the nature of the shock.

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Figures

Figure 1: Randomisation in the DHS satellite survey

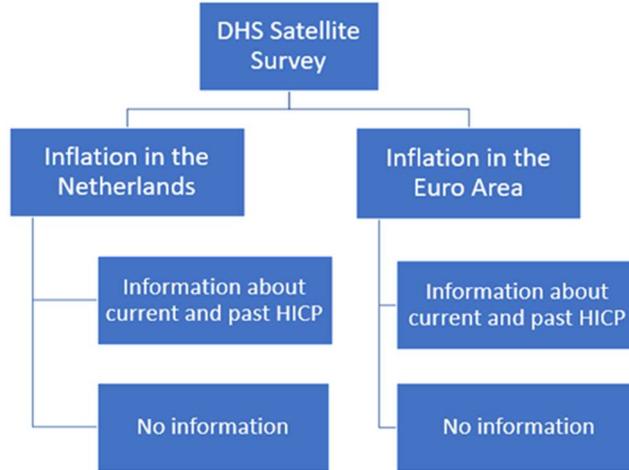
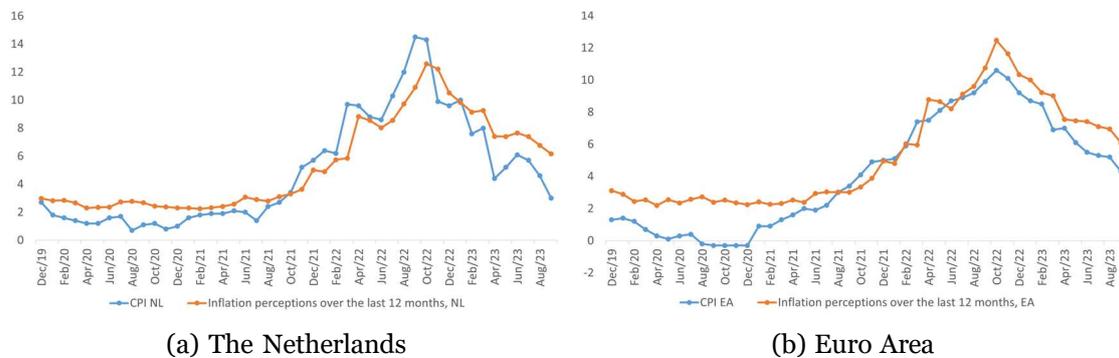


Figure 2: Dynamics of mean inflation perceptions and actual HICP inflation



Sources: DHS satellite survey. Perceptions: Means, observations truncated to interval $[-5; +30]$.

Tables

Table 1: Information Effects on Level Inflation Expectations

| Dependent variable: Inflation Expectations | | | | |
|--|--------------------|--------------------|--------------------|--------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.52*** (0.03) | -0.50*** (0.05) | -0.82*** (0.03) | -0.94*** (0.05) |
| constant | 3.61*** (0.15) | 6.10*** (0.27) | 3.23*** (0.16) | 6.74*** (0.27) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52989 | 50987 | 54207 | 52018 |
| <i>R</i> ² | 0.28 | 0.05 | 0.28 | 0.04 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-
Huber-White) in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, *
 $p < 0.1$. Wave controls include a dummy for each wave. Socio-demographic controls
include gender, household income, education, age, region and a dummy equal to 1
if a respondent has a partner. The dependent variable (short-term inflation
expectations) is measured by answers to the quantitative survey question: “What
do you think the rate of inflation will be over the next twelve months?”. The
dependent variable (long-term inflation expectations) is measured by the
quantitative survey question: “What do you think the rate of inflation will be 10
years in the future?”. *NL* and *EA* denote whether expectations refer to future
inflation in the Netherlands or in the euro area. *Info* denotes a dummy variable
that equals 1 if a household was provided with information about current and past
inflation, and 0 otherwise. Expectations are truncated to [30;-5]. The data span
waves 1-46 of the survey (December 2019 - September 2023).

Table 2: Information Effects on Probabilistic Inflation Expectations

| Dependent variable: Probability attached to the highest inflation bin | | | | |
|---|--------------------|--------------------|--------------------|--------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -3.09*** (0.45) | -4.75*** (0.56) | -4.48*** (0.46) | -6.56*** (0.56) |
| constant | 3.47** (1.60) | 20.31*** (2.06) | 9.98*** (1.65) | 25.48*** (2.09) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 18500 | 18357 | 18939 | 18777 |
| <i>R</i> ² | 0.38 | 0.09 | 0.36 | 0.08 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-
Huber- White) in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, *
 $p < 0.05$. Wave and socio-demographic controls are the same as in Table 1. The
dependent variable (short-term expected probabilities) is measured by the following
survey question: “In your view, what is the chance that, over the next 12 months,
the rate of inflation will be 4% or higher”. The dependent variable (long-term expected
probabilities) is measured by the following survey question: “In your view, what is
the chance that, 10 years in the future, the rate of inflation will be 4% or higher”. *NL*
and *EA* denote whether expectations refer to future inflation in the Netherlands or
in the euro area. *Info* is defined as in Table 1. The data span waves 1-46 of the
survey (December 2019 - September 2023)

Table 3: Information Effects on Probabilistic Inflation Expectations

| Dependent variable: Probability attached to inflation around the ECB's target | | | | |
|---|--------------------|--------------------|--------------------|--------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | 3.66*** (0.42) | 4.54*** (0.46) | 1.69*** (0.42) | 4.38*** (0.46) |
| constant | 53.14*** (1.62) | 38.25*** (1.64) | 48.55*** (1.63) | 37.84*** (1.69) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 18503 | 18356 | 18938 | 18776 |
| <i>R</i> ² | 0.30 | 0.10 | 0.27 | 0.08 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-Huber- White) in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave and socio-demographic controls are the same as in Table 1. The dependent variable is measured by the quantitative survey question: "In your view, what is the chance that, over the next 12 months (10 years), the rate of inflation will be 2% or higher, but less than 3% or the rate of inflation will be 1% or higher, but less than 2%". *NL* and *EA* denote whether expectations refer to future inflation in the Netherlands or in the euro area. *Info* is defined as in Table 1. The data span waves 1-46 of the survey (December 2019 - September 2023)

Table 4: Information Effects on Uncertainty about Future Inflation

| Dependent variable: Variance of the subjective probability distribution of future inflation | | | | |
|---|--------------------|--------------------|-------------------|-------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.29*** (0.05) | -0.49*** (0.10) | 0.06 (0.05) | 0.15*** (0.05) |
| constant | 2.44*** (0.19) | 4.70*** (0.41) | 1.40*** (0.19) | 1.16*** (0.19) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 9607 | 9531 | 9725 | 9688 |
| <i>R</i> ² | 0.06 | 0.04 | 0.03 | 0.02 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-Huber- White) in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave and socio-demographic controls are the same as in Table 1. The dependent variable is measured as the variance derived from the subjective probability distribution of inflation expectations over the next year (10 years). *NL* and *EA* denote whether expectations refer to future inflation in the Netherlands or in the euro area. *Info* is defined as in Table 1. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 5: Gender and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|--------------------|--------------------|--------------------|--------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.32*** (0.04) | -0.06 (0.07) | -0.56*** (0.04) | -0.72*** (0.07) |
| Female | 0.29*** (0.05) | 1.13*** (0.08) | 0.56*** (0.05) | 0.78*** (0.08) |
| Female*Info | -0.43*** (0.07) | -0.92*** (0.11) | -0.46*** (0.06) | -0.46*** (0.11) |
| constant | 3.57*** (0.14) | 6.50*** (0.25) | 3.43*** (0.15) | 7.16*** (0.26) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52989 | 50987 | 54207 | 52018 |
| <i>R</i> ² | 0.28 | 0.05 | 0.28 | 0.04 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-
Huber- White) in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave and socio-demographic controls are the same as in Table 1. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *NL* and *EA* denote whether expectations refer to future inflation in the Netherlands or in the euro area. *Info* is defined as in Table 1. Expectations are truncated to [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 6: Income and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|--------------------|--------------------|--------------------|--------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.43*** (0.04) | -0.31*** (0.06) | -0.79*** (0.04) | -0.93*** (0.06) |
| Low income | 0.64*** (0.07) | 0.90*** (0.11) | 0.08 (0.07) | -0.09 (0.10) |
| Low income*Info | -0.37*** (0.09) | -0.81*** (0.14) | -0.04 (0.08) | 0.08 (0.13) |
| constant | 3.08*** (0.13) | 5.38*** (0.25) | 2.68*** (0.15) | 5.87*** (0.25) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52989 | 50987 | 54207 | 52018 |
| <i>R</i> ² | 0.28 | 0.05 | 0.27 | 0.04 |

Notes: Columns 1-4 report OLS estimates, with robust standard errors (Eicker-
Huber- White) in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave and socio-demographic controls are the same as in Table 1. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *NL* and *EA* denote whether expectations refer to future inflation in the Netherlands or in the euro area. *Info* is defined as in Table 1. Expectations are truncated to [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 7: Education and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|-----------------------|----------------------|-----------------------|-----------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.75*** (0.05) | -0.48*** (0.07) | -0.98*** (0.05) | -1.066*** (0.0714) |
| High education | -0.752*** (0.0483) | -1.163*** (0.076) | -0.627*** (0.0480) | -1.031*** (0.081) |
| High education*Info | 0.543*** (0.0631) | -0.113 (0.104) | 0.460*** (0.0626) | 0.393** (0.107) |
| constant | 4.055*** (0.141) | 7.339*** (0.256) | 3.813*** (0.154) | 7.773*** (0.259) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52918 | 50914 | 54107 | 51932 |
| <i>R</i> ² | 0.286 | 0.056 | 0.279 | 0.047 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-demographic controls include gender, household income, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a household was provided with information about current and past inflation and 0 otherwise. Expectations are truncated to [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023)

Table 8: Home ownership and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|-----------------------|-----------------------|-----------------------|----------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.833*** (0.0758) | -0.312*** (0.111) | -1.475*** (0.0783) | -1.680*** (0.117) |
| Homeowners | -0.650*** (0.0688) | -0.516*** (0.0990) | -0.897*** (0.0715) | -0.752*** (0.108) |
| Home-owners*Info | 0.417*** (0.0834) | -0.238* (0.126) | 0.853*** (0.0858) | 0.976*** (0.132) |
| constant | 3.735*** (0.157) | 6.063*** (0.274) | 3.709*** (0.166) | 7.151*** (0.277) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52193 | 50213 | 53772 | 51600 |
| <i>R</i> ² | 0.285 | 0.050 | 0.281 | 0.045 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a household was provided with information about current and past inflation and 0 otherwise. Expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 9: High-inflation Environment and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|-----------------------|-----------------------|-----------------------|----------------------|
| | NI | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.490*** (0.0356) | -0.529*** (0.0659) | -0.621*** (0.0362) | -1.003*** (0.068) |
| High inflation | 2.793*** (0.154) | -0.351 (0.274) | 3.163*** (0.168) | 0.144 (0.280) |
| High inflation*Info | -0.0660 (0.0675) | 0.0670 (0.107) | -0.422*** (0.0663) | 0.142 (0.108) |
| constant | 3.597*** (0.149) | 6.110*** (0.267) | 3.121*** (0.160) | 6.771*** (0.271) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52989 | 50987 | 54207 | 52018 |
| <i>R</i> ² | 0.282 | 0.047 | 0.277 | 0.043 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a household was provided with information about current and past inflation and 0 otherwise. Expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 10: First Occurrence in the Panel and Information Effects

| Dependent variable: Inflation Expectations | | | | |
|--|-----------------------|----------------------|-----------------------|-----------------------|
| | NI | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | -0.522*** (0.0332) | -0.48*** (0.0534) | -0.801*** (0.0327) | -0.914*** (0.0539) |
| First Occurrence | 0.324 (0.235) | 0.917*** (0.351) | 0.638*** (0.217) | 1.215*** (0.343) |
| First Occurrence*Info | 0.0288 (0.188) | -0.454 (0.329) | -0.339* (0.191) | -0.633* (0.330) |
| constant | 3.260*** (0.252) | 5.366*** (0.393) | 2.736*** (0.250) | 5.798*** (0.400) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 52989 | 50987 | 54207 | 52018 |
| <i>R</i> ² | 0.282 | 0.047 | 0.276 | 0.043 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-demographic controls include gender, household income, age, education, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a household was provided with information about current and past inflation and 0 otherwise. Expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 11: Socio-economic Characteristics of Outliers in the "No Information" Group

| Dependent variables: Inflation Perceptions and Expectations | | | | | | |
|---|-----------------------------|-----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|
| | NL | | | EA | | |
| | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| homeowner | -0.00709*** (0.00223) | -0.0151*** (0.00265) | -0.0524*** (0.00425) | -0.0214*** (0.00244) | -0.0220*** (0.00255) | -0.0423*** (0.00417) |
| female | 0.00137 (0.00170) | 0.000229 (0.00193) | 0.00900*** (0.00315) | 0.000912 (0.00179) | 0.00551*** (0.00197) | 0.00598* (0.00315) |
| age | -0.000693*** (0.0000547) | -0.000591*** (0.0000565) | -0.000259*** (0.000085) | -0.000672*** (0.0000602) | -0.000738*** (0.0000644) | -0.000658*** (0.0000916) |
| partner | 0.00155 (0.00190) | 0.00766*** (0.00224) | 0.0325*** (0.00360) | -0.00107 (0.00182) | 0.00234 (0.00192) | -0.0110*** (0.00342) |
| west (not 3 biggest cities) | -0.00135 (0.00302) | 0.00283 (0.00318) | -0.0180*** (0.00554) | -0.0121*** (0.00316) | -0.0119*** (0.00334) | -0.00801 (0.00492) |
| north | -0.00964*** (0.00339) | 0.00322 (0.00397) | -0.0113* (0.00629) | -0.00787** (0.00394) | -0.00896** (0.00410) | -0.0149*** (0.00574) |
| east | -0.0104*** (0.00288) | -0.00876*** (0.00303) | -0.0258*** (0.00566) | -0.0195*** (0.00313) | -0.0195*** (0.00331) | -0.0146*** (0.00498) |
| south | -0.00909*** (0.00291) | -0.00936*** (0.00304) | -0.0248*** (0.00555) | -0.0192*** (0.00287) | -0.0176*** (0.00308) | -0.00672 (0.00487) |
| low income | 0.00545* (0.00293) | 0.0170*** (0.00325) | 0.0224*** (0.00493) | 0.0137*** (0.00296) | 0.0127*** (0.00328) | 0.0101** (0.00489) |
| medium income | 0.000786 (0.00169) | 0.00372** (0.00171) | 0.0107*** (0.00315) | 0.000614 (0.00184) | -0.00381* (0.00211) | 0.00508 (0.00343) |
| medium level of education | -0.00695 (0.00648) | -0.0434*** (0.00925) | -0.0548*** (0.0123) | 0.0107** (0.00517) | 0.0149*** (0.00531) | 0.0344*** (0.00724) |
| high level of education | -0.0183*** (0.00642) | -0.0531*** (0.00910) | -0.0763*** (0.0122) | -0.00150 (0.00513) | 0.0000320 (0.00527) | 0.00761 (0.00738) |
| constant | 0.0726*** (0.00948) | 0.101*** (0.0118) | 0.145*** (0.0167) | 0.0889*** (0.0105) | 0.0718*** (0.00984) | 0.126*** (0.0154) |
| Wave dummies | + | + | + | + | + | + |
| Controls | + | + | + | + | + | + |
| N | 26720 | 26700 | 26537 | 26811 | 26790 | 26635 |
| R ² | 0.019 | 0.023 | 0.034 | 0.028 | 0.029 | 0.028 |

Notes: Columns 1-6 report OLS estimates (linear probability model). Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05. Wave controls include a dummy for each wave. The dependent variables are dummy variables equal to 1 if inflation perceived current inflation (expected future inflation) is above 30% or below -5%. NL and EA denote whether a household is asked about the future inflation in the Netherlands or in the Euro Area. Only respondents from the groups that received no information are included in the estimation. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 12: Socio-economic Characteristics of Outliers in the "Information" Group

| Dependent variables: Inflation Expectations | | | | |
|---|-----------------------------|----------------------------|-----------------------------|-----------------------------|
| | NL | | EA | |
| | 1Y ^{exp} (1) | 10Y ^{exp} (2) | 1Y ^{exp} (3) | 10Y ^{exp} (4) |
| homeowner | -0.0145*** (0.00203) | -0.0266*** (0.00316) | -0.0263*** (0.00246) | -0.0408*** (0.00357) |
| female | 0.00103 (0.00175) | -0.00600** (0.00273) | -0.000189 (0.00177) | 0.000630 (0.00279) |
| age | -0.000183*** (0.0000483) | -0.000316*** (0.000079) | -0.000616*** (0.0000590) | -0.000975*** (0.0000845) |
| partner | -0.000415 (0.00182) | -0.00220 (0.00289) | 0.00402* (0.00212) | 0.00619* (0.00325) |
| west (not 3 biggest cities) | -0.00126 (0.00222) | -0.00915** (0.00407) | 0.00648** (0.00280) | 0.00807* (0.00415) |
| north | -0.00531** (0.00252) | -0.0148*** (0.00468) | -0.00240 (0.00314) | 0.0324*** (0.00585) |
| east | 0.00918*** (0.00266) | 0.00270 (0.00446) | 0.0130*** (0.00320) | 0.0163*** (0.00460) |
| south | 0.0145*** (0.00277) | 0.0104** (0.00452) | 0.000319 (0.00280) | 0.000804 (0.00421) |
| low income | 0.0224*** (0.00301) | 0.0347*** (0.00431) | -0.00936*** (0.00321) | -0.0138*** (0.00459) |
| medium income | -0.000909 (0.00153) | 0.00755*** (0.00268) | -0.00887*** (0.00231) | -0.000845 (0.00330) |
| medium level of education | -0.0190*** (0.00586) | -0.0407*** (0.00860) | -0.0398*** (0.00820) | -0.0395*** (0.00996) |
| high level of education | -0.0274*** (0.00576) | -0.0535*** (0.00856) | -0.0626*** (0.00813) | -0.0759*** (0.00992) |
| constant | 0.0574*** (0.00929) | 0.150*** (0.0153) | 0.122*** (0.0112) | 0.201*** (0.0157) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| N | 26328 | 26164 | 28056 | 27819 |
| R ² | 0.020 | 0.027 | 0.024 | 0.031 |

Notes: Columns 1-4 report OLS estimates (linear probability model). Robust standard errors (Eicker-
Huber-White) are reported in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05.
Wave controls include a dummy for each wave. The dependent variables are dummy variables equal to
1 if inflation expected future inflation is above 30% or below -5%. *NL* and *EA* denote whether a household
is asked about the future inflation in the Netherlands or in the Euro Area. Only respondents from the
groups that received information are included in the estimation. The data span waves 1-46 of the survey
(December 2019 - September 2023).

Table 13: The Effect of Ukraine War on Inflation Perceptions and Expectations

Dependent variables: Inflation Perceptions and Expectations

| | NL | | | EA | | |
|----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $I_{30d}^{afterwar}$ | 0.0913 (0.160) | 1.141*** (0.150) | 0.489* (0.266) | -0.114 (0.204) | 0.932*** (0.151) | 0.392 (0.257) |
| constant | 5.455*** (0.613) | 5.961*** (0.570) | 4.570*** (0.830) | 8.705*** (0.846) | 5.558*** (0.598) | 6.100*** (0.919) |
| Controls | + | + | + | + | + | |
| N | 1194 | 2349 | 2264 | 1131 | 2362 | 2279 |
| R ² | 0.020 | 0.037 | 0.016 | 0.028 | 0.021 | 0.018 |

Notes: Columns 1-6 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation perceptions) is measured by the quantitative survey question: "What do you think inflation currently is in the Netherlands/euro area?". The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". NL and EA denote whether a household is asked about the future inflation in the Netherlands or in the Euro Area. Perceptions and expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 14: The Effect of Covid Lockdown on Inflation Perceptions and Expectations

| Dependent variables: Inflation Perceptions and Expectations | | | | | | |
|---|---------------------|---------------------|----------------------|---------------------|---------------------|----------------------|
| | NL | | | EA | | |
| | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} | 1Y ^{perc} | 1Y ^{exp} | 10Y ^{exp} |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| I_{30d}^{covid} | -0.215 (0.223) | 0.112 (0.144) | -1.071*** (0.308) | -0.135 (0.208) | 0.179 (0.156) | -0.781*** (0.301) |
| constant | 2.745*** (0.742) | 2.002*** (0.475) | 4.755*** (1.012) | 3.457*** (0.751) | 2.923*** (0.585) | 5.902*** (1.059) |
| Controls | + | + | + | + | + | + |
| N | 987 | 1953 | 1876 | 974 | 1996 | 1907 |
| R ² | 0.032 | 0.010 | 0.018 | 0.062 | 0.023 | 0.021 |

Notes: Columns 1-6 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation perceptions) is measured by the quantitative survey question: "What do you think inflation currently is in the Netherlands/euro area?". The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". NL and EA denote whether a household is asked about the future inflation in the Netherlands or in the Euro Area. Perceptions and expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 15: The Effect of ECB Rate Hike on Inflation Perceptions and Expectations

| Dependent variables: Inflation Perceptions and Expectations | | | | | | |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| | NL | | | EA | | |
| | 1Y perc | 1Y exp | 10Y exp | 1Y perc | 1Y exp | 10Y exp |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $I_{30d}^{ecb_rate}$ | 1.114*** (0.226) | 0.799*** (0.206) | 0.351 (0.301) | 0.500** (0.253) | 0.522** (0.204) | 0.0612 (0.295) |
| constant | 8.003*** (0.910) | 7.958*** (0.745) | 8.030*** (1.052) | 10.38*** (1.087) | 7.618*** (0.741) | 6.078*** (0.924) |
| Controls | + | + | + | + | + | + |
| <i>N</i> | 1052 | 2127 | 2015 | 1090 | 2204 | 2087 |
| <i>R</i> ² | 0.048 | 0.033 | 0.019 | 0.030 | 0.015 | 0.020 |

Notes: Columns 1-6 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation perceptions) is measured by the quantitative survey question: "What do you think inflation currently is in the Netherlands/euro area?". The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *NL* and *EA* denote whether a household is asked about the future inflation in the Netherlands or in the Euro Area. Perceptions and expectations are truncated [30;-5]. The data span waves 1-46 of the survey (December 2019 - September 2023).

Table 16: Information Effects at the Time of the Ukraine War Shock

| Dependent variable: Inflation Expectations | | | | |
|--|---------------------|---------------------|----------------------|----------------------|
| | NL | | EA | |
| | 1Y | 10Y | 1Y | 10Y |
| | (1) | (2) | (3) | (4) |
| Info | -0.118 (0.188) | -0.262 (0.354) | -1.047*** (0.208) | -0.989*** (0.350) |
| $I_{30d}^{afterwar}$ | 1.100*** (0.219) | 0.525 (0.382) | 0.602** (0.249) | 0.175 (0.386) |
| $I_{30d}^{afterwar}*Info$ | 0.0839 (0.299) | -0.0700 (0.533) | 0.632** (0.306) | 0.402 (0.515) |
| constant | 6.031*** (0.580) | 4.734*** (0.867) | 6.068*** (0.626) | 6.602*** (0.946) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| <i>N</i> | 2349 | 2264 | 2362 | 2279 |
| <i>R</i> ² | 0.037 | 0.017 | 0.033 | 0.022 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-White) are reported in parentheses. Significance levels: *** p<0.001, ** p<0.01, * p<0.05. Wave controls include a dummy for each wave. Socio-demographic controls include gender, household income, education, age, region and a dummy equal to 1 if a respondent has a partner. The dependent variable (short-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be over the next twelve months?". The dependent variable (long-term inflation expectations) is measured by the quantitative survey question: "What do you think the rate of inflation will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a household was provided with information about current and past inflation and 0 otherwise. $I_{30d}^{afterwar}$ is a dummy variable equal to 1 for the period of 30 days after the start of the war in Ukraine (24 February 2022) and 0 for 30 days before this date. Expectations are truncated to [30;-5].

Table 17: Information Effects at the Time of the Covid Shock

| Dependent variable: Inflation Expectations | | | | |
|--|----------|-----------|----------|-----------|
| | NL | | EA | |
| | 1Y | 10Y | 1Y | 10Y |
| | (1) | (2) | (3) | (4) |
| Info | -0.345* | -1.583*** | -0.501** | -1.428*** |
| | (0.185) | (0.430) | (0.198) | (0.423) |
| I_{30d}^{covid} | 0.134 | -1.458*** | 0.189 | -1.012** |
| | (0.221) | (0.460) | (0.234) | (0.456) |
| $I_{30d}^{covid} * Info$ | -0.0186 | 0.845 | -0.0211 | 0.470 |
| | (0.290) | (0.609) | (0.317) | (0.606) |
| constant | 2.202*** | 5.642*** | 3.059*** | 6.508*** |
| | (0.492) | (1.056) | (0.593) | (1.104) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| N | 1953 | 1876 | 1995 | 1906 |
| R^2 | 0.014 | 0.027 | 0.029 | 0.029 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-
Huber-White) are reported in parentheses. Significance levels: *** $p < 0.001$,
** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-
demographic controls include gender, household income, education, age, region
and a dummy equal to 1 if a respondent has a partner. The dependent variable
(short-term inflation expectations) is measured by the quantitative survey
question: "What do you think the rate of inflation will be over the next twelve
months?". The dependent variable (long-term inflation expectations) is measured
by the quantitative survey question: "What do you think the rate of inflation
will be 10 years in the future?". *Info* denotes the dummy variable equal to 1 if a
household was provided with information about current and past inflation and
0 otherwise. I_{30d}^{covid} is a dummy variable equal to 1 for the period of 30 days
after the first Covid-19 lockdown in the Netherlands (12 March 2020) and 0 for
30 days before this date. Expectations are truncated to [30;-5].

Table 18: Information Effects at the Time of the first ECB Rate Hike

| Dependent variable: Inflation Expectations | | | | |
|--|---------------------|---------------------|----------------------|---------------------|
| | NL | | EA | |
| | 1Y (1) | 10Y (2) | 1Y (3) | 10Y (4) |
| Info | 0.0196 (0.412) | 0.706 (0.604) | -1.401*** (0.273) | -0.338 (0.409) |
| $I_{30d}^{ECB\ rate}$ | 0.794** (0.309) | -0.00752 (0.440) | 0.501 (0.316) | 0.378 (0.424) |
| $I_{30d}^{ECB\ rate} * Info$ | -0.436 (0.280) | -0.512 (0.416) | 0.0332 (0.405) | -0.635 (0.590) |
| constant | 8.231*** (0.762) | 8.306*** (1.081) | 8.210*** (0.751) | 6.177*** (0.947) |
| Wave dummies | + | + | + | + |
| Controls | + | + | + | + |
| N | 2127 | 2015 | 2204 | 2087 |
| R^2 | 0.035 | 0.020 | 0.036 | 0.023 |

Notes: Columns 1-4 report OLS estimates. Robust standard errors (Eicker-
Huber-White) are reported in parentheses. Significance levels: *** $p < 0.001$,
** $p < 0.01$, * $p < 0.05$. Wave controls include a dummy for each wave. Socio-
demographic controls include gender, household income, education, age, region
and a dummy equal to 1 if a respondent has a partner. The dependent variable
(short-term inflation expectations) is measured by the quantitative survey
question: "What do you think the rate of inflation will be over the next twelve
months?". The dependent variable (long-term inflation expectations) is
measured by the quantitative survey question: "What do you think the rate
of inflation will be 10 years in the future?". *Info* denotes the dummy variable
equal to 1 if a household was provided with information about current and
past inflation and 0 otherwise. I_{30d}^{ECB} is a dummy variable equal to 1 for the
period of 30 days after the first rate hike by the ECB and 0 for 30 days before
this date. Expectations are truncated to [30;-5].

Appendix A: Survey Questions

1. **Inflation perceptions:** *What do you think inflation currently is in the Netherlands/euro area?*

Please provide a percentage (%). Inflation is the percentage change in consumer prices over twelve months. If you think prices increased, please fill in a positive percentage. If you think prices decreased, please fill in a negative percentage (insert a minus sign (-) before the number). If you think prices did not change, please fill in 0 (zero).

Answer: [...] %

2. **Quantitative short-term inflation expectations:** *We are interested in your opinion on what will happen to inflation in the Netherlands/euro area over the next twelve months. Inflation is the percentage change in consumer prices over twelve months. What do you think the rate of inflation will be **over the next twelve months**?*

Please give your best guess. If you think prices will increase, please fill in a positive percentage. If you think prices will decrease, please fill in a negative percentage (insert a minus sign (-) before the number). If you think prices will not change, please fill in 0 (zero).

Answer: [...] %

3. **Probabilistic short-term inflation expectations:** *Now we would like you to think about the different things that may happen to inflation in the Netherlands/euro area **over the next 12 months**. Please allocate 100 points in the table below indicating how likely in your view the listed inflation rates, were 0 points means no chance at all and 100 points means absolutely sure. In your view, what is the chance that, **over the next 12 months**,*

- The rate of inflation will be 4% or higher
- The rate of inflation will be 3% or higher, but less than 4%
- The rate of inflation will be 2% or higher, but less than 3%
- The rate of inflation will be 1% or higher, but less than 2%
- The rate of inflation will be 0% or higher, but less than 1%
- The rate of deflation (negative of inflation) will be between 0% and 1%
- The rate of deflation (negative of inflation) will be between 1% and 2%
- The rate of deflation (negative of inflation) will be between 2% and 3%

- The rate of deflation (negative of inflation) will be between 3% and 4%
- The rate of deflation (negative of inflation) will be 4% or higher

The points should sum to a total of 100.

4. **Quantitative long-term inflation expectations:** *We are interested in your opinion on what will happen to inflation in the Netherlands/euro area **10 years in the future**. What do you think the rate of inflation will be **10 years in the future**?*

Please give your best guess. If you think prices will increase, please fill in a positive percentage. If you think prices will decrease, please fill in a negative percentage (insert a minus sign (-) before the number). If you think prices will not change, please fill in 0 (zero).

Answer: [...] %

5. **Probabilistic long-term inflation expectations:** *Now we would like you to think about the different things that may happen to inflation in the Netherlands/euro area **10 years in the future**. Please allocate 100 points in the table below indicating how likely in your view the listed inflation rates, were 0 points means no chance at all and 100 points means absolutely sure. In your view, what is the chance that, **10 years in the future**,*

- The rate of inflation will be 4% or higher
- The rate of inflation will be 3% or higher, but less than 4%
- The rate of inflation will be 2% or higher, but less than 3%
- The rate of inflation will be 1% or higher, but less than 2%
- The rate of inflation will be 0% or higher, but less than 1%
- The rate of deflation (negative of inflation) will be between 0% and 1%
- The rate of deflation (negative of inflation) will be between 1% and 2%
- The rate of deflation (negative of inflation) will be between 2% and 3%
- The rate of deflation (negative of inflation) will be between 3% and 4%
- The rate of deflation (negative of inflation) will be 4% or higher

The points should sum to a total of 100.

6. **Information provided about inflation and the ECB target**¹²

¹² The following information was provided to respondents of the December 2019 survey. This information was updated each month for subsequent waves of the survey.

- Inflation is the percentage change in consumer prices over twelve months. Most recently, inflation in the Netherlands/euro area was 2.6%/1.0% (see Figure A1/A2).
- The primary objective of the European Central Bank (ECB) is to maintain price stability. The ECB has defined price stability as inflation in the euro area below but close to 2%.

Figure A1: Inflation in the Netherlands (information provided to group 2)

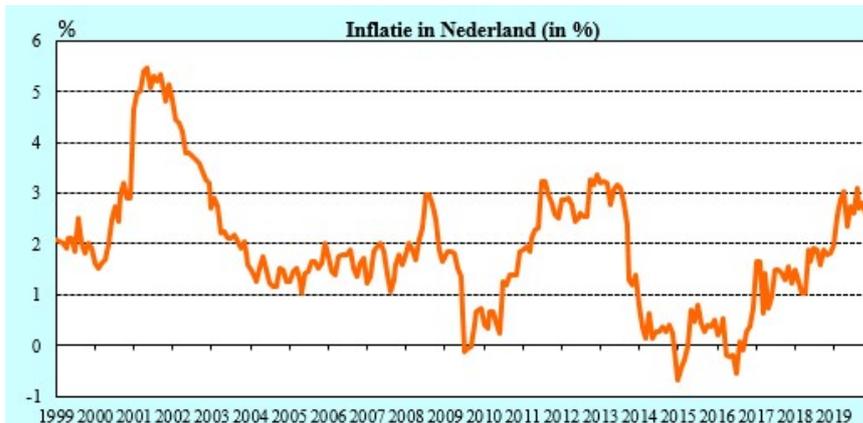


Figure A2: Inflation in the euro area (information provided to group 4)



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