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Drawbacks of Household Panel Data on Inflation Perceptions and Expectations: Representativeness and Selectivity Issues

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Drawbacks of Household Panel Data on Inflation Perceptions and Expectations: Representativeness and Selectivity Issues

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Abstract

By comparing the Bundesbank's BOP-HH and the ECB's CES-ECB household panel surveys with an omnibus survey conducted in Germany in December 2021 and 2022, this paper investigates potential sample selection bias in panel surveys due to (i) individuals' willingness to commit to joining a household panel, and (ii) the 'learning effect' arising participation in multiple waves of the panel. Our analysis shows that focusing on the newcomers in the panel is unlikely to resolve these issues, as they suffer from selection bias and are not representative of the population. We construct new population weights for this subsample and find substantial divergence in opinions between inexperienced and experienced respondents during the high-inflation period of 2022. There are also notable differences in the means, medians, and variances across the three surveys for both years and inflation measures.

Keywords: inflation expectations; inflation perceptions; panel household surveys; selection bias; Germany.

JEL classification: C83, D83, D84, E31, E37.

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1 Introduction

Understanding how laypersons perceive and form expectations about inflation plays a potentially important role in macroeconomic analysis and forecasting, as emphasised by some researchers, such as Weber et al. (2022); D'Acunto et al. (2023); D'Acunto et al. (2024). The underlying argument is that households determine private consumption and their spending behaviour may be affected by how they perceive past and future changes in prices. Moreover, their inflation perceptions/expectations may have an influence on wage setting, credit demand, and other relevant macroeconomic variables.

However, we believe there are a number of issues which reduce the usefulness of household inflation attitudes for macroeconomic purposes. First, there are typical survey problems related to specifying the questions of interest (e.g. Bruine de Bruin et al. (2017)) as well as the answer options (Hayo and Méon, 2023). Second, our reading of the literature is that, on average, laypersons systematically mispredict, typically overpredict, the inflation rate, at least when compared to the inflation rate measured by the consumer price index. Third, it is hard to find strong economic reactions to changes in inflation perceptions and expectations, particularly at moderate levels of inflation (Bachmann et al., 2015; Burke and Ozdagli, 2021; Andrade et al., 2023). Fourth, a substantial number of laypersons appear not to think continuously about inflation and tend to make up the answer when confronted with the respective survey question. In other words, there may be substantial proportion of non-attitudes (Zaller, 1992) in the measured inflation attitudes. For example, Hayo and Neumeier (2023) find in New Zealand during times of low inflation, that only one third of the population state that they regularly monitor the inflation rate.

Nevertheless, despite these issues, there is now a burgeoning literature investigating different dimensions of household's inflation perceptions and expectations (Weber et al., 2022; D'Acunto and Weber, 2024; D'Acunto et al., 2024). Methodologically, the most widespread approach to study people's inflation perceptions and expectations is to conduct representative household surveys (D'Acunto and Weber, 2024). These surveys tend to be of two types: (i) cross-sectional surveys and (ii) household panels. Cross-section surveys are either one-off surveys or they are repeated with different participants. It is quite common that they are part of an omnibus, that is, different topics are combined in one survey, but they can also be focussed on one theme.

In principle, household panels use the same individuals repeatedly over time. For several reasons – for example, loss of interest, lack of time, illness, etc. – it is normal for some participants to drop out of the panel and need to be replaced. This attrition implies that, to some extent, household panels are subject to changing respondents. While most household panels tend to focus on a single theme, there is often a section with varying questions on related topics.

Panel household surveys are often the preferred type, because they allow observation of the development of an individual's attitudes and opinions over time. Moreover,

they enable the inclusion of individual fixed effects, whereas even large cross-sectional surveys may lack potentially important characteristics of individuals. A major obstacle to conducting panel studies is the funding required, which explains why most panels are organised by large institutions, in the case of inflation, these are often central banks.[1]

However, we believe it is important to emphasise that household panels suffer from serious drawbacks, which should make us more cautious when drawing inferences from them for the entire population. So far, only a few researchers mention the problems associated with household panels, specifically that their results may not be representative of the population and all of them focus on inflation expectations, rather than the perception of current or past inflation. The main criticism is based on the 'learning effect' of respondents in panel surveys with fixed participants.[2] Using both the Federal Reserve Bank of New York's Survey of Consumer Expectations (Fed NY SCE) and the Canadian Survey of Consumer Expectations, Bellemare et al. (2020) argues that participants incorporate information and lower their inflation expectations after the first round of participating in the survey. More specifically, Kim and Binder (2023) examine the Fed NY SCE and find that experienced respondents have a keen interest in following current economic trends, revising inflation expectations and uncertainty downward. Most recently, this argument has been supported by evidence in Mitchell et al. (2024) who claimed that the more times interviewees participate, the more accurate and less uncertain their forecasts become. Comerford (2024) finds that in the first round some respondents have lower cognitive reflection than others but improve their forecast accuracy with repeated survey participation. In light of this, Kim and Binder (2023) argue that opinions from all participants in the panel surveys do not reflect the average view of the population. To address this issue, they suggest focusing on and increasing the size of the group of new participants. Along similar lines, Mitchell et al. (2024) propose to report the results based on participants' tenure separately.

In this paper, we argue that implementing these recommendations is insufficient to overcome the drawbacks of household panels with respect to representativeness and selectivity. Instead, we suggest that the problem is much broader and more deep-rooted than previously acknowledged. First, there may be issues with the representativeness of this group, as first-time or new respondents may not match the quota criteria necessary to claim that the sample is representative of the total population. Second, there may be further issues with selectivity, as we would argue that participation in a panel on a specific topic requires an above-average interest in this topic. Third, the existing literature

[1] A number of central banks conduct regular panel household surveys, such as the monthly Federal Reserve Bank of New York's Survey of Consumer Expectations (Armantier et al., 2016), the monthly European Central Bank's Consumer Expectation Survey (Bańkowska et al., 2021), the monthly Bundesbank Online Panel-Households (BOP-HH Team, 2024), the quarterly Bank of Canada's Canadian Survey of Consumer Expectations (Gosselin and Khan, 2015), the biannual Bank of England/NMG Survey of Household Finances (Anderson et al., 2016), and the annual De Nederlandsche Bank's Household Survey (Teppa and Vis, 2012).

[2] This effect is also called 'panel conditioning' in Weber et al. (2022).

employs only one panel survey for one country per study, and there is no comparison of the results with other panel and cross-sectional surveys from the same country at specific points in time. Fourth, the literature on the 'learning effect' has focused exclusively on the United States and it is important to assess the external reliability of this finding in other countries.

Taking this into account, the purpose of this paper is to address the issues associated with household panels by comparing two widely employed surveys, the Bundesbank Online Panel Households (BOP-HH) and the Consumer Expectation Survey of the European Central Bank (CES-ECB), with an omnibus survey (Hayo (2022, 2023), hereafter GfK) conducted in Germany in December 2021 and December 2022. These time periods are particularly interesting, as they allow us to examine how responses to the inflation questions change, conditional on the actual inflationary environment. In December 2021, respondents were not yet affected by the inflation surge, but by December 2022, they had experienced it vividly. We consider both inflation perceptions and expectations, as some studies have shown that inflation perceptions are not only interesting themselves, but are also highly correlated with inflation expectations.[3]

In this paper, we (i) analyse whether there is potential sample selection bias in the panel surveys, (ii) examine whether focusing on a subsample of first-time participants, as recommended by Kim and Binder (2023), addresses the 'learning effect' problem in panel surveys, (iii) compare our results for both inflation perceptions and expectations in the case of Germany, and (iv) investigate the impact on average inflation perceptions and expectations in the household panels once we re-weight the respondents to align with the actual population shares.

Our analysis indicates that about 40% of the participants in the omnibus surveys did not provide a quantitative value for the inflation rate during times of moderate inflation and this value declines to 30% in time of high inflation. This suggests that people's attention for price developments depends on the prevailing inflation environment. However, even in a situation of high inflation, a substantial number of people remain unwilling or unable to provide a numerical inflation answer if they have the choice to do so.

We find that the new participants in panel surveys do not appear to represent average laypersons. They are relatively more dedicated to answering the surveys and more knowledgeable about the topic of inflation. We can also confirm the 'ready-to-learn' attitude observed by Kim and Binder (2023): participants who stay in the panel for more waves tend to have relatively higher response rates on the inflation questions.

We also discover that it is not always possible to replicate a representative cross-sectional survey by using the subsample of first-time participants in a panel survey. For

[3]There is a large body of literature on this result, dating back to the first publication by Jonung (1981) on Swedish households. For example, Hayo and Neumeier (2022) show the high correlation between inflation perceptions and expectations for New Zealand. Using the BOP-HH surveys, Huber et al. (2023) find a strong link between German houshold's inflation perceptions and inflation expectations both in times of low and high inflations.

instance, the CES-ECB in December 2021 did not include any observations in the oldest age category. In this case, it is impossible to use population weights to generate a sample which can be considered representative of the German population.

In other cases, our findings for Germany are consistent with those of Bellemare et al. (2020); Kim and Binder (2023); Mitchell et al. (2024). On average, new participants have different opinions from the average participant in the panel survey, especially when the inflationary environment changes. In particular, we confirm Kim and Binder (2023)'s conjecture that the means and medians of perceived and expected inflation rates for first-time respondents are not different under the two types of weights (the survey's original weight and our newly constructed weight). Interestingly, with the newly constructed weight, we find evidence of a reduction in the variance of point forecasts for first-time participants in 2022.

Focusing on new participants, our paper reveals significant differences in quantitative inflation answers across the three surveys in terms of the mean, median, and variance. BOP-HH participants report lower point estimates than GfK participants, possibly reflecting relatively higher interest in and knowledge of monetary affairs. We observe the highest variance in inflation answers for the CES-ECB. We believe that this could be due to the issue that respondents are forced to provide a numerical answer. The selection in terms of panel participants does not seem strong enough to ensure that only respondents who monitor the inflation rate and have clear opinions remain. But including respondents with non-attitudes typically generates a great deal of noise in the responses. Our findings suggest that researchers studying inflation perceptions and expectations should be cautious of the pitfalls associated with using household panels. The results are likely biased estimates of the underlying population values for inflation perceptions and expectations due to a selection effect and lack of representativeness.

In general, our analysis makes four main contributions. First, it is the first study to use both panel and cross-sectional surveys to compare households' opinions on inflation, demonstrating selectivity issues even for new participants. Second, this research contributes to a better understanding of both perceived and expected inflation in panel household surveys. Third, our paper provides evidence for the recommendation made by Kim and Binder (2023). Fourth, using German data, we offer external reliability for the importance of the 'learning effect' (Kim and Binder, 2023) in household panels. Finally, we contribute to the literature on how to design survey inflation questions by highlighting the inappropriateness of not including 'don't know' and 'don't care' as answer options.

The rest of this paper is organised as follows. We describe briefly the data used in Section 2. In Section 3, we present the potential bias of using the panel household surveys. Section 4 constructs population weights for the new participants of the panel surveys. We also report the new weighted means and variances of inflation perceptions and inflation expectations in comparison to the original weighted ones. Conclusions and implications are given in Section 5.

2 Data

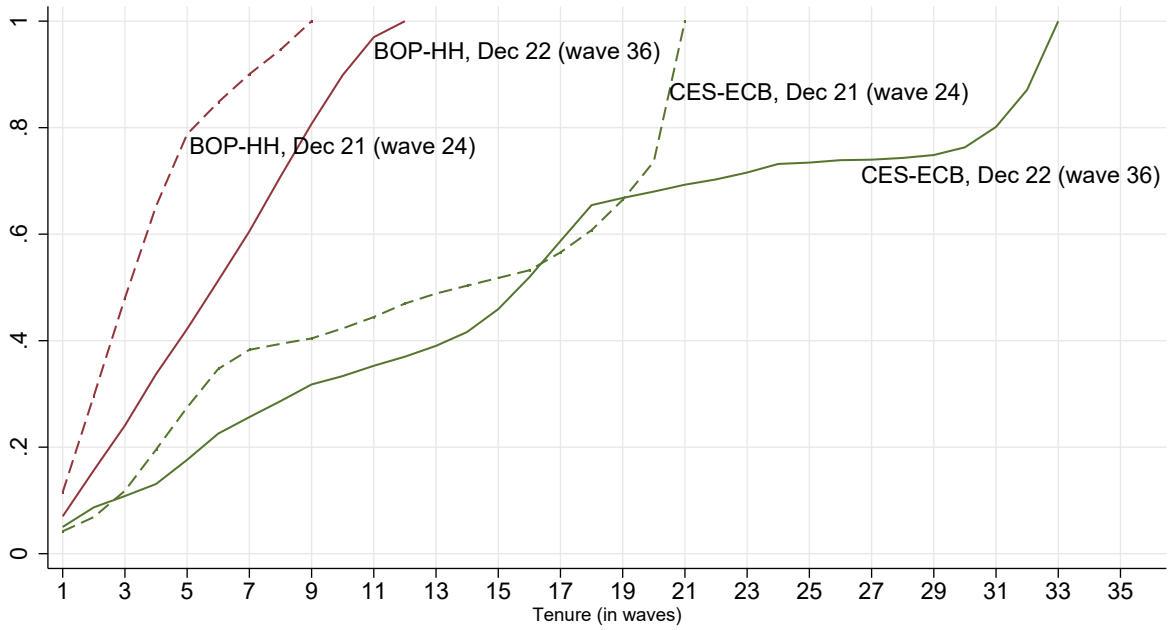
Sample structure This paper utilises data for Germany from wave 24 (December 2021) and wave 36 (December 2022) of two household panel surveys, the BOP-HH and the CES-ECB, carried out by Forsa and IPSOS Public Affairs, respectively. As a yardstick for comparison, our paper also employs data from two representative cross-sectional household surveys developed by Hayo (2022, 2023) and carried out by GfK in December 2021 and December 2022.

Both CES-ECB and BOP-HH are online surveys conducted on a monthly basis, starting from April 2020, with sample sizes ranging from approximately 3000 to 4000 participants, respectively. Each wave is made up of repeat participants and newcomers who participate for the first time or return after a long break after being rotated out of the panel (Bańkowska et al., 2021; BOP-HH Team, 2024). Usually, the share of participants who remain in the survey for a certain period of time (between 12 and 24 months) is much larger than the share of newcomers. Figure A1 in the Appendix briefly describes how the BOP-HH and CES-ECB panels are constructed.[4] Figure 1 shows that after 24 waves (December 2021), 20% of the respondents in the BOP-HH and 65% of the respondents in the CES-ECB respondents participated in more than 5 waves. These numbers increase to around 60% and 80%, respectively, in Wave 36 (December 2022).

Our representative cross-sectional comparison data for December 2021 and December 2022 are from Hayo (2022, 2023). The inflation questions were included in online omnibus surveys conducted by GfK (Gesellschaft für Konsumforschung), one of the largest private research companies in Germany specialising in market research and public opinion surveys. Respondents in each wave were randomly selected from a panel of approximately 60,000 participants, with quotas imposed on sex, age, household size, community size, schooling of head of household, and region. Given the sampling process, it is likely that there was no noteworthy overlap between the 2021 and 2022 respondents.

[4]The methodology used to construct these household panels is similar to that employed in the online monthly New York Fed's Survey of Consumer Expectations (Armantier et al., 2016) starting in June 2013, quarterly Bank of Canada's Survey of Consumer Expectations (Gosselin and Khan, 2015) starting from the fourth quarter of 2014.

Figure 1: Empirical Cumulative of Participated Waves in BOP and CES Surveys



Questions In this paper, we analyse the questions regarding the quantitative perceptions and expectations of inflation rates for the past 12 months and the next 12 months, respectively. While both BOP-HH and GfK directly ask about inflation rates, the CES-ECB inquiries about the growth rate of general prices. Although the questions are slightly different, we find the concepts to be reasonably similar, allowing us to compare the numerical perceptions and expectations about inflation rates in Germany. While differences in the phrasing of inflation questions (Bruine de Bruin et al., 2017) and in the specification of answer options (Hayo and Méon, 2023) may influence the results, researchers often use these questions in a comparable manner. The exact wording of the questions and answer options is as follows:

Perceived Inflation Questions

BOP-HH: What do you think the rate of inflation or deflation in Germany was over the past twelve months? Note: If you assume there was deflation, please enter a negative value. Values may have one decimal place. Please enter a value here: _____ percent.

GfK: What do you think is the current inflation rate in Germany? Please write the percentage here. a) _____% b) I don't monitor the inflation rate. c) Don't know.

CES-ECB: How much higher (lower) do you think prices in general are now compared with 12 months ago in the country you currently live in? Please

give your best guess of the change in percentage terms. You can provide a number up to one decimal place. _____._%

Expected Inflation

BOP-HH: What do you think the rate of inflation (or deflation) will roughly be over the next twelve months? Note: Inflation is the percentage increase in the general price level. It is mostly measured using the consumer price index. A decrease in the price level is generally described as deflation. Please enter a value in the input field (values may have one decimal place) _____ percent.

GfK: What do you expect the inflation rate to be next year? Please write the percentage here. a) _____% b) I don't form opinions about future rates of inflation. c) Don't know.

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

Although the inflation rate questions in GfK refer to the current year for perceptions and the next year for expectations, these time spans are similar to the last 12 months and the next 12 months used in BOP-HH and CES-ECB, as all three surveys were conducted in December.

3 Panel surveys: The potential for sample selection bias

This section addresses the possibility of a sample selection bias due to (i) people's willingness to commit to joining a household panel and (ii) participating in the survey repeatedly (the 'learning effect').

In general, participants in an omnibus survey, which covers many, often diverse topics, do not necessarily have any specific interest in issues related to inflation. This is arguably different for respondents willing to participate in a panel survey specialising in monetary issues. Previous studies have shown that laypersons' interest in and knowledge of monetary issues is generally limited (see Hayo and Neuenkirch (2018) for evidence on Germany), meaning panels are prone to select people with greater interest and knowledge on these issues. Hence, in contrast to respondents in omnibus surveys, panellists are willing to commit to completing a survey repeatedly. One characteristic of panel surveys is that respondents are informed about the recurring nature of the panel before deciding

to participate. The 'ready-to-learn' attitude and the practice of answering the same or similar surveys familiarise them with the topic. Given that they have committed to participating in a panel survey, they are likely to be more alert to news on the topic than the average person in the population.

Figure 2: How Interesting and Difficult is it to answer the BOP-HH Surveys, and How Important is Monetary Policy and Inflation in the GfK Surveys?

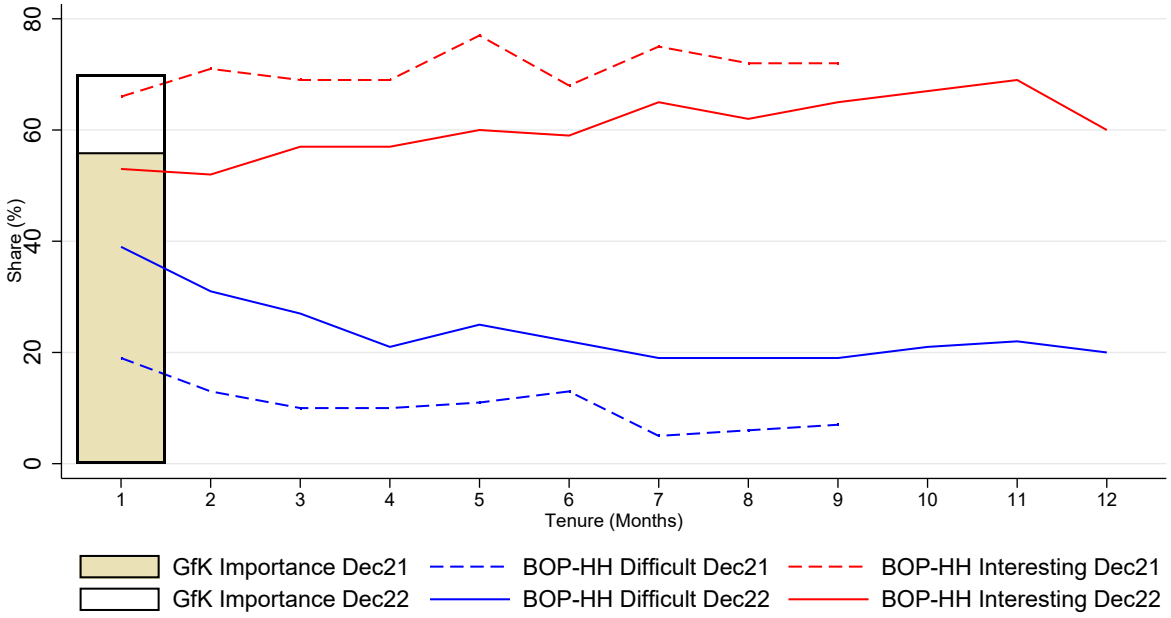


Figure 2 shows that, as panellists' tenure increases, so does their interest in the BOP-HH surveys. Repeat participants also find it easier to answer the survey than new participants do. In December 2022, GfK recorded a higher proportion of responses indicating that inflation was considered 'important' compared to December 2021. These changes are not surprising, as the sharp rise in inflation rates in 2022 raised the attention of laypersons to monetary and finance issues. This type of behaviour supports the imperfect information perspective proposed by Sims (2003) and Caplin and Dean (2015), which has been applied to the present context by Cavallo et al. (2017), who emphasise information frictions, by and Bracha and Tang (2024), who highlight (in)attention. In all approaches, the argument is that consumers are more sensitive and pay more attention to inflation when inflation rates are high. Unfortunately, we cannot compare the results from CES-ECB, as comparable variables are not included in the publicly available dataset.

Reflecting the stronger commitment to regular participation, as well as the higher knowledge of and greater interest in monetary issues of panel participants, we find that both the BOP-HH and the CES-ECB participants are more likely to provide a numerical answer to questions about inflation rates, showing extremely high response rates. Bracha and Tang (2024) use the share of individuals who answer 'Don't know' as a gross measure of inattention. However, this is problematic, as 'Don't know' could mean 'I don't know

how to answer this question', or it could mean 'I do know how to answer this question but I am not sure about the current or future inflation rate'. In any case, it has become standard in the social science literature on conducting surveys, see, e.g. Zaller (1992) to include a 'Don't know' option, and this aspect has also been emphasised recently in economic perspectives on conducting surveys (see, e.g. Stantcheva (2023)).

Table 1: High rates of Responses

	BOP-HH		**CES-ECB**		**GfK**	
	Perceived	Expected	Perceived	Expected	Perceived	Expected
Dec 21						
Total Sample	495	3365	3040	3040	2007	2007
Numerical Sample	481	3318	3040	3040	1295	1135
% of Total Sample	97.2	98.6	100	100	64.5	56.6
Truncated Sample	446	3075	2771	2753	1172	1063
% of Total Sample	90.1	91.4	91.2	90.6	58.4	53
Dec 22						
Total Sample	4687	4687	3103	3103	2013	2013
Numerical Sample	4611	4616	3103	3103	1470	1285
% of Total Sample	98.4	98.5	100	100	73	63.8
Truncated Sample	4206	4263	2852	2825	1340	1168
% of Total Sample	89.7	91	91.9	91	66.6	58

Note: BOP surveys allow 'don't know' answers, whereas CES surveys do not. GfK surveys allow both 'don't know' and 'don't monitor/don't form an opinion'. The truncated sample includes 90% of the distribution to remove outliers due to high dispersion in consumer inflation expectations (Mankiw et al., 2003).

In contrast to these recommendations, the CES-ECB questions 'force' participants to provide a number in the input field because there are no other answer options. The benefit is that the response rate is 100%, but the costs are very noisy answers from people who have not formed a perception or expectation and are now forced to come up with it on the spot. This poses a methodological challenge, as the underlying behavioural assumption is that we measure something that exists independently of our attempt to measure it. Following Campbell et al. (1960), these answers, made up only because of the interview, can be characterised as 'non-attitudes'. Note that this issue should not be confused with the 'social desirability bias', also called 'experimenter demand effect' in the experimental economics literature. Unlike CES-ECB, BOP-HH offers the possibility of responding with 'don't know' and 'no answer'. Nevertheless, the total shares of numerical answers are still remarkably high, namely over 97% in both waves for both inflation measures (see Table 1). Moreover, Table A2 reports similarly high shares when focusing on first-time participants, which suggests that this outcome is not due to a tenure effect.

GfK contains both 'Don't know' and 'I do not monitor the rate' in the question on perceived inflation and 'Don't know' and 'I do not form opinions about future inflation rates' in the question on expected inflation. These options allow us to measure the extent of inattention about the inflation rates more accurately, as in this case, 'Don't know' does not imply that respondents are uninterested in the topic but rather that unable to provide

a concrete number at this point in time. Of those who did not give a numeric answer, about half chose 'Don't know' and the other half chose 'Do not form an opinion' or 'Do not monitor the rate'.[5] This finding suggests that Bracha and Tang (2024) overestimate the degree of inattention. Table 1 reveals a notable share of missing numerical responses in the GfK survey, namely 36% (December 2021) and 27% (Dec 2022) for perceived inflation and 43% (December 2021) and 36% (Dec 2022) for expected inflation.

In summary, this section adds evidence for the existence of a potential sample selection bias when using panel surveys in collecting opinions about inflation. Participants in household panels appear to have stronger commitments, greater interest, and/or better knowledge when asked about the inflation rate than 'normal' laypersons. It is important to emphasise that this selection effect is methodologically different from the 'learning effect' emphasised by Kim and Binder (2023), as we do not find a significant difference between panel respondents who participated for the first time or have already participated several times.

4 Refreshers in Panel Survey

To resolve the 'learning-effect' problem, Kim and Binder (2023) suggest focussing on the new participants and to increase the size of this subsample. This proposal, however, may introduce new issues, as it could interfere with the aim of working with a representative sample of the population. In this section, we show that the subsample of first-time participants in the panel surveys is not representative. Then we construct appropriate population weights for these participants and recalculate the first two moments of the perceived and expected inflation rates.

4.1 The representativeness issue

While the full sample in each wave of a household panel survey aim to be representative of the underlying population, the subsample of new respondents does not always reflect it. To check the representativeness of each survey-wave, we concentrate on three widely-used quota variables in population surveys: age group, gender, and education level.[6] To facilitate the comparison, we recode the data from the BOP-HH and GfK surveys according to the chosen categories in the CES-ECB's survey. The question on educational attainment is not identical in the three surveys. Therefore, we combine the categories in BOP-HH and in GfK to match CES-ECB. The exact matching is reported in Table A1 in the Appendix.

[5] Tables A4 and A5 provide some demographic statistics for each group.

[6] The variables on region or residential area are also used as quota variables; however, we cannot use them as they are not in the published CES-ECB dataset. Likewise, we do not have these variables in the BOP-HH for December 2022.

Table 2 reports the weighted percentages (using the original weights) of age groups in the first-time respondents' sample survey wave (Column 2 to 7) compared to those in the population (Column 8).[7] The samples of new respondents in BOP-HH and CES-ECB from December 2021 and December 2022 are substantially overrepresented by the youngest group, which is about 1.5 or 3 times larger than in the population. Similarly, the oldest groups in BOP-HH (December 2021, December 2022) and CES-ECB (December 2022) exceed their population numbers by a factor of 2 to 4. Moreover, the CES-ECB (December 2021) contains no observations in the age range above 70. Correspondingly, the middle-aged groups (from 35 to 70) are substantially underrepresented in both waves of BOP-HH and CES-ECB. By design, these discrepancies do not appear in the two GfK samples.

Table 2: Percentages of each Age Group of first-time participants with original weights

	BOP-HH		**CES-ECB**		**GfK**		**Pop.**
	Dec21	Dec22	Dec21	Dec22	Dec21	Dec22	
Under 35	41.1	57.3	77.4	48.8	26.8	25.7	26.5
35-49	16.6	18.7	16.0	16.3	27.0	28.1	27.5
50-70	30.7	15.2	6.5	17.0	41.8	41.3	41.5
Above 70	11.6	8.7	.	18.0	4.4	4.9	4.5
No. of Obs	389	329	128	156	2007	2013	

Note: Pop. stands for Population.

For gender and education level, we report the percentages in Table A6. We find that the male/female ratios and the three education level percentages in the BOP-HH and CES-ECB also differ from those prevailing in the general population.

Thus, the group of new participants does not represent the entire population. In the case where there are no observations in one or more subgroups, a proper reweighting cannot be done at all. Even when a few observations are available, applying high weights to these may exacerbate potential idiosyncrasies of the respondents, which could potentially invalidate inference. Furthermore, even if there is sufficient representation from all subgroups, using the original weight, which is generated for the entire sample of each wave, may not ensure representativeness of the population.

4.2 Reweight the new-participants' subsample

In this section, we recalculate the mean, median, and standard deviation values for perceived and expected inflation rates using constructed weights for new participants based on three criteria: age group, gender, and education level (ase weights).[8] We are interested

[7] Note that the original weight is the weight that ensures representativeness for the entire sample of each survey-wave.

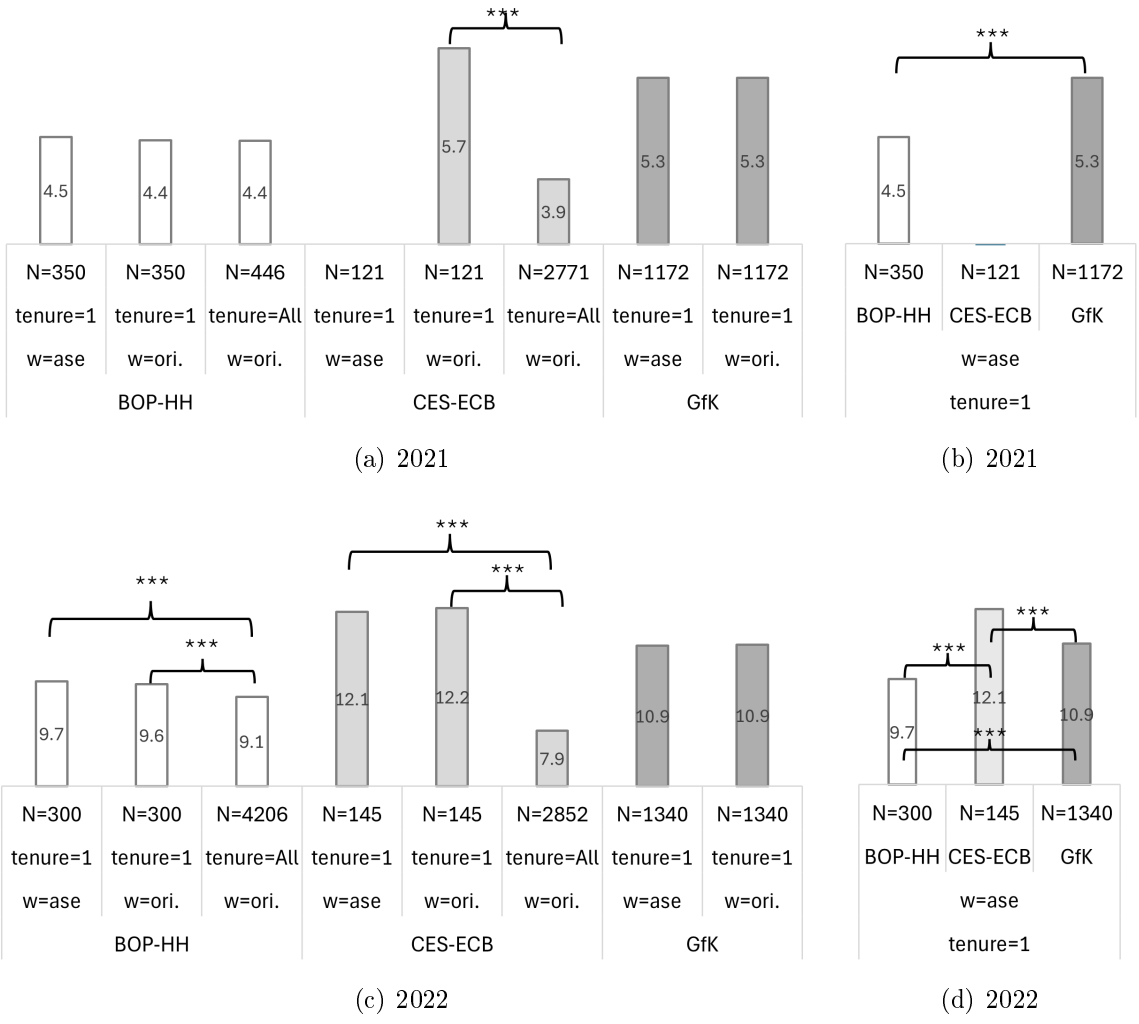
[8] As mentioned above, stratification of the weights for the CES-ECS in December 2021 is not possible due to zero observations in the age group over 70.

in both the arithmetic mean and median of about the responses to the inflation questions, as they capture different aspects of the average (D'Acunto et al., 2024).

4.2.1 Inflation Perceptions

For each survey, Figures 3a and 3c display the means of the current inflation rates using the full survey samples with original weights compared to those of the subsamples of new participants with original weights and ase weights.

Figure 3: Inflation perceptions of the current year



Note: According to Statistisches Bundesamt (2025), actual (consumer price index) inflation rates in 2021 and 2022 were 3.1% and 6.9%, respectively. Details of the t-test are reported in Table A7.

The results for the BOP-HH wave 24 (December 2021) are illustrated in the left panel of Figure 3a. Interestingly, there is no statistical difference in the beliefs about Germany's inflation rate in 2021 between new and all respondents (4.4 and 4.5%, respectively), even when applying the ase weights for the first-time participants subsample. As seen in the middle of Figure 3a, results from the CES-ECB show a statistically difference at the

1% significance level between the mean of inflation rate of the full sample (5.7%) and that of the new participants' subsample (3.9%). For 2021, the weighted mean for GfK respondents remains unchanged at 5.3%, as there is only slightly difference between the original and ase weights.

For 2022, BOP-HH respondents believe that the inflation rate in Germany ranges from 9.1% to 9.7%, as depicted in Figure 3c. While the rates are similar in the subsample of new respondents when using the two weights (9.6% and 9.7%), there is a statistically significant difference at the 1% significance level when comparing the values for new respondents with those of all respondents (9.1%). Likewise, results from the CES-ECB, reported in the middle of Figure 3c, show significant differences between the weighted average perceived inflation rates of the first-time participants (12.1% and 12.2%) and those of the full sample (7.9%). The two bars to the right of Figure 3c summarise the results for the GfK survey from December 2022, which, in all cases, is consistently 10.9%.

Focusing on the new participants, Figures 3b and 3d compare the means of inflation perceptions with original weights and ase weights across three surveys. Although we correct the population's representative issue by using ase weights, different surveys still show different results, suggesting that the sampling is heterogeneous. For example, Figure 3b shows that the (ase) weighted average inflation rates for 2021 of the first-time respondents in BOP-HH and GfK are significantly different at 4.5% and 5.3%, respectively. According to the December 2022 data depicted in Figure 3d, the numbers for BOP-HH, CES-ECB, and GfK are also not equal at 9.7%, 12.1%, and 10.9%, respectively. Although the results vary across three surveys, they always exceed the actual inflation rates of 3.1% in 2021 and 6.9% in 2022. This result is linked to the argument that past prices are remembered as being cheaper due to agents' limited memory and the stylised fact that the most important sources of information on inflation for consumers are shopping experiences, conversations with friends and family, and the media (Hayo and Neuenkirch, 2018; D'Acunto and Weber, 2024; D'Acunto et al., 2024). In both years, the Covid-19 pandemic as well as the fuel price shock, left deep impressions of high inflation among the people, especially in a context where inflation had previously been low and stable.

When considering the medians of inflation perceptions across different samples, we find evidence only in CES-ECB's survey Wave 36 (Table 3a and 3b). There is a 0.5 to 4 percentage points decrease in the weighted median when considering new participants rather than all participants in CES-ECB's survey Wave 36 at the 5% significance level. The change in weights is not sufficient to alter the central values of the distribution of perceived inflation among first-time respondents (Table 3c). However, among new participants in all three surveys, Table 3d indicates that the BOP-HH medians are from 0.5 to 1 and from 0.2 to 1 percentage points smaller than the GfK medians for December 2021 and 2022, at the 5% significance level, respectively.

In short, in the cases of BOP-HH and CES-ECB, even though the subsamples of new participants are not representative of the entire population, the weighted means and

Table 3: Confidence Intervals of Median Differences in Inflation Perceptions

Panel a	Wave	Tenure=All Original weight	Tenure=1 Original weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	446	350	0	-0.2	0.2
CES-ECB	24	2771	121	-0.8	-1.5	0
GfK	24	1172	1172	0	0	0
BOP-HH	36	4206	300	0	0	0
CES-ECB	36	2852	145	-2	-3.7	-0.5
GfK	36	1340	1340	0	0	0

Panel b	Wave	Tenure=All Original weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	446	350	0	-0.2	0
GfK	24	1172	1172	0	0	0
BOP-HH	36	4206	300	0	0	0
CES-ECB	36	2852	145	-2	-4	-0.5
GfK	36	1340	1340	0	0	0

Panel c	Wave	Tenure=1 Original weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	350	350	0	-0.3	0
GfK	24	1172	1172	0	0	0
BOP-HH	36	300	300	0	0	0
CES-ECB	36	145	145	0	-1.2	0.5
GfK	36	1340	1340	0	0	0

Panel d	Wave	Tenure=1 Ase weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH vs GfK	24	350	1172	-0.8	-1	-0.5
BOP-HH vs GfK	36	300	1340	-1	-1	-0.2
BOP-HH vs CES-ECB	36	300	145	0	-1.4	0
CES-ECB vs GfK	36	145	1340	0	-1	0

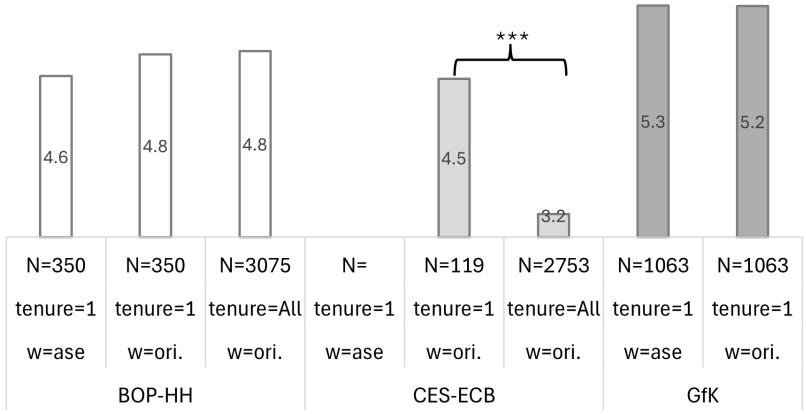
Note: Column 2 and 3 are the number of observations. Results are calculated from Hodges-Lehmann median differences.

medians calculated using the original weights and the ase weights are not statistically different.

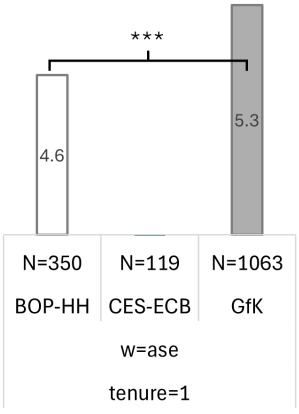
4.2.2 Inflation Expectations

Figures 4a and 4c present the weighted averages of inflation expectations for the next 12 months in Wave 24 (December 2021) and Wave 36 (December 2022) across the three surveys. In Figures 4b and 4d, we compare the results from the three surveys and observe notable differences.

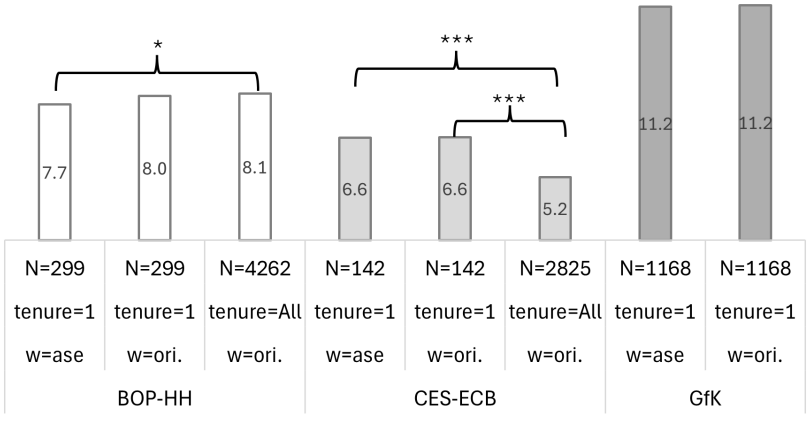
Figure 4: Inflation expectations for the next year



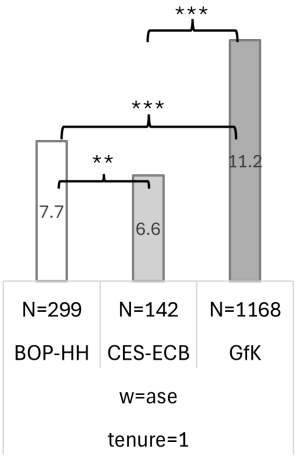
(a) 2021



(b) 2021



(c) 2022



(d) 2022

Note: According to Statistisches Bundesamt (2025), actual (consumer price index) inflation rates in 2022 and 2023 were 6.9% and 5.9%, respectively. Details of the t-test are reported in Table A8.

In the BOP-HH (left panel of Figure 4a), the point forecasts of inflation rates range from 4.6% to 4.8% and do not differ statistically when applying different weights and samples. For the GfK survey, the right panel of Figure 4a shows similar values of weighted inflation expectations, ranging from 5.2 to 5.3%. In contrast, the results from CES-ECB

(see the light grey bars of Figure 4a) show a statistically significant difference at the 1% level between the new participants' average expectation and that of the entire sample.

When comparing the forecasts of new participants across surveys, the average inflation rates in 2022 were expected to be 4.6% and 5.3% by respondents from BOP-HH and GfK, respectively (see Figure 4b). It is interesting to note that the unanticipated cost shocks caused by the Ukraine-Russia war and the energy price surge in 2022 led to the unusual situation in which actual inflation in 2022 was higher than the rate expected by households.[9]

For 2023, inflation rates in CES-ECB, BOP-HH, and GfK were expected to be much higher in 2023 than in 2022, at 6.6%, 7.7%, and 11.2%, respectively. Given that the actual inflation rate was 5.9%, we are back in the normal scenario where household expectations have an upward bias. When comparing within each survey, we observe a remarkable difference in average expectations between CES-ECB's first-time respondents (6.6%) and the full CES-ECB sample (5.2%), which is significant at the 1% level (see Figure 4c). There is a small but significant difference at the 10% significance level in the BOP-HH when comparing the subsample of new respondents with ase weights to the full sample with original weights. As before, there is no difference in the average expected inflation rate in the two differently weighted GfK samples.

In this section, we also test the difference in medians of inflation expectations across samples. Within the BOP-HH and GfK surveys, the weighted medians do not differ at the 5% significance level when applying different samples and population weights (Table 4a, 4b, and 4c). However, we find that, in December 2021, half of all participants, participated in CES-ECB Wave 24, expected inflation to be 0.3% to 1.5% percentage points lower than that of new respondents (Table 4a). Among new participants in all three surveys, Table 4d shows that GfK had significantly higher weighted medians, at the 5% level, than BOP-HH and CES-ECB, ranging from 2 to 3 percentage points higher than BOP-HH and 3 to 5 percentage points higher than CES-ECB.

Since we find evidence that the means and medians of inflation perceptions and expectations differ between new participants and all participants, it is interesting to examine whether the dispersion in inflation attitudes around the respective means differs between old and new panel participants, as well as between differently weighted samples. As an indicator of this variation, we use the standard deviation of the inflation variables.

[9]The main stylised facts reported in the literature about household's inflation expectations are upward bias, high deviation, and high uncertainty than that of firms and professional forecasters (Armantier et al., 2013; Weber et al., 2022; D'Acunto et al., 2023; D'Acunto and Weber, 2024).

Table 4: Confidence Intervals of Median Differences in Inflation Expectations

Panel a	Wave	Tenure=All Original weight	Tenure=1 Original weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	3075	350	0	0	0.1
CES-ECB	24	2753	119	-1	-1.5	-0.3
GfK	24	1063	1063	0	0	0
BOP-HH	36	4263	299	0	-1	1.5
CES-ECB	36	2825	142	-1.5	-2.5	0
GfK	36	1168	1168	0	0	0

Panel b	Wave	Tenure=All Original weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	3075	350	0	0	0.5
GfK	24	1063	1063	0	0	0
BOP-HH	36	4263	299	0.4	0	1
CES-ECB	36	2825	142	-1.4	-2	0
GfK	36	1168	1168	0	0	0

Panel c	Wave	Tenure=1 Original weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH	24	350	350	0	0	0.5
GfK	24	1063	1063	0	0	0
BOP-HH	36	299	299	0	-1	2
CES-ECB	36	142	142	0	-1	1.5
GfK	36	1168	1168	0	0	0

Panel d	Wave	Tenure=1 Ase weight	Tenure=1 Ase weight	Difference in Medians	95% Confidence Interval Lower	Upper
BOP-HH vs GfK	24	350	1063	-0.5	-1	0
BOP-HH vs GfK	36	299	1168	-2.5	-3	-2
BOP-HH vs CES-ECB	36	299	142	1.9	0	2.5
CES-ECB vs GfK	36	142	1168	-4.1	-5	-3

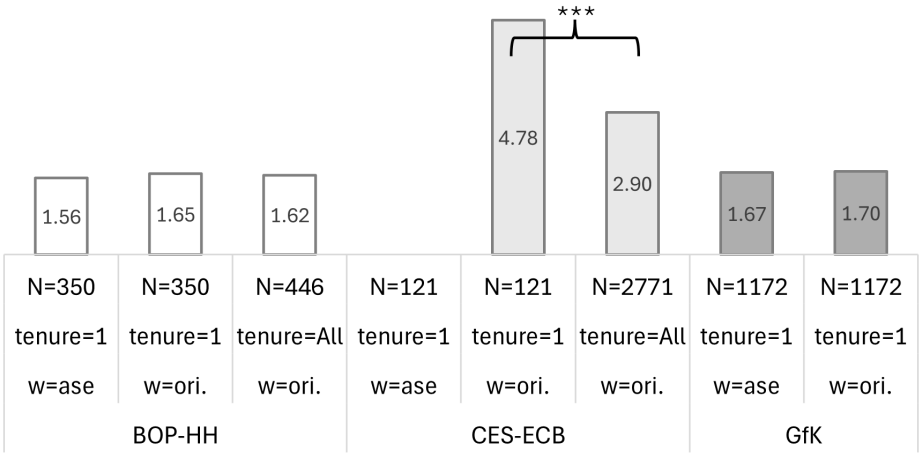
Note: Column 2 and 3 are the number of observations. Results are calculated from Hodges-Lehmann median differences.

4.2.3 The divergence in opinions

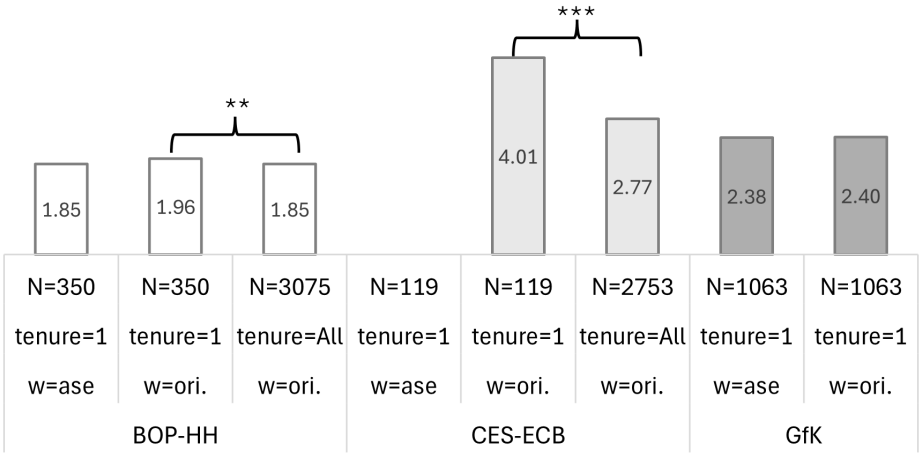
Figure 5 and 6 present the standard deviations of perceived and expected inflation rates for first-time participants and the entire samples. We find that the former group has higher values than the latter, implying that the variance in opinions decreases after participating in more waves. This result again supports the 'learning-effect' mentioned above.

When focusing on new participants and comparing the two population weights, we find evidence of a decrease in the standard deviation of inflation expectations, which is significant at the 1% level in the BOP-HH survey for December 2022. We find no statistically significant differences in the other survey waves.

Figure 5: Standard Deviations of Inflation Perceptions and Expectations at December 2021



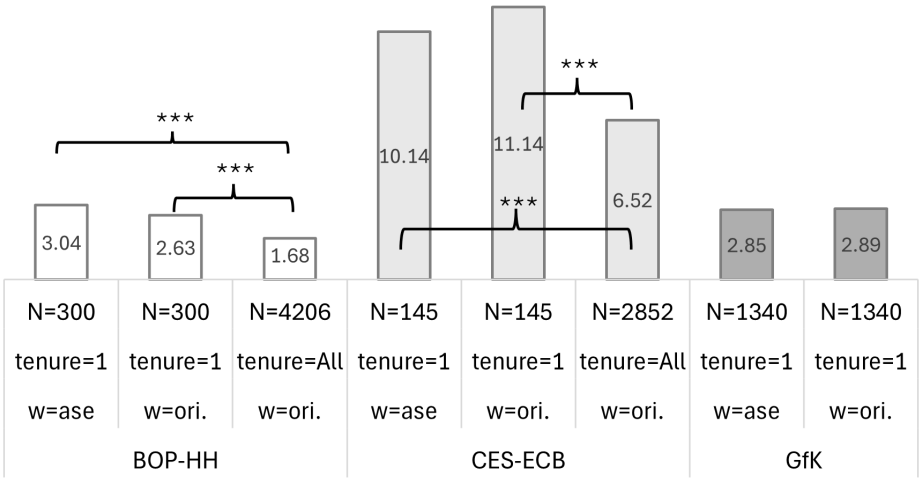
(a) Perceptions



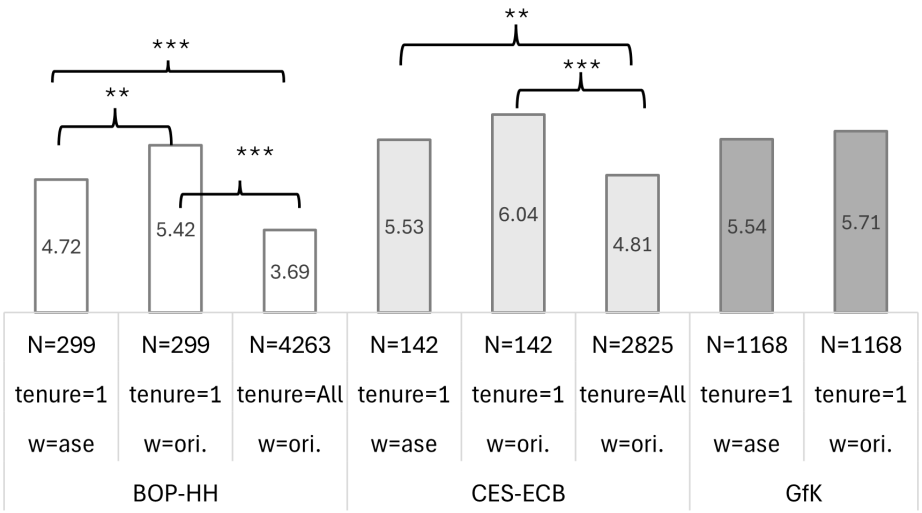
(b) Expectations

Note: Details of the F-test are reported in Table A9 and Table A10.

Figure 6: Standard Deviations of Inflation Perceptions and Expectations at December 2022



(a) Perceptions

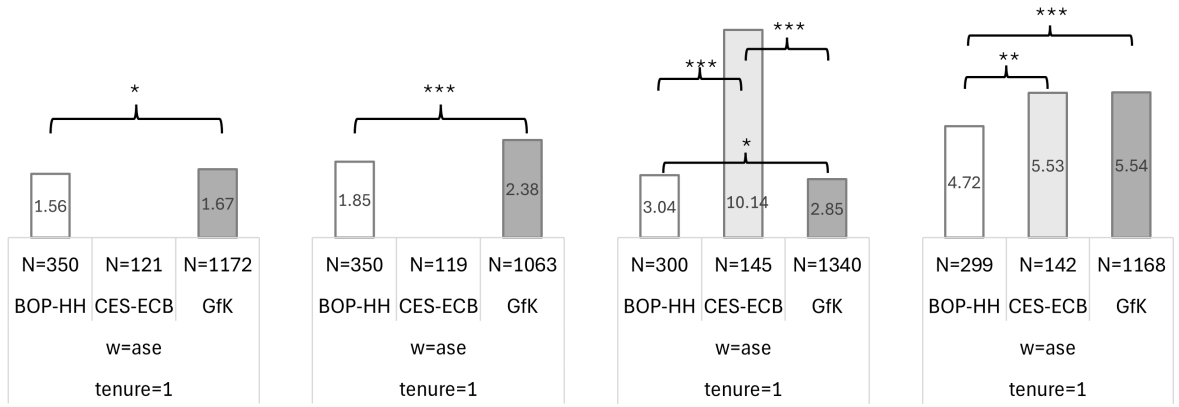


(b) Expectations

Note: Details of the F-test are reported in Table A9 and Table A10.

Across the sub-sample of first-time participants in the three surveys with ase weights, we find that there are remarkable differences in the standard deviations of both inflation measures in most cases (Figure 7). The finding that the CES-ECB surveys have the highest standard deviations supports the argument regarding the creation of 'non-attitudes' when forcing respondents to provide an answer, as well as the higher degree of attentiveness and knowledge in a household panel. The former should increase the standard deviation, while the latter should decrease it. The lower standard deviations found in the BOP-HH and GfK surveys could be due to the fact that they allow people who do not have an opinion on the inflation questions to express it.

Figure 7: Standard Deviations of Inflation Perceptions and Expectations



(a) Perceptions Dec21 (b) Expectations Dec21 (c) Perceptions Dec22 (d) Expectations Dec22

Note: Details of the F-test are reported in Table A11 and Table A12.

5 Conclusion

Is the use of household panel data advantageous compared to cross-sectional surveys when studying laypersons' inflation perceptions and expectations? The literature has already identified a 'learning effect' among panellists who participate in several waves. However, we argue that the issues with household panels should be viewed more broadly and can be divided into selection and representativeness issues.

We have compared the results of quantitative inflation perceptions and expectations from two panel household surveys—the Bundesbank's BOP-HH and the ECB's CES-ECB—with those of an omnibus survey (GfK) for Germany. Examining the three surveys conducted in December 2021 and December 2022, our investigation provides evidence that the panel surveys suffer from a sample selection issue.

Our analysis also highlights a representativeness issue, which remains unresolved even if one focuses on the newcomers in the panel. First, we show that this subsample is not representative of the population. Second, we demonstrate that applying the population

weights from the full panel does not resolve this issue. Third, we construct new population weights for this subsample based on the appropriate weights for three widely used quota variables (age, sex, and education). This allows us to compare the means, medians, and variances of laypersons' numerical responses to the inflation questions within and across the three surveys. For December 2021, focusing on first-time participants and applying new weights within each survey, we find no significant effect of reweighting on the average values of the means, medians, and standard deviations. However, for December 2022, we observe higher means, lower medians, and smaller variances in the new respondent group with our corrected weights, compared to the values derived from the entire sample with original weights.

The contrasting results from the two survey waves imply the importance of the inflation environments when the surveys were conducted. During the high inflation period of 2022, opinions strongly diverged between the inexperienced and experienced respondents. Interestingly, for both years and measures, there are notable differences in the means, medians, and variances across the three surveys, with BOP-HH having lower means and variances than GfK, whereas CES-ECB exhibits a mixed pattern and the highest variation.

Based on our results, we derive several recommendations. First, if the research question is to obtain a representative view of inflation perceptions and expectations of the population in a country, cross-sectional surveys—especially when part of an omnibus—cannot be replaced by panel surveys. Second, to overcome the 'learning effect' in household panels on inflation, Kim and Binder (2023) suggested focusing on new panellists. We show that this suggestion is unlikely to solve the issue, as even new panellists suffer from a selection bias. Moreover, this subsample is not representative of the entire population. So, if for some reason the selection problem is not considered to be of prime importance, the subsample of new panellists should only be used after applying appropriate population weights, which differ from those for the entire household panel.

Thus, while panel surveys have indisputable advantages, in particular the possibility to observe individual respondents across time and to create datasets with large numbers of observations, the results derived from these analyses have to be interpreted carefully and should not be used to derive conclusions about the underlying population.

Our study is not without limitations. First, we cannot guarantee that all participants in the omnibus survey are new. However, at least they do not explicitly commit to regular participation and are not influenced by answering similar questionnaires. Moreover, inasmuch as there is overlap between the respondents to the two cross-sectional GfK surveys, it would make it more difficult to find differences to the panel results. In other words, it would make our analysis more conservative. Second, we can make no claims regarding the external reliability of our findings outside of Germany in the analysed time period. Still, our ability to replicate the 'learning effect' proposed by Kim and Binder (2023) based on US data suggests that the expectation of external reliability may not be unreasonable. Third, the ECB does not publish the full set of variables collected with

the CES-ECB, which limits our analysis, especially in terms of constructing appropriate population weights for the subsample of new panellists. Fourth, another methodological issue with the CES-ECB is that the respondents cannot answer 'don't know', which likely creates a lot of noise due to 'non-attitudes'. We find some evidence supporting this view, as the variance of inflation answers is higher than in the BOP-HH and GfK surveys.

Finally, we have only considered numerical inflation questions regarding perceptions and expectations. Although both the BOP-HH and the CES-ECB questionnaires include more ambitious questions on inflation (i.e., they attempt to measure the degree of uncertainty in the responses about inflation), the GfK did not. This is not purely coincidental, as Comerford (2019) argue against asking the density forecast, on the grounds that a large fraction of the population cannot answer it. Hence, it is not yet possible to compare the dimension of uncertainty across the three surveys. Other studies using household panels focus on different variables, such as laypersons' trust in central banks (see, e.g., Ehrmann (2024) and Dreher (2024), using the CES-ECB surveys). It is also unclear how the selection and representativeness issues affect their results. Therefore, we believe that further research on these issues is important to avoid biased conclusions.

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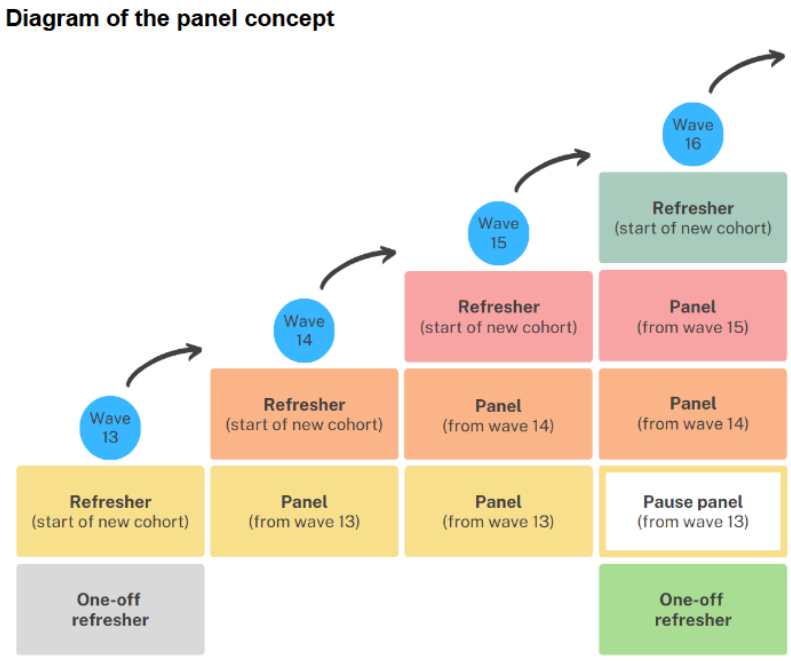
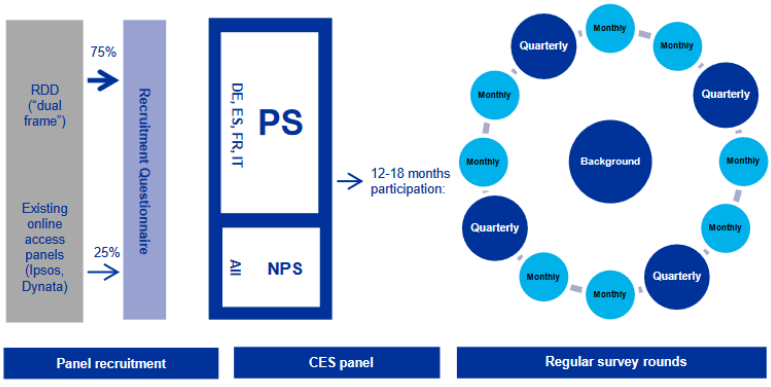
A Appendix

Figure A1: The concept of constructing panels in the BOP-HH and CES-ECB



(a) Source: BOP-HH Team (2024)

Figure 1.2
Constructing the CES



(b) Source: Bańkowska et al. (2021)

Table A1: Recoding the Education Level variable

Survey	Question	Answer's Categories 1	2	3
CES-ECB	What is the highest level of school you have completed, or the highest degree you have received?	Up to lower secondary education	Higher secondary education	Higher education
GfK	What is the highest level of school you have completed, or the highest degree you have received?	No certified apprenticeship training	Certified apprenticeship Secondary school	University-entrance diploma University-entrance diploma
BOP-HH	What level of vocational training or university degree do you have? Please think of your highest qualification here.	10 No vocational training completed (and currently not in training/higher education)	1 Currently in training or studying (bachelor's degree not yet completed) 2 Completed vocational training (apprenticeship) 3 Completed vocational training (vocational school or commercial college) 4 Completed training at a technical or commercial college, school for master craftsmen or engineers or university of cooperative education with shorter preparation time (up to 880 hours) 5 Completed training at a university of cooperative education with longer preparation time (more than 880 hours)	6 Bachelor's degree, applied sciences degree, completed training at an engineering college 7 Diploma or master's degree, completed teacher training degree 8 Doctorate/postdoctoral qualification obtained 9 Other professional qualification

Table A2: Response rates of new participants

	BOP-HH		**CES-ECB**		**GfK**	
	Perceived	Expected	Perceived	Expected	Perceived	Expected
Dec 21						
Total Sample	389	389	128	128	2007	2007
Numerical Sample	377	378	128	128	1295	1135
% of Total Sample	96.9	97.2	100	100	64.5	56.6
Truncated Sample	350	350	121	119	1172	1063
% of Total Sample	90	90	94.5	93	58.4	53
Dec 22						
Total Sample	329	329	156	156	2013	2013
Numerical Sample	323	327	156	156	1470	1285
% of Total Sample	98.2	99.4	100	100	73	63.8
Truncated Sample	300	299	145	142	1340	1168
% of Total Sample	91.2	90.9	92.9	91	66.6	58

Note: BOP surveys allow 'don't know' answers, whereas CES surveys do not. GfK surveys allow both 'don't know' and 'don't monitor/don't form an opinion.' The truncated sample includes 90% of the distribution to remove outliers.

Table A3: The shares of those who 'don't know' or 'don't monitor/form opinion' about inflation perceptions and expectations in GfK Surveys

	Inflation Perception		Inflation Expectation	
	Dec 21	Dec 22	Dec 21	Dec 22
Age Group				
Under 35	33.3	38.3	31.3	31.7
35-49	29.4	30.8	29.5	29.7
50-70	34.2	28.8	36.3	33.9
Above 70	3	2.1	2.9	4.7
No of obs	712	543	872	728
Education Level				
Up to lower secondary education	9.9	10.4	9.4	8.5
Higher secondary education	55.1	58.5	54.2	58.2
Higher education	34.9	31.1	36.5	33.3
No of obs	712	540	872	726
Gender				
Male	38.2	34.8	39.2	35.8
Female	61.8	65.2	60.8	64.2
No of obs	712	543	872	728
Region				
West	84.2	85.7	84.9	86.1
East	15.8	14.3	15.1	13.9
No of obs	712	543	872	728
Family Status				
Single Widowed Divorced Separated	44.6	39.2	43	40.5
Married Living with Partner	55.4	60.8	57	59.5
No of obs	711	541	871	725

Table A4: The shares of those who 'don't know' about inflation perceptions and expectations in GfK Surveys

	Inflation Perception		Inflation Expectation	
	Dec 21	Dec 22	Dec 21	Dec 22
Age Group				
Under 35	31.2	28.7	27.8	25.6
35-49	28.7	34.8	30.5	33.1
50-70	37.2	33.9	38.9	36.3
Above 70	2.9	2.6	2.7	4.9
No of obs	351	291	454	362
Education Level				
Up to lower secondary education	9.1	9.9	9.7	7.2
Higher secondary education	56.4	60.9	56	60.6
Higher education	34.5	29.2	34.3	32.2
No of obs	351	289	454	360
Gender				
Male	38.9	33.3	38.9	36.1
Female	61.1	66.7	61.1	63.9
No of obs	351	291	454	362
Region				
West	84.5	85.3	85.2	85
East	15.5	14.7	14.8	15
No of obs	351	291	454	362
Family Status				
Single Widowed Divorced Separated	47.4	37.4	44.1	41.1
Married Living with Partner	52.6	62.6	55.9	58.9
No of obs	350	291	454	361

Table A5: The shares of those who 'don't monitor' about inflation perceptions and 'don't form opinion' about inflation expectations in GfK Surveys

	Inflation Perception		Inflation Expectation	
	Dec 21	Dec 22	Dec 21	Dec 22
Age Group				
Under 35	35.3	50	34.8	37.7
35-49	30	26	28.4	26.2
50-70	31.5	22.5	33.7	31.5
Above 70	3.2	1.4	3.1	4.6
No of obs	361	252	418	366
Education Level				
Up to lower secondary education	10.7	11.1	9	9.8
Higher secondary education	54	55.6	52.4	55.7
Higher education	35.3	33.3	38.6	34.4
No of obs	361	251	418	366
Gender				
Male	37.6	36.8	39.5	35.6
Female	62.4	63.2	60.5	64.4
No of obs	361	252	418	366
Region				
West	84	86.3	84.5	87.1
East	16	13.7	15.5	12.9
No of obs	361	252	418	366
Family Status				
Single Widowed Separated	42	41.3	41.9	39.9
Married Living with Partner	58	58.7	58.1	60.1
No of obs	361	250	417	364

Table A6: Percents of gender and education level of new participants with original weights

	BOP-HH		CES-ECB		GfK		Pop.
	Dec21	Dec22	Dec21	Dec22	Dec21	Dec22	
Gender							
Male	42.7	51.7	45.8	46.3	50.2	50.2	50.0
Female	57.3	48.3	54.2	53.7	49.8	49.8	50.0
No. of obs	389	329	128	156	2007	2013	
Education Level							
Up to lower secondary education	7.9	26.1	10.5	12.2	6.6	5.4	6.0
Higher secondary education	63.0	48.6	50.1	46.8	50.1	51.7	51.0
Higher education	29.2	25.4	39.5	41.0	43.3	42.8	43.0
No. of obs	389	329	128	156	2007	2013	

Table A7: Inflation perceptions: t-tests of equal means

Panel a	Wave	Tenure=All Original Weights N	Mean	Std.	Tenure=1 Original Weights N	Mean	Std.	P.Value
BOP-HH	24	446	4.41	1.62	350	4.41	1.65	0.98
CES-ECB	24	2771	3.88	2.90	121	5.67	4.78	0.00***
GfK	24	1,172	5.26	1.70	1,172	5.26	1.70	1.00
BOP-HH	36	4,206	9.13	1.68	300	9.55	2.63	0.00***
CES-ECB	36	2,852	7.93	6.52	145	12.23	11.14	0.00***
GfK	36	1,340	10.94	2.89	1,340	10.94	2.89	1.00

Panel b	Wave	Tenure=All Original Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH	24	446	4.41	1.62	350	4.46	1.56	0.67
CES-ECB	24	2771	3.88	2.90				
GfK	24	1,172	5.26	1.70	1,172	5.26	1.67	0.96
BOP-HH	36	4,206	9.13	1.68	300	9.67	3.04	0.00***
CES-ECB	36	2,852	7.93	6.52	145	12.10	10.14	0.00***
GfK	36	1,340	10.94	2.89	1,340	10.90	2.85	0.78

Panel c	Wave	Tenure=1 Original Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH	24	350	4.41	1.65	350	4.46	1.56	0.71
CES-ECB	24	121	5.67	4.78				
GfK	24	1,172	5.26	1.70	1172	5.26	1.67	0.96
BOP-HH	36	300	9.55	2.63	300	9.67	3.04	0.63
CES-ECB	36	145	12.23	11.14	145	12.10	10.14	0.92
GfK	36	1,340	10.94	2.89	1340	10.90	2.85	0.78

Panel d	Wave	Tenure=1 ASE Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH vs GfK	24	350	4.46	1.56	1340	10.90	2.85	0.00***
BOP-HH vs CES-ECB	24	350	4.46	1.56				
CES-ECB vs GfK	24				1340	10.90	2.85	
BOP-HH vs GfK	36	300	9.67	3.04	1340	10.90	2.85	0.00***
BOP-HH vs CES-ECB	36	300	9.67	3.04	145	12.10	10.14	0.00***
CES-ECB vs GfK	36	145	12.10	10.14	1340	10.90	2.85	0.00***

Note: For each row, we use a t-test to determine whether the mean in column 4 is significantly equal to the mean in column 7. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: Inflation expectations: t-tests of equal means

Part a	Wave	Tenure=All Original Weights N	Mean	Std.	Tenure=1 Original Weights N	Mean	Std.	P.Value
BOP-HH	24	3075	4.81	1.85	350	4.78	1.96	0.77
CES-ECB	24	2753	3.22	2.77	119	4.54	4.01	0.00***
GfK	24	1,063	5.24	2.40	1,063	5.24	2.40	1.00
BOP-HH	36	4,262	8.12	3.69	299	8.04	5.42	0.73
CES-ECB	36	2,825	5.20	4.81	142	6.60	6.04	0.00***
GfK	36	1,168	11.22	5.71	1,168	11.22	5.71	1.00

Panel b	Wave	Tenure=All Original Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH	24	3075	4.81	1.85	350	4.56	1.85	0.02**
CES-ECB	24	2753	3.22	2.77				
GfK	24	1063	5.24	2.40	1,063	5.25	2.38	0.95
BOP-HH	36	4262	8.12	3.69	299	7.75	4.72	0.10*
CES-ECB	36	2825	5.20	4.81	142	6.59	5.53	0.00***
GfK	36	1168	11.22	5.71	1,168	11.17	5.54	6.00

Panel c	Wave	Tenure=1 Original Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH	24	350	4.78	1.96	350	4.56	1.85	0.14
CES-ECB	24	119	4.54	4.01				
GfK	24	1063	5.24	2.40	1063	5.25	2.38	0.95
BOP-HH	36	299	8.04	5.42	299	7.75	4.72	0.48
CES-ECB	36	142	6.60	6.04	142	6.59	5.53	0.99
GfK	36	1168	11.22	5.71	1168	11.17	5.54	0.81

Panel d	Wave	Tenure=1 ASE Weights N	Mean	Std.	Tenure=1 ASE Weights N	Mean	Std.	P.Value
BOP-HH vs GfK	24	350	4.56	1.85	1063	5.25	2.38	0.00***
BOP-HH vs CES-ECB	24	350	4.56	1.85				
CES-ECB vs GfK	24				1063	5.25	2.38	
BOP-HH vs GfK	36	299	4.72	0.48	1168	11.17	5.54	0.02**
BOP-HH vs CES-ECB	36	299.00	4.72	0.48	142	6.59	5.53	0.00***
CES-ECB vs GfK	36	142	5.53	0.99	1168	11.17	5.54	0.00***

Note: For each row, we use a t-test to determine whether the mean in column 4 is significantly equal to the mean in column 7. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A9: Inflation perceptions: F-tests of equal variance

Panel a	Wave	Tenure=All Original Weights N	Std.	Tenure=1 Original Weights N	Std.	F-statistics	Critical Values at 10%	at 5 %	at 1%
BOP-HH	24	446	1.62	350	1.65	1.04	1.14	1.18	1.26
CES-ECB	24	2771	2.90	121	4.78	2.72***	1.17	1.23	1.33
GfK	24	1172	1.70	1172	1.70	1.00	1.08	1.10	1.15
BOP-HH	36	4206	1.68	300	2.63	2.45***	1.11	1.14	1.21
CES-ECB	36	2852	6.52	145	11.14	2.92***	1.16	1.21	1.30
GfK	36	1340	2.85	1340	2.89	1.00	1.07	1.09	1.14
Panel b	**Wave**	**Tenure=All Original Weights N**	**Std.**	**Tenure=1 ASE Weights N**	**Std.**	**F-statistics**	**Critical Values at 10%**	**at 5 %**	**at 1%**
BOP-HH	24	446	1.62	350	1.56	0.93	1.14	1.18	1.26
CES-ECB	24	2771	2.90						
GfK	24	1172	1.70	1172	1.67	0.97	1.08	1.10	1.15
BOP-HH	36	4206	1.68	300	3.04	3.26***	1.11	1.14	1.21
CES-ECB	36	2852	6.52	145	10.14	2.42***	1.16	1.21	1.30
GfK	36	1340	2.85	1340	2.85	0.98	1.07	1.09	1.14
Panel c	**Wave**	**Tenure=1 Original Weights N**	**Std.**	**Tenure=1 ASE Weights N**	**Std.**	**F-statistics**	**Critical Values at 10%**	**at 5 %**	**at 1%**
BOP-HH	24	350	1.65	350	1.56	1.12	1.19	1.23	1.32
CES-ECB	24	121	4.78						
GfK	24	1172	1.70	1172	1.67	1.03	1.10	1.12	1.16
BOP-HH	36	300	2.63	300	3.04	0.75	1.21	1.25	1.35
CES-ECB	36	145	11.14	145	10.14	1.21	1.32	1.39	1.54
GfK	36	1340	2.89	1340	2.85	1.02	1.09	1.11	1.15

Note: For each row, we use an F-test to determine whether the larger standard deviation (in column 4 or 6) is significantly greater than the smaller one. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A10: Inflation expectations: F-tests of equal variance

Panel a	Wave	Tenure=All Original Weights N	Tenure=All Original Weights Std.	Tenure=1 Original Weights N	Tenure=1 Original Weights Std.	F-statistics	Critical Values at 10%	Critical Values at 5 %	Critical Values at 1%
BOP-HH	24	3075	1.85	350	1.96	1.12**	1.10	1.14	1.20
CES-ECB	24	2753	2.77	119	4.01	2.1***	1.17	1.23	1.34
GfK	24	1063	2.40	1063	2.40	1.00	1.08	1.11	1.15
BOP-HH	36	4263	3.69	299	5.42	2.16***	1.11	1.14	1.21
CES-ECB	36	2825	4.81	142	6.04	1.57***	1.16	1.21	1.31
GfK	36	1168	5.54	1168	5.71	1.00	1.08	1.10	1.15
Panel b	**Wave**	**Tenure=All Original Weights N**	**Tenure=All Original Weights Std.**	**Tenure=1 ASE Weights N**	**Tenure=1 ASE Weights Std.**	**F-statistics**	**Critical Values at 10%**	**Critical Values at 5 %**	**Critical Values at 1%**
BOP-HH	24	3075	1.85	350	1.85	1.00	1.10	1.14	1.20
CES-ECB	24	2753	2.77						
GfK	24	1063	2.40	1063	2.38	0.98	1.08	1.11	1.15
BOP-HH	36	4263	3.69	299	4.72	1.64***	1.11	1.14	1.21
CES-ECB	36	2825	4.81	142	5.53	1.32**	1.16	1.21	1.31
GfK	36	1168	5.54	1168	5.54	0.94	1.08	1.10	1.15
Panel c	**Wave**	**Tenure=1 Original Weights N**	**Tenure=1 Original Weights Std.**	**Tenure=1 ASE Weights N**	**Tenure=1 ASE Weights Std.**	**F-statistics**	**Critical Values at 10%**	**Critical Values at 5 %**	**Critical Values at 1%**
BOP-HH	24	350	1.96	350	1.85	1.12	1.19	1.23	1.32
CES-ECB	24	119	4.01						
GfK	24	1063	2.40	1063	2.38	1.02	1.11	1.13	1.17
BOP-HH	36	299	5.42	299	4.72	1.32**	1.21	1.26	1.35
CES-ECB	36	142	6.04	142	5.53	1.19	1.32	1.39	1.55
GfK	36	1168	5.71	1168	5.54	1.06	1.10	1.12	1.16

Note: For each row, we use an F-test to determine whether the larger standard deviation (in column 4 or 6) is significantly greater than the smaller one. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A11: Inflation perceptions: F-tests of equal variance (continued)

Panel d	Wave	Tenure=1 ASE Weights N	Std.	Tenure=1 ASE Weights N	Std.	F-statistics	Critical Values at 10%	at 5 %	at 1%
BOP-HH vs GfK	24	350	1.56	1172	1.67	1.15*	1.12	1.16	1.23
BOP-HH vs CES-ECB	24	350	1.56						
CES-ECB vs GfK	24			1172	1.67				
BOP-HH vs GfK	36	300	3.04	1340	2.85	1.13*	1.12	1.16	1.23
BOP-HH vs CES-ECB	36	300	3.04	145	10.14	11.16***	1.20	1.26	1.39
CES-ECB vs GfK	36	145	10.14	1340	2.85	12.64***	1.16	1.22	1.32

Note: For each row, we use an F-test to determine whether the larger standard deviation (in column 4 or 6) is significantly greater than the smaller one. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A12: Inflation expectations: F-tests of equal variance (continued)

Panel d		**Tenure=1**		**Tenure=1**			**Critical Values**		
	Wave	**ASE Weights**		**ASE Weights**		**F-statistics**	**at 10%**	**at 5 %**	**at 1%**
		N	**Std.**	**N**	**Std.**				
BOP-HH vs GfK	24	350	1.85	1063	2.38	1.66***	1.12	1.16	1.23
BOP-HH vs CES-ECB	24	350	1.85						
CES-ECB vs GfK	24			1063	2.38				
BOP-HH vs GfK	36	299	4.72	1168	5.54	1.38***	1.13	1.17	1.25
BOP-HH vs CES-ECB	36	299	4.72	142	5.53	1.37**	1.20	1.26	1.39
CES-ECB vs GfK	36	142	5.53	1168	5.54	1.00	1.18	1.24	1.36

Note: For each row, we use an F-test to determine whether the larger standard deviation (in column 4 or 6) is significantly greater than the smaller one. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.