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Uncertainty and Rounding in Expectation Surveys*

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Abstract

This paper examines whether the rounding of survey responses in the case of probabilistic question formats is related to expectation uncertainty. Using data from a survey on macroeconomic expectations of private households in Germany, we analyze self-reported reasons for rounding probabilistic inflation expectations. Although rounding is correlated with expectation uncertainty, only 14 percent of respondents explicitly attribute rounding to uncertainty. Most households round to simplify responses or because rounded values reflect their true expectations. Regression analyses do not find significant differences in uncertainty between these groups. The findings suggest caution in interpreting rounding in such settings as a measure of uncertainty and highlight the need for further research on the cognitive mechanisms behind rounding in expectation surveys.

JEL classification: C18, C83, D84, E31

Keywords: uncertainty, rounding, survey data, inflation expectations

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1 Introduction

At least since the seminal papers by Bloom (2009) and Baker et al. (2016), economic (policy) uncertainty is seen as an important factor behind macroeconomic dynamics. Because uncertainty is inherently unobservable, it is difficult to measure. A wide range of proxy measures have been proposed. One type of measurement is based on macroeconomic expectations surveys and is based on the idea that participants report rounded numbers to convey uncertainty and that, thus, aggregate uncertainty is measurable based on the frequency of rounded survey responses (Krifka, 2009; Binder, 2017).

Building on previous papers in the area of health economics suggesting alternative motivations of survey participants to provide rounded numbers (e.g., Manski and Molinari, 2010), we study the reasons behind rounding in a household survey on macroeconomic expectations in Germany. Our data are from the well-established Survey on Consumer Expectations conducted by Deutsche Bundesbank. We first analyze the frequency of different reasons behind the rounding of the reported probabilistic inflation expectations. Then, we study whether households that round survey responses due to uncertainty differ from other households in terms of different metrics that are commonly interpreted as reflecting expectation uncertainty.

We find that only about 14 percent of households that provide rounded numbers as survey responses do so because they want to communicate uncertainty. Households more frequently indicate that the rounded numbers reflect their true expectations or that they round to simplify their answers. Although our data confirm the positive association between expectation uncertainty and rounding in survey responses, we do not find significant uncertainty differences between households that round responses due to uncertainty and those who round for other reasons.

We contribute to the literature on rounding in expectation surveys. Rounding patterns in surveys that elicit probabilistic expectations have been studied by Giustinelli and Pavoni (2017), Manski and Molinari (2010) and Giustinelli et al. (2022). Few papers have studied the association between survey-based macroeconomic uncertainty and rounding. Exceptions include Binder (2017) and Reiche and Meyler (2022) and Reiche (2025) in the case of household surveys and Clements (2021) and Glas and Hartmann (2022) for professional forecasters. Interestingly, in the case of professional forecasters, rounding is *negatively* related to expectation uncertainty, which contrasts with the *positive* association documented for households.

We also contribute to the broader literature on measuring macroeconomic uncertainty. In particular, we investigate whether uncertainty is indeed the driving factor behind statements of rounded numbers in household surveys about macroeconomic expectations. Other approaches for measuring macroeconomic uncertainty are based on the expected volatility of financial markets (e.g., the VIX for the US), on textual analysis of newspaper articles or other media (Baker et al., 2016), statistical models (Jurado et al., 2015), the dispersion of point forecasts (Zarnowitz and Lambros, 1987), or probabilistic survey expectations (Manski, 2004). See Cascaldi-Garcia et al. (2023) for a recent survey of this literature.

We proceed by describing the survey data that we use in Section 2. We show our empirical results in Section 3. Finally, we summarize and discuss our findings in Section 4.

2 Data

Our analysis is based on data from the Survey on Consumer Expectations (BOP-HH) conducted by Deutsche Bundesbank on a monthly basis since 2019. The study focuses on expectations for a wide range of economic variables and also includes socioeconomic information about participating households. In each survey wave, around 2000 households that are representative of the German population are surveyed by the survey institute *forsa*.

We use data from the wave conducted in July 2024. In each wave, the survey contains a question to elicit probabilistic inflation expectations that asks participants to assign probabilities to a predefined set of intervals for consumer price inflation over the next twelve months. The survey enforces that probabilities sum up to 100 percent.

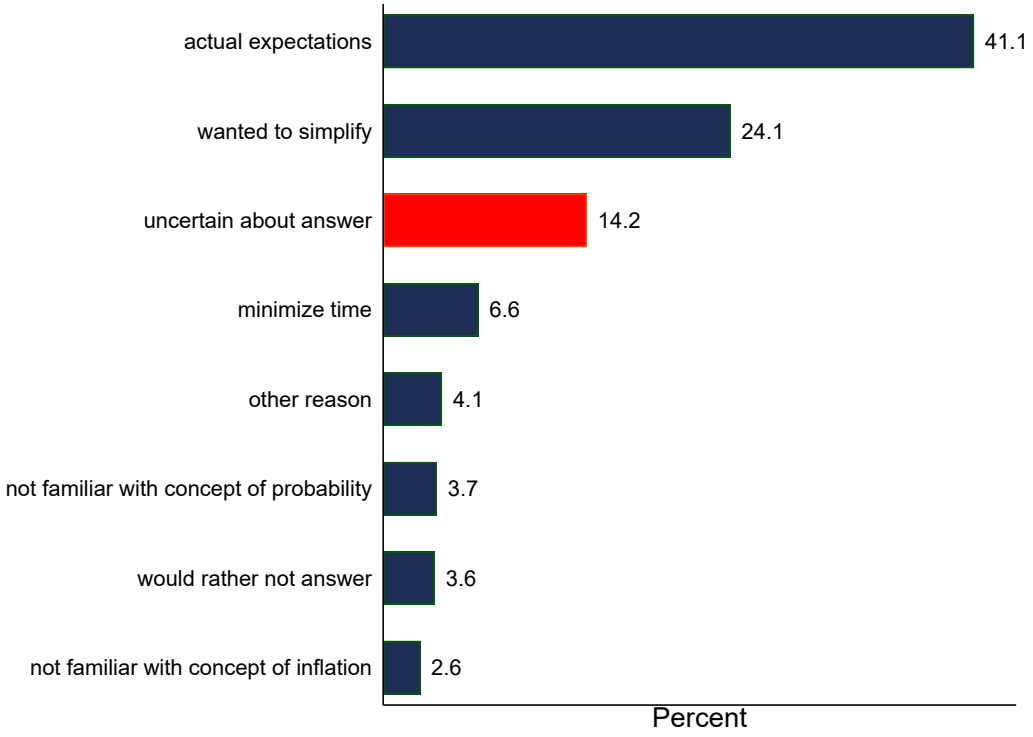
The July 2024 wave included a special question that directly asked those households that provided at least one probability that is a multiple of five about the reason for providing (a) rounded number(s). The question was the following:

> You appear to have provided rounded probabilities (partially or entirely) when answering the question about the likelihood of possible future inflation rates. What was the main reason for this? Please select one answer.
>
> - The rounded values reflect my actual expectations.
> - I was uncertain about my answer.
> - I wanted to simplify my answer.
> - I am not familiar with the concept of inflation.
> - I am not familiar with the concept of probability.
> - I would have preferred not to answer the question at all.
> - I wanted to minimize the time required to answer the question.
> - I rounded my answer for another reason.

The order of all answer options (except the last one) was randomized.

There are 2972 households in our sample that reported point forecasts, probabilistic inflation expectations, and information about the control variables that we use below. Since rounding appears to be very common, the follow-up question on the reasons behind rounding was presented to almost all households. In fact, 92 (71) percent of households stated exclusively probabilities that are multiples of five (ten). This is much higher than the share of households that provide point forecasts that are multiples of five (11 percent) or ten (3 percent). In the following analysis we use the notation 'M5' ('M10') to indicate probabilities and points forecasts that are multiples of five (ten). 30 percent of households are "gross rounders" as defined in Manski and Molinari (2010), in the sense that they either report a probability of 100 percent for one bin or probabilities of 50 percent for two bins. This issue is also discussed in Dominitz and Manski (1997) and Fischhoff and Bruine De Bruin (1999) for other survey contexts. Only 1 percent of respondents do not report any probabilities that are multiples of five. In the end, 2174 households also answered the special question about the reasons behind rounding.

Figure 1: Self-Reported Reasons for Rounding



Notes: Shares of answers selected as the primary reason for having provided probabilistic inflation expectations that are multiples of five in the July 2024 wave of the BOP-HH.

3 Results

Figure 1 presents our first main result—the distribution of answers to the question about the reasons for providing rounded numbers in response to the probabilistic question about inflation expectations. Evidently, most participants do not perceive uncertainty as the primary reason for using rounded numbers. Only 14.2 percent report that they round due to uncertainty. Although uncertainty rounding is selected more frequently among the "gross rounders" than other respondents (16.2 vs. 13.3 percent), the difference is significant only at the 10% level. It is much more common for households to indicate that the rounded numbers correspond to their actual expectations (41.1 percent) or that they wanted to simplify their answers (24.2 percent). The fraction of households who indicate that they reported their actual expectations aligns well with the evidence in Giustinelli et al. (2022), who find that 49 percent of households indicate that their stated probabilities of developing dementia reflect their actual expectations. The high share also suggests that it is very relevant to model the share of rounded expectations that reflect the actual underlying expectations when constructing uncertainty proxies based on rounding as in the approach of Binder (2017).

At the same time, our survey data confirm a positive correlation between expectation uncertainty and rounding in survey responses that has been documented elsewhere (Binder, 2017; Glas and Hartmann, 2022). To do so, we use the common "mass-at-midpoint" method (e.g., Dovern and Kenny, 2020)

Table 1: Differences in Expectation Uncertainty across Household Groups

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
M5 point forecast	0.92***					0.84***		
	(0.15)					(0.19)		
Share of M5 probs.		0.75***					1.63***	
		(0.25)					(0.31)	
Share of M10 probs.			0.46***					0.56***
			(0.10)					(0.13)
Number of bins used		0.71***	0.72***				0.71***	0.70***
		(0.01)	(0.02)				(0.01)	(0.02)
Uncertainty rounder				0.02	0.06	0.04	1.51	0.34
				(0.11)	(0.13)	(0.11)	(1.06)	(0.29)
M5 point forecast × Uncertainty rounder						-0.08		
						(0.48)		
Share of M5 probs. × Uncertainty rounder							-1.59	
							(1.07)	
Share of M10 probs. × Uncertainty rounder								-0.44
								(0.31)
Constant	4.16***	0.22	0.50	4.92***	6.84***	4.42***	-0.56	0.57
	(0.63)	(0.47)	(0.43)	(0.78)	(0.93)	(0.74)	(0.58)	(0.53)
Observations	2,972	2,972	2,972	2,174	1,534	2,174	2,174	2,174
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$\bar{R}^2$	0.05	0.69	0.69	0.03	0.06	0.05	0.69	0.69

Notes: This table presents the estimates from linear regressions of the histogram standard deviation on the rounding status of participants in the July 2024 wave of the BOP-HH and socioeconomic characteristics (not shown). We calculate standard deviations by the common "mass-at-midpoint" method. Heteroskedasticity-consistent standard errors are reported in parentheses. Controls include a categorical variable that indicates whether the respondent expects decrease, stay the same or increase over the next twelve months, the age of the participant, a dummy for households that lived in East Germany in 1989, a dummy for female household heads, a dummy for full-time employment, log household income, and years of education. Asterisks '*', '**', and '***' indicate significance at the 10%, 5%, and 1% critical level, respectively. The sample for Model 5 excludes households that either report a probability of 100 percent for one bin or probabilities of 50 percent for two bins.

to calculate the standard deviation implied by the households' responses to the probabilistic inflation expectation question. Dovern (2024) shows that this measure is positively related to the qualitative assessment of inflation uncertainty of the BOP-HH participants. The average uncertainty in our full sample is 1.64 percentage points with a standard deviation of 1.75 percentage points. We regress this uncertainty measure on various rounding measures while controlling for several household characteristics. In particular, we include as control variables a categorical variable that indicates whether the respondent expects inflation to decrease, stay the same or increase over the next twelve months (infl_exp), the age of the participant (age), a dummy for households that lived in East Germany in 1989 (east1989), a dummy for female household heads (female), a dummy for full-time employment (fullemploy), log household income (ln(income))), and years of education (yoe).[1]

The first column of Table 1 shows that providing a rounded point forecast for inflation is, on average, associated with higher expectation uncertainty. This is in line with the evidence presented in Binder (2017). The second and third columns show that there is also a positive correlation between the share of reported bin probabilities that are multiples of five or ten and expectation uncertainty.[2] This contrasts with the evidence presented in Glas and Hartmann (2022), who explain the difference by the fact that in the case of professional forecasters, rounded forecasts reflect a higher usage of judgment in expectation formation, which leads to a lower subjective expectation uncertainty due to overconfidence of forecasters.

[1] Goldfayn-Frank and Wohlfart (2020) show that the inflation expectations of households that lived in East Germany before 1990 are higher than those of other households due to the inflationary shock experienced after the German reunification. Similarly, Binder et al. (2024) show that geographic variation can matter for inflation expectations due to differences in political affiliation. Thus, we include the east1989 dummy as a control variable in all regressions.

[2] Note that we need to control for the number of bins with nonzero probabilities because using more bins mechanically leads to higher expectation uncertainty.

Table 2: Differences in Reasons for Rounding across Household Groups

	Actual expectations	Wanted to simplify	Uncertain about answer	Minimize time	Unfamiliarity with inflation/probability
infl_exp	1.08	-2.51*	0.35	-0.63	0.69
	(1.49)	(1.30)	(1.04)	(0.72)	(0.75)
age	0.34***	-0.57***	0.22***	-0.17***	0.11**
	(0.10)	(0.09)	(0.07)	(0.05)	(0.05)
east1989	2.59	-3.29	0.36	-0.93	-3.30***
	(2.82)	(2.40)	(1.94)	(1.43)	(1.04)
female	-13.13***	0.57	7.08***	-0.50	6.14***
	(2.28)	(1.93)	(1.70)	(1.20)	(1.27)
fullemploy	5.43*	-1.20	-1.82	-2.46	0.87
	(2.78)	(2.50)	(1.92)	(1.51)	(1.31)
ln(income)	1.88	3.72**	-3.68**	1.05	-2.99***
	(2.27)	(1.85)	(1.51)	(1.07)	(1.06)
yoe	-0.46	0.76***	-0.14	0.36**	-0.50***
	(0.30)	(0.25)	(0.21)	(0.15)	(0.13)
Constant	14.13	16.90	31.97**	4.41	29.16***
	(19.64)	(16.30)	(13.01)	(9.71)	(9.58)
Observations	2,174	2,174	2,174	2,174	2,174
$\bar{R}^2$	0.02	0.04	0.03	0.01	0.04

Notes: This table presents the estimates from linear regressions of dummy variables that equal one for those who state that they round due to the respective reason on the socioeconomic characteristics of participants in the July 2024 wave of the BOP-HH. Heteroskedasticity-consistent standard errors are reported in parentheses. The reported coefficients and standard errors are the estimated ones times 100. Asterisks '*', '**', and '***' indicate significance at the 10%, 5%, and 1% critical level, respectively.

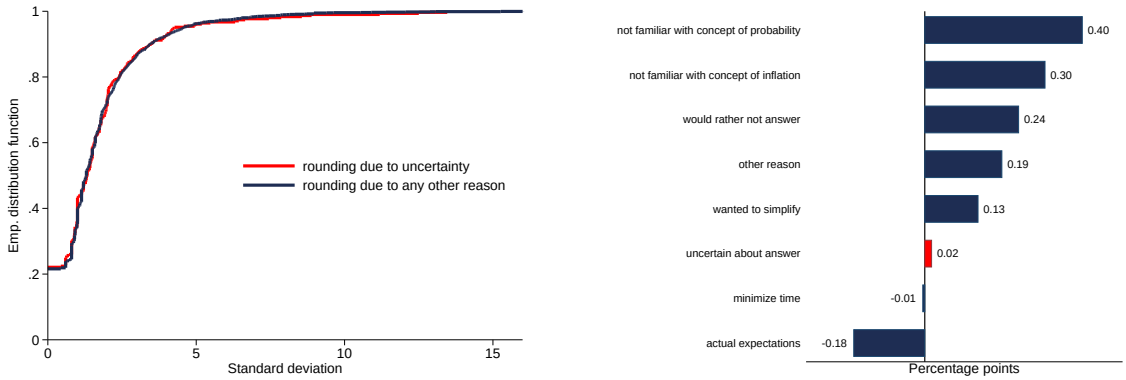
The appendix contains an extended version of Table 1 that includes the estimated coefficients for the control variables (Table A.1). The most important results confirm previous results in the literature: Women tend to have a higher expectation uncertainty, while households with higher income and participants with higher education tend to have a lower expectation uncertainty (Bruine de Bruin et al., 2011; Das et al., 2020). In addition, we find that households that expect inflation have higher uncertainty than those who expect deflation.

Having established, first, that rather few households perceive the communication of uncertainty to be the main factor behind the provision of rounded numbers in the BOP-HH and, second, that there is a positive correlation between uncertainty and rounding, we now investigate if those households who state that they round due to uncertainty differ from households who round for other reasons in terms of socioeconomic characteristics and expectation uncertainty.

We begin by regressing dummies that indicate whether a household reported a particular reason for rounding on the socioeconomic variables that we already used as control variables in Table 1. We merge unfamiliarity with either the concept of probability or the concept of inflation because both relate to a different kind of uncertainty grounded in a limited understanding of what was asked in the survey.[3] The results, shown in Table 2, show the following: First, older survey participants are significantly more likely to round because they are uncertain or because they are unfamiliar with the concepts required

[3]We do not consider households that rounded because of other—unspecified—reasons (4.1 percent) or did not want to answer the question (3.6 percent).

Figure 2: Expectation Uncertainty for Different Household Groups



Notes: The left plot shows the empirical distribution functions for the standard deviation implied by the answers to the probabilistic inflation expectation question in the July 2024 wave of the BOP-HH. The right plot shows average uncertainty conditional on the self-reported reason for rounding minus the unconditional average uncertainty. We calculate standard deviations by the common "mass-at-midpoint" method.

to adequately answer the probabilistic question. They are also more likely to state that the rounded probabilities reflect their actual expectations. At the same time, they are less likely to round to simplify their answer or to minimize response time. Second, females are more likely to round due to uncertainty or because they are unfamiliar with the concepts of inflation or probability while reporting significantly less often that the rounded probabilities reflect their actual expectations. Higher income and more education go in line with an increasing likelihood of rounding to simplify answers and with a smaller likelihood of rounding due to uncertainty and unfamiliarity with the concepts of inflation or probability.

Next, we compare the distribution of expectation uncertainty for different types of households. The empirical distribution functions do not reveal substantial differences between the households that round due to uncertainty and those who round for any other reason (Figure 2, left plot). A t-test of the null hypothesis of no differences in mean uncertainty between the two groups of rounding households does not reject the null (p-value: 0.847).

The lack of differences in mean expectation uncertainty between households that state that they round due to uncertainty and those who round for other reasons is confirmed by linear regressions that include the same control variables as above. The fourth column in Table 1 shows that the coefficient associated with a dummy variable for households that round due to uncertainty is not significantly different from zero.[4] This picture does not change if we exclude all "gross rounders" that either report a probability of 100 percent for one bin or probabilities of 50 percent for two bins (fifth column).

The right plot of Figure 2 shows that other reasons for rounding matter more for uncertainty: Those who round because of unfamiliarity with the concepts of probabilities or inflation report above-average uncertainty, whereas those who state that the rounded numbers represent their actual expectations have below-average uncertainty. A regression analysis shows that the differences between these groups are statistically significant (not shown). In line with our previous results, the average uncertainty of those who state that they round due to uncertainty is nearly identical to the unconditional average uncertainty.

Next, we investigate whether the correlation between expectation uncertainty and rounding is stronger

[4]Note that we focus here on the subsample of households that answered the question about the primary reason behind the rounding decision.

Table 3: (Non-)Revisions between Waves Conditional on Rounding Reason

	Subsample: June/July			Subsample: July/August		
	Share of M5 probs.	Uncertainty	Point forecast	Share of M5 probs.	Uncertainty	Point forecast
Uncertainty rounder	0.89	0.19	0.26	0.88	0.21	0.27
Any other reason	0.91	0.25	0.21	0.91	0.16	0.23
p-value (χ^2-test)	0.38	0.10	0.18	0.26	0.15	0.19

Notes: This table presents the share of respondents with the same share of M5 probabilities, the same uncertainty and the same point forecast in two consecutive waves conditional on the self-reported rounding reason elicited in the July 2024 wave. While the left panel focuses on 1,179 respondents who participated in June and July, the right panel focuses on 1,306 respondents who participated in July and August. The last row reports p-values for Pearson's χ^2-test of statistical independence between (non-)revisions and self-reported rounding reasons.

for those households that state that they round because of uncertainty. The last three columns of Table 1 show that this is not the case. The coefficients corresponding to the interaction terms are not significantly different from zero for any of the rounding measures.

Finally, the rotating panel structure of the BOP-HH allows us to analyze whether the self-reported rounding reasons help to explain differences in the updating of expectations between waves. We focus on respondents who state their rounding reason in the July 2024 wave and who are also included in the previous or subsequent wave. The subsample of those participating in June and July includes 1,179 respondents (151 uncertainty rounders). 1,306 respondents (194 uncertainty rounders) participated in July and August. For both cases, we calculate the share of respondents with the same share of M5 probabilities in both waves and the share of respondents who do not revise uncertainty or point forecasts conditional on the self-reported rounding reason (due to uncertainty vs. any other reason). Table 3 presents the results along with p-values for Pearson's χ^2-test of statistical independence between (non-)revisions and self-reported rounding reasons. We find that the majority of respondents update their uncertainty and point forecasts from one wave to the next. By contrast, the share of M5 probabilities is rarely revised. Moreover, we cannot reject the null hypothesis of no updating differences between those who state that they round due to uncertainty and those who round for any other reason.

4 Discussion and Conclusion

Our study provides new insight into the relationship between rounding behavior in probabilistic expectation surveys and expectation uncertainty. In line with the previous literature (Binder, 2017), we show that more rounding of bin probabilities and rounding of point expectations is positively correlated with expectation uncertainty as derived from a probabilistic expectation question in a survey of private households in Germany. Despite the observed correlation, only a small fraction——approximately 14 percent——of households who report at least one rounded bin probability explicitly attribute their rounding behavior to uncertainty. Vastly more households claim that the rounded probabilities reflect their actual expectations or that they rounded to simplify their answers. We find no difference in terms of expectation uncertainty or rounding frequency regarding point expectations between those who round probabilities to indicate uncertainty and other household groups.

The results indicate that rounding behavior may not systematically capture an individual's level of uncertainty, at least not in a conscious or deliberate manner. Thus, researchers should exercise caution when interpreting rounding patterns in households' responses to probabilistic question formats as indicative of underlying uncertainty. Of course, we cannot rule out that, in some instances, households do

not accurately report their reason for rounding, e.g., if they are not self-aware about the true reason or because they want to justify their forecasts ex post by stating that it reflects their actual expectations.

Overall, our results contribute to the broader discussion on the measurement of expectation uncertainty in macroeconomics and suggest that rounding behavior, while correlated with uncertainty, may not be a reliable standalone proxy for it. Our findings emphasize the need for more research to better understand the cognitive mechanisms behind rounding in expectation surveys. In future work, a randomized controlled trial with information treatments that generate exogenous variation in uncertainty (e.g., similar to Coibion et al., 2024) could be used to study the causal influence of shifts in expectation uncertainty on rounding in expectation surveys. Causal evidence from a laboratory experiment (in a context not related to expectations) shows that uncertainty leads to more rounding (Ruud et al., 2014). Learning more about the nexus between rounding and uncertainty will improve our understanding of uncertainty measures a la Binder (2017) and potentially lead to improved versions of such measures.

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Appendix

A Additional Results

Table A.1: Differences in Expectation Uncertainty across Household Groups (Full Estimates)

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
M5 point forecast	0.92***					0.84***		
	(0.15)					(0.19)		
Share of M5 probs.		0.75***					1.63***	
		(0.25)					(0.31)	
Share of M10 probs.			0.46***					0.56***
			(0.10)					(0.13)
Number of bins used		0.71***	0.72***				0.71***	0.70***
		(0.01)	(0.02)				(0.01)	(0.02)
Uncertainty rounder				0.02	0.06	0.04	1.51	0.34
				(0.11)	(0.13)	(0.11)	(1.06)	(0.29)
M5 point forecast × Uncertainty rounder						-0.08		
						(0.48)		
Share of M5 probs. × Uncertainty rounder							-1.59	
							(1.07)	
Share of M10 probs. × Uncertainty rounder								-0.44
								(0.31)
infl_exp	0.12***	0.15***	0.15***	0.18***	0.23***	0.13**	0.15***	0.15***
	(0.05)	(0.03)	(0.03)	(0.05)	(0.06)	(0.05)	(0.03)	(0.03)
age	-0.01***	0.00	0.00	-0.02***	-0.01***	-0.02***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
east1989	0.05	0.06	0.06	-0.01	0.17	-0.02	0.07	0.05
	(0.09)	(0.05)	(0.05)	(0.10)	(0.12)	(0.10)	(0.05)	(0.05)
female	0.09	0.19***	0.18***	0.10	0.30***	0.08	0.17***	0.16***
	(0.07)	(0.04)	(0.04)	(0.08)	(0.10)	(0.08)	(0.04)	(0.05)
fullemploy	-0.06	-0.02	-0.03	-0.05	0.04	-0.08	-0.01	-0.03
	(0.09)	(0.06)	(0.06)	(0.10)	(0.12)	(0.10)	(0.07)	(0.07)
ln(income)	-0.22***	-0.16***	-0.15***	-0.28***	-0.47***	-0.23***	-0.17***	-0.15***
	(0.07)	(0.04)	(0.04)	(0.09)	(0.11)	(0.08)	(0.05)	(0.05)
yoe	0.00	-0.02***	-0.02***	-0.00	-0.02**	-0.00	-0.02***	-0.02***
	(0.01)	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	4.16***	0.22	0.50	4.92***	6.84***	4.42***	-0.56	0.57
	(0.63)	(0.47)	(0.43)	(0.78)	(0.93)	(0.74)	(0.58)	(0.53)
Observations	2,972	2,972	2,972	2,174	1,534	2,174	2,174	2,174
$\bar{R}^2$	0.05	0.69	0.69	0.03	0.06	0.05	0.69	0.69

Notes: This table presents the estimates from linear regressions of the histogram standard deviation on the rounding status of participants in the July 2024 wave of the BOP-HH and socioeconomic characteristics. We calculate standard deviations by the common "mass-at-midpoint" method. Heteroskedasticity-consistent standard errors are reported in parentheses. Controls include a categorical variable that indicates whether the respondent expects decrease, stay the same or increase over the next twelve months, the age of the participant, a dummy for households that lived in East Germany in 1989, a dummy for female household heads, a dummy for full-time employment, log household income, and years of education. Asterisks '*', '**', and '***' indicate significance at the 10%, 5%, and 1% critical level, respectively. The sample for Model 5 excludes households that either report a probability of 100 percent for one bin or probabilities of 50 percent for two bins.