

## *Project Description*

*Dieter Nautz, Freie Universität Berlin*

### *Expectation Formation and Inflation Target Credibility in Times of High Inflation*

## **1 Starting Point**

Inflation expectations have become the main indicator for assessing the credibility of a central bank and its inflation target. Inflation expectations of consumers are particularly important in times of high inflation and monetary policies that are thought to operate primarily through expectation channels. However, the formation of consumer inflation expectations seems to be under researched. During the COVID-19 crisis, for example, inflation expectations of German consumers *increased* at a time when inflation rates had been persistently below 2% and the economy headed to the largest recession in recent history. The current project investigates the behavior of consumer inflation expectations before and during the recent high inflation period employing a unique data set of the medium-term inflation expectations of more than 120,000 German citizens. Advancing on the preliminary analysis of Coleman and Nautz (2022a,b), we estimate econometric models that allow to disentangle the impact of different personal characteristics and macroeconomic variables on the formation of consumer inflation expectations and the evolution of inflation target credibility.

### **1.1 State of the art and preliminary work**

#### **1.1.1 Inflation target credibility and expectations anchoring: Evidence from time series**

##### *News regressions*

The predominant criterion to investigate the degree of credibility of an inflation target is the anchoring of inflation expectations. Firmly anchored expectations should be insensitive to the announcement of macroeconomic news, forecast errors or shocks that are unrelated to the inflation target. Following Gürkaynak et al. (2005), many empirical contributions run *news regressions* to investigate whether inflation expectations respond to a set of surprises in macroeconomic news announcements ( $X_t$ ):

$$\Delta\pi_t^e = \alpha + \beta' X_t + \varepsilon_t. \quad (1)$$

Inflation expectations ( $\pi_t^e$ ) are anchored if the news coefficients  $\beta$  are jointly zero. According to this literature, U.S. long-term inflation expectations show signs of de-anchoring, particularly during the financial crisis, see Nautz and Strohsal (2015). According to Galati et al. (2011) inflation expectations in the Euro Area were well-anchored before the European sovereign debt crisis. More recent papers, including e.g. Nautz et al. (2017) and Corsello et al. (2022), find that Euro Area inflation expectations have been de-anchored ever since. Ehrmann (2015) shows that inflation expectations behave differently when inflation is well below or close to target.

News regressions ignore the dynamics of inflation expectations because they restrict the attention to the *immediate* response of inflation expectations to news. As a result, news regressions tend to exaggerate the degree of de-anchoring if the estimated response to news actually dies out quickly. On the other hand, if the effect of news on inflation expectations is highly persistent, the de-anchoring problem is probably more severe than the short-run reaction of expectations seems to suggest. Consequently, the anchoring of inflation expectations requires a dynamic perspective. The recent literature shares the notion that long-term inflation expectations, pushed away from the inflation target by a shock, are anchored if they eventually return to the inflation target, see e.g. Carvalho et al. (2022). The less persistent the effect of the shock (the faster inflation expectations return to the target), the higher the credibility of the inflation target. Short-term inflation expectations are often used as a variable summarizing all relevant news shocks. Using a time-varying parameter model, Strohsal et al. (2016) confirm that spillovers from short-term to long-term expectations are a major source of de-anchoring.

#### *The structural VAR approach*

Nautz et al. (2019) propose a structural vector autoregressive (VAR) model to assess the anchoring of inflation expectations. In a bi-variate VAR of short- and long-term inflation expectations, inflation expectations are driven by two types of structural shocks: macro-news and target shocks. Macro-news shocks refer to short-run macroeconomic developments that should have no implications for the long run while target shocks refer to news about the long-run monetary policy strategy. Inflation expectations are defined to be *anchored in the long run*, if the impact of macro-news shocks on long-term inflation expectations is only transitory. In the spirit of Blanchard and Quah (1989), this anchoring criterion is implemented by a long-run neutrality restriction for macro-news shocks in the structural VAR model. The degree of *short-run* de-anchoring is defined as the relative importance of macro-news shocks for the variance of long-term inflation expectations. *Long-run* anchoring for U.S. expectations data is confirmed (i.e. not rejected). Yet, anchoring is not complete because the short-run impact of macro-news shocks on U.S. long-term inflation expectations is economically and statistically significant.

The above identification strategy implies that the estimated macro-news series are hard to interpret economically. In particular, they might be only weakly related to the standard measures of macro news taken from surveys. Therefore, Hachula and Nautz (2018) use a proxy SVAR of short- and long-term inflation expectations, where the surprise components of data announcements help to identify the structural macro-news shocks. While Gertler and Karadi (2015) restrict the attention to the surprise component of FOMC decisions to identify monetary policy shocks, they use a much broader set of macro data announcements for the identification of the unobserved macro-news shock. They show that macro news shocks have no impact on U.S. long-term inflation expectations in the long run. In the short run, however, the degree of expectations de-anchoring is non-negligible.

The macro-news shock identified in the bi-variate SVAR of Hachula and Nautz (2018) represent a conglomerate of all structural economic shocks related to short-term macroeconomic

developments. Yet, abstracting from economic key variables like economic activity, inflation and interest rates, bi-variate models of short- and long-term inflation expectations cannot account for the various shocks considered by macroeconomic theory. As a result, a growing literature embeds inflation expectations data into macroeconomic models. In line with a re-anchoring channel of monetary policy, Doh and Oksol (2018) find that central banks' announcements play an active role in steering inflation expectations towards the inflation target. However, it remains unclear how this expectation management affects the dynamics of inflation and the transmission of monetary policy shocks. In order to fill this gap Diegel and Nautz (2021) investigate the role of long-term inflation expectations for the monetary transmission mechanism in a structural VAR. In contrast to Clark and Davig (2011) or Geiger and Scharler (2020), they do not restrict the response of inflation expectations to the monetary policy shock. In a counterfactual scenario analysis, they show that monetary policy contributes importantly to the stabilization of inflation via its reaction to too-low long-term inflation expectations. Therefore, the response of inflation expectations to monetary policy shocks is not always a sign of de-anchoring but can contribute to stabilizing inflation.

### **1.1.2 Expectation formation and inflation target credibility: Evidence from surveys**

Schmidt and Nautz (2012) use survey data from the Financial Market Survey conducted by the Centre for European Economic Research (ZEW) to investigate how financial experts perceive the interest rate policy of the ECB. For monetary policy analysis, surveys of consumer inflation expectations are of particular interest. Consequently, there has been an increased interest in the analysis of household expectations and several new surveys, like the Fed's Survey of Consumer Expectations (SCE), the Bundesbank's Online Panel (BOP-HH), or the ECB's Household Finance and Consumption Survey (HFCS), have been launched. The literature analyzing survey data of inflation expectations has increased remarkably in recent years. D'Acunto et al. (2022) and Weber et al. (2022) provide comprehensive overviews of this literature.

#### *A new survey on inflation target credibility*

The interpretation of survey-based measures of inflation expectations taken from standard surveys is not without problems. In the tradition of the Michigan Consumer Survey, households are typically asked how they expect that consumer prices will develop over the next 12 months. One of the answer categories is that prices will "stay about the same" which should imply that the expected inflation rate is zero and, thus, clearly below the policy-intended level, see Andrade et al. (2020). However, for many consumers the mapping between observed prices and inflation rates is not an easy task, see Arioli et al. (2017). As a result, it is far from obvious to what extent a high percentage of "prices will stay about the same"-responses actually indicates the low credibility of a non-zero inflation target.

In view of these problems, Coleman and Nautz (2022a) introduce a representative online survey that is especially designed to measure the credibility of the ECB's inflation target. To this end, we

cooperate with Civey, Germany's largest company for online surveys. Civey surveys are spread out across more than 25,000 partner websites including major German online-newspapers. The Civey panel consists of approximately one million German citizens that signed up with their email-address and created a user profile that provides further personal information. Since the launch of the credibility survey in January 2019, the total number of participants has increased steadily to approximately 120,000 respondents in May 2022. Exactly according to the wording of the ECB, the survey question reads as follows<sup>1</sup>:

*In what range do you think the annual inflation rate will be over the medium term?*

*It will be...*

*(A) ... clearly above 2%      (B) ... slightly above 2%      (C) ... below, but close to, 2%*

*(D) ... clearly below 2%      (N) Do not know*

On July 8, 2021 the ECB announced that its inflation target is changed to "close to 2%". Consequently, we adjusted answer *C* accordingly. The answers *C* and, to a lesser degree, *B* are compatible with a credible inflation target. Therefore, the degree of credibility is summarized by the variable  $CI = C + 1/2 B$ . Note that this survey with intentionally vague answers could be more useful for measuring inflation target credibility than a detailed distribution of quantitative inflation expectations. Consider, for example, consumers with inflation expectations of, say, 3%. For some consumers, 3% may be "close to 2%" implying that they perceive inflation target credibility as high. For others, however, 3% may be "clearly above 2%". In this case, identical numerical expectations would have different implications for inflation target credibility. This shows that the answer "clearly above 2%" (*deutlich über 2%*) may be more informative about consumers' perception concerning inflation target credibility than a simple numerical value like "3%".

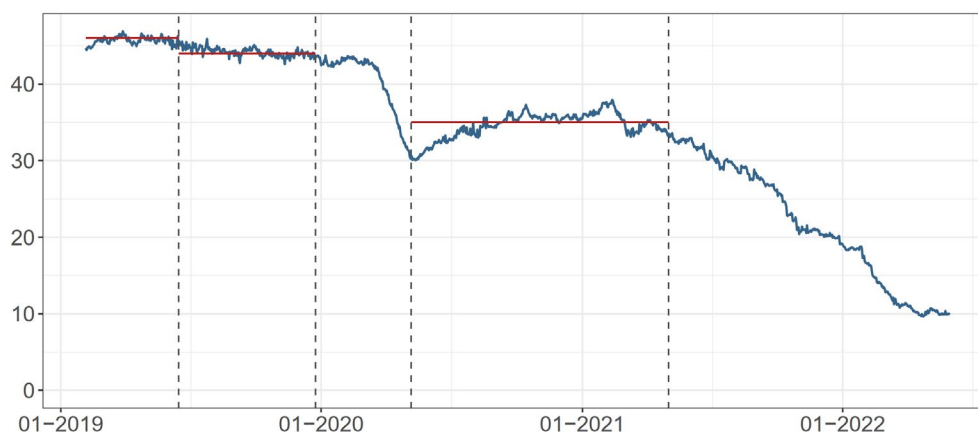
Coleman and Nautz (2022a) find that the credibility of the ECB's inflation target has significantly decreased until May 2021, particularly in the course of the coronavirus pandemic, see Figure 1. In line with evidence from Dietrich et al. (2022) for the U.S. and Stanislawski and Paloviita (2021) for the Euro Area, Coleman and Nautz (2022a) demonstrate that the credibility of the ECB's inflation target has declined mainly because participants increasingly expect that inflation will be *clearly above 2% over the medium term (A)*, see Figure 2. Remarkably, consumer inflation expectations increased at a time when inflation rates have been persistently below 2% and the economy headed to the largest recession in recent history. The starting point of Coleman and Nautz (2022b) is that the inflationary environment has changed dramatically ever since. In Germany, inflation rates have increased rapidly from about 2% in May 2021 to almost 8% in May 2022. If inflation expectations were firmly anchored and inflation target credibility was high, then

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<sup>1</sup> The actual survey question is stated in German and applies to the official translation used by the ECB and the Bundesbank, i.e. "unter aber nahe bei 2% in der mittleren Frist", see <https://widget.civey.com/4417>.

longer-term inflation expectations should not respond to an increase of inflation that the central bank describes as a transitory phenomenon.<sup>2</sup> However, Coleman and Nautz (2022b) show that the return of inflation resulted in a dramatic downward trend of inflation target credibility.

Figure 1 The Credibility of the ECB's Inflation Target

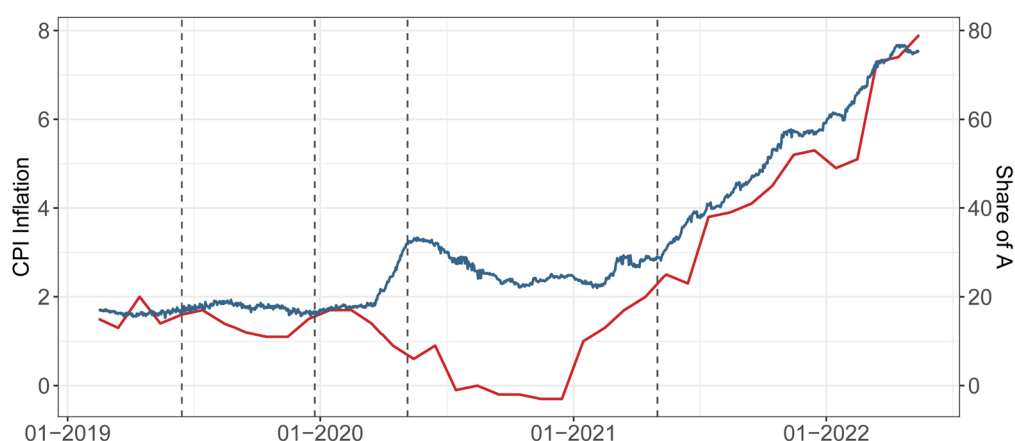


Notes: Credibility indicator  $CI = C + 0.5B$ , where  $C$  and  $B$  denote the proportion of “(below, but) close to 2%” and “slightly above 2%” answers, respectively. The vertical lines refer to the credibility regimes identified by Coleman and Nautz (2022a). The horizontal lines show the corresponding mean value of the indicator.

Coibion et al. (2022b) find that the de-anchoring of U.S. household inflation expectations stirred by the outbreak of the pandemic was accompanied by a rise in disagreement and higher uncertainty about future inflation. Coleman and Nautz (2022b) show that - when inflation returned - German consumers increasingly agree about the low-credibility of the inflation target. Moreover, introducing the share of “Do not know” answers ( $N$ ) as a simple proxy for aggregate uncertainty, there are also fewer survey respondents that are uncertain about the credibility of the inflation target. The current project extends the mainly descriptive analysis of the aggregated survey data by Coleman and Nautz (2022a,b). In particular, we base the analysis on individual survey data and disentangle the various drivers of inflation expectations, disagreement and uncertainty by means of econometric models that account for the ordinal structure of the survey data.

<sup>2</sup> In March 2022, when inflation in the euro area was around 6%, the ECB's projections for inflation rates in 2023 and 2024 have been 2.1% and 1.9%, see [https://www.ecb.europa.eu/pub/pdf/other/ecb\\_projections202203\\_ecbstaff~44f998dfd7.en.pdf](https://www.ecb.europa.eu/pub/pdf/other/ecb_projections202203_ecbstaff~44f998dfd7.en.pdf).

Figure 2 The Share of A-Answers and CPI Inflation



Notes: Share of “clearly above 2%” answers (A, blue line) and the German CPI inflation rate (red line), see Coleman and Nautz (2022a).

### *The role of personal characteristics for the formation of inflation expectations*

In the tradition of representative agent models, the macroeconomic literature using survey data typically considers the *average* of inflation expectations. However, inflation expectations may differ significantly across personal characteristics. Accordingly, heterogeneity in expectation formation may have implications for how central banks should communicate to the broader public, see Coibion et al (2019). The empirical literature investigates inflation expectation heterogeneity along several dimensions. *Income* and *education* are seen as proxies for financial literacy and the awareness of the central bank’s inflation target, which are found to be associated with lower inflation expectations, see e.g. Meyler and Reiche (2021). It is well-documented that females tend to have higher inflation expectations than males, see D’Acunto et al. (2022). This *gender gap* in expectations is often explained by different degrees of financial literacy. For Spanish data, Hospido et al. (2021) show that a significant gender gap in financial literacy remains when considering the differences between men and women in terms of their socio-demographic characteristics. However, gender gaps are significantly smaller in regions with more egalitarian financial arrangements for custody and marriage, suggesting that social norms may be important in explaining these disparities. Conrad et al. (2022) extend the Bundesbank online pilot survey on consumer expectations by a question on the use of information channels. They find that female participants are less likely to inform themselves about monetary policy, perceive a higher inflation rate and expect higher inflation rates over the next 12 months.

The evidence on the influence of *inflation experience* and, thereby, of age on the formation of inflation expectations is mixed. Using data from the Michigan Consumer Survey, Malmendier and Nagel (2016) and Dräger and Lamla (2018) find that differences in experienced mean inflation generate differences in inflation expectations between younger and older cohorts, since only the latter experienced the high inflation period of the 1970s. By contrast, Bryan and Venkatu (2001b)

find that U.S. consumers are likely to have higher inflation expectations if they are younger. Meyler and Reiche (2021) provide similar results for consumers' inflation expectations in the Euro Area. Inflation expectations may also depend on *political attitudes*. Gillitzer et al. (2021) show that U.S. and Australian consumers expect significantly lower inflation when the political party they support holds the executive office. Coleman and Nautz (2022a) reinvestigate this “partisan bias” for Germany where (until fall 2021) the executive office was held by chancellor Merkel representing the largest political party, the Christian Democrats (CDU). In contrast to the situation in the U.S, her government was challenged from two sides of the political spectrum. From the left-wing, there is “Die Linke” and from the right-wing, there is the “AfD”. Coleman and Nautz (2022a) confirm that for both opposition parties, the proportion of A-answers (“clearly above 2%”) is significantly higher than those observed for the government party. This effect is of moderate size and rather stable over time for the left-wing party. For the right-wing party AfD, however, the anti-european and anti-ECB attitude apparently translates into exceptionally high inflation expectations. Interestingly, the pandemic has significantly reinforced the conviction of AfD-supporters that inflation rates will be *clearly above 2% over the medium term*.

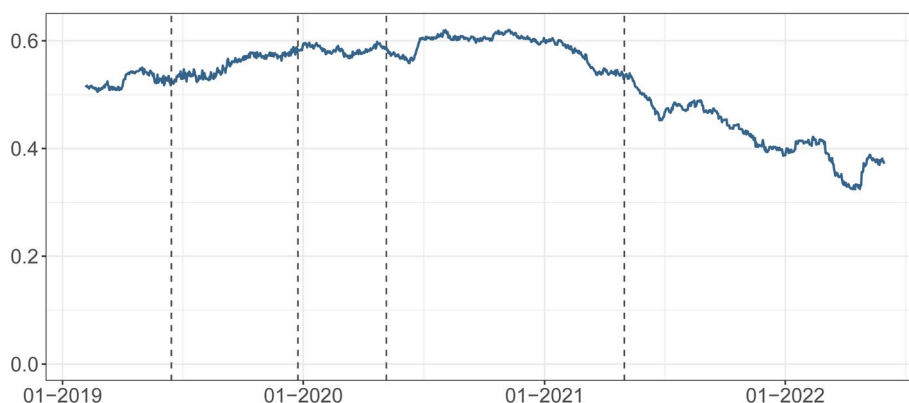
#### *Disagreement and uncertainty about inflation target credibility*

Our survey data does not allow to derive a disagreement measure that accounts for the uncertainty at the individual level, see Rich and Tracy (2021). However, the impact of individual uncertainty among respondents that choose the answer  $A, B, C$ , or  $D$  might not be critical in our application. Because survey respondents that are highly uncertain about their answer will not choose  $A, B, C$  or  $D$  but the “do not know” category  $N$ . Coleman and Nautz (2022b) define disagreement ( $Dis$ ) at day  $t$  as the weighted standard deviation of survey responses:

$$Dis_t = \sqrt{A_t^*(1 - \mu_t^*)^2 + B_t^*(1 - \mu_t^*)^2 + C_t^*(1 - \mu_t^*)^2 + D_t^*(1 - \mu_t^*)^2} \quad (2)$$

Considering the sign and the size of the deviation of medium-term expectations from the inflation target, we code the responses  $A, B, C$  and  $D$  by  $+1, +1/2, 0$  and  $-1$ , respectively. In order to control for the time-varying share of “do not know” ( $N$ ) responses we consider  $N$ -adjusted shares and define, for example,  $A^* = A/(1 - N)$ . This ensures that  $A^* + B^* + C^* + D^* = 1$ . The average response  $\mu^*$  is defined accordingly. Higher values of  $Dis_t$  are associated with higher disagreement. Specifically,  $Dis_t$  ranges from 0 (when everyone provides the same answer) to 1 (when the share of both extreme answers ( $A, D$ ) is 50%).

Figure 3 Disagreement about inflation target credibility



Notes: Disagreement about inflation target credibility defined in (2), see Coleman and Nautz (2022b).

Coleman and Nautz (2022b) show that – with rising rates of actual inflation – survey respondents increasingly agree that inflation will be clearly above 2% over the medium term. It is also interesting to investigate the role of personal characteristics for the level of disagreement. For example, Malmendier and Nagel (2016) show that in the US disagreement between young and old individuals is particularly high in periods of highly volatile inflation. In order to investigate the determinants of disagreement about future rates of inflation, we employ a multiple regression model controlling for various personal characteristics and macroeconomic developments designed for the analysis of ordinal survey data.

Disagreement is often a poor proxy for uncertainty, see e.g. Glas (2020). The empirical literature suggests various ways to quantify the level of uncertainty related to survey measures of inflation expectations. Typically, the analysis of uncertainty about expected inflation requires information about subjective probability distributions. The Survey of Consumer Expectations (SCE) by the Federal Reserve Bank of New York, for example, elicits a subjective probability distribution for inflation by asking for the percent chance that inflation might take values in each of a set of pre-defined non-overlapping bins. The resulting individual distributions can be used to estimate the average standard deviation and (with some additional assumptions) the percentiles of the distribution of consumer inflation expectations as an aggregate measure of uncertainty about future inflation. D'Acunto et al. (2022) discuss the multiple aspects of the survey design that might affect the outcome of distribution questions. Coleman and Nautz (2022b) propose a simple measure of uncertainty that does not require additional information based on sophisticated subjective probability distributions: they use the share of respondents that “do not know” how inflation will evolve over the medium term as a proxy for the prevailing uncertainty about the credibility of the inflation target. In general, the role and information content of “do not know” (N) answers depend on the survey question and the aim of the study. There are surveys where “N” answers can be simply treated as missing observations. Researchers may probe survey participants that “do not know” to obtain more information from those who might have been too comfortable to answer seriously in the first round. However, follow-up probing questions may lead



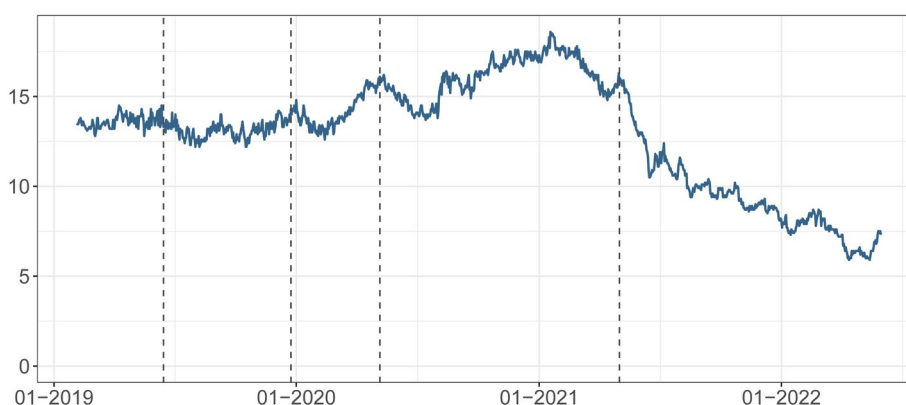
to a distorted measure of what people truly think about future inflation, see Kuha et al. (2018). In some applications, it makes sense to omit the “do not know” option from the list of possible answers. For example, Bucher-Koenen et al. (2021) show that disclosing the “do not know” answer reduces the gender gap in survey measures of financial literacy. Interestingly, a gender gap in the share of  $N$  answers is also present in our data, see Coleman and Nautz (2022b).

In the February 2021 wave of the Bundesbank Online Panel, survey participants were asked to state their “degree of trust in the ECB’s ability to achieve price stability” on a scale from 0 (no trust) to 10 (full trust). Hoffmann et al. (2022) report that even in February 2021, when inflation was still very low, the average trust level does not exceed 5 and only very few respondents fully trust the ECB. While the distribution of answers could be used to derive a level of disagreement about the trust in the ECB’s inflation target, the survey design does not allow to draw conclusions about the prevailing uncertainty. In particular, there is no trust-related “do not know” option. Rather, survey participants who are not able to quantify their level of trust (probably because they are too uncertain about it) can only choose the answer “do not know the European Central Bank”. In our survey on inflation target credibility, the information content and the interpretation of the “do not know” response is more obvious. “Do not know” ( $N$ ) is exactly the answer you should give if you feel too uncertain about the rate of inflation over the medium term because you perceive the credibility of the central bank’s target as too low.

Note that our data is taken from an opt-in survey. In contrast to many other surveys, our respondents are intrinsically motivated to answer the question and are interested in the topic. Therefore, survey participants do not respond “do not know” only because they are reluctant or unable to give a more informative response. Particularly, consumers who “do not know the European Central Bank” would hardly decide to participate in a survey about the credibility of the inflation target. Typically, the motivation to participate in a survey is less intrinsic. Survey participants run by Amazon-Turk have to be paid for each answer and monetary incentives are also common in standard consumer surveys. In our survey, the only benefit for participants is the access to aggregate results after they have responded.

Figure 4 shows the share  $N$  of “do not know” answers. In line with the findings of Coibion et al. (2022) obtained for the U.S., uncertainty in Germany rose in the early phase of the pandemic (the third credibility regime). However, in the recent high inflation period, German consumers are increasingly convinced that - in contrast to the ECB’s inflation target - inflation will be well above 2% over the medium term. It is important to note that the share  $N$  of “do not know” answers should be a good indicator for uncertainty about the credibility of the inflation target but not necessarily for *general* uncertainty about future inflation. In particular, uncertainty about inflation target credibility can be low when general inflation uncertainty is high. For example, general uncertainty about future inflation might have increased significantly in the recent high inflation period because people became more uncertain about whether inflation will be, say, 5, 10 or 15% in the medium term. For inflation target credibility, however, the resulting increase in inflation uncertainty has no effects because expected rates of inflation are “clearly above 2%” in any case.

Figure 4 Uncertainty about inflation target credibility



Notes: Share  $N$  of “do not know” answers in the survey about inflation expectations over the medium term (in percentage points), see Coleman and Nautz (2022b).

In the current project, we investigate the shape of the frequency distribution of survey responses. In particular, we estimate the impact of personal characteristics and macroeconomic variables on the time-varying disagreement among consumers about the credibility of the inflation target.

## 1.2 Project-related publications

Coleman, W. and Nautz, D. (2022a). Inflation Expectations, Inflation Target Credibility and the COVID-19 Pandemic: New Evidence from Germany. Freie Universität Berlin, DP 2021/12. Forthcoming in the Journal of Money, Credit and Banking.

Coleman, W. and Nautz, D. (2022b). Inflation Target Credibility in Times of High Inflation. Freie Universität Berlin, DP 2022/5.

Diegel, M. and Nautz, D. (2021). Long-Term Inflation Expectations and the Transmission of Monetary Policy Shocks: Evidence from a SVAR Analysis. Journal of Economic Dynamics and Control 130:104192.

Hachula, M. and Nautz, D. (2018). The Dynamic Impact of Macroeconomic News on Long-Term Inflation Expectations. Economics Letters, 165: 39-43.

Nautz, D., Pagenhardt, L., and Strohsal, T. (2017): The (De-)anchoring of Inflation Expectations: New Evidence from the Euro Area, The North American Journal of Economics and Finance 40: 103-115.

Nautz, D. and Strohsal, T. (2015). Are U.S. Inflation Expectations re-anchored? Economics Letters, 127: 6-9.

Nautz, D., Strohsal, T., and Netšunajev, A. (2019). The Anchoring of Inflation Expectations in the Short and in the Long Run. Macroeconomic Dynamics, 23(5): 1959-1977.

Schmidt, S. and Nautz, D. (2012), Central Bank Communication and the Perception of Monetary Policy by Financial Market Experts. Journal of Money, Credit and Banking, 44: 323-340.

Strohsal, T., Melnick, R. and Nautz, D. (2016). The Time-Varying Degree of Inflation Expectations Anchoring. Journal of Macroeconomics, 48: 62-71.