# Anchoring of Inflation Expectations and the Role of Monetary Policy and Cost-Push Factors

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# Anchoring of Inflation Expectations and the Role of Monetary Policy and Cost-Push Factors*

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**Abstract**

This paper proposes a new measure proxying the degree of anchoring of inflation expectations on an individual forecaster level and studies the co-movement of this measure with expectations regarding monetary policy and different cost-push factors. In doing so, we rely on data taken from the ECB Survey of Professional Forecasters for both parts of the analysis. First, we construct a measure for the degree of anchoring of inflation expectations for each forecaster based on his inflation expectations taking into account both point and density forecasts. Second, we regress this anchoring measure on the professional forecasters' expectations regarding the policy rate of the ECB and three different cost factors potentially affecting the inflation rate: the crude oil price, the USD/EUR exchange rate, and unit labor costs. The main findings indicate that expectations regarding a tightening of monetary policy are generally able to enhance the degree of anchoring while an expected increase in both the crude oil price and unit labor costs seems to lower the degree of anchoring. The latter finding is more pronounced for shorter horizons.

*Keywords*: Anchoring, Inflation expectations, Monetary policy, Crude oil, Unit labor costs
*JEL*: E31, E52, Q43

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# 1 Introduction

The anchoring of inflation expectations is crucial for the effectiveness of monetary policy (King, 1995). When inflation expectations are well-anchored, it is easier for central banks to achieve their inflation targets. If market participants expect the central bank to be willing and able to control inflation around the announced target level, they are less likely to react strongly to short-term fluctuations in prices (Gürkaynak *et al.*, 2005). Otherwise, a de-anchoring of inflation expectations might result in second-round price increases, which might occur when workers expect prices to rise rapidly. Then, they may demand higher wage increases to maintain their real purchasing power. Employers, in turn, may raise prices to cover the increased labor costs. This cycle of rising wages and prices can become self-reinforcing, leading to sustained inflation. This can make it more difficult for central banks to control inflation and may require more aggressive monetary policy actions to bring inflation back under control. Consequently, central banks monitor the anchoring of inflation expectations closely and take preemptive measures to prevent a potential de-anchoring. This issue has appeared even more on the agenda of many central banks as inflation has started accelerating in 2021 due to disrupted supply-chains resulting from the COVID-19 pandemic and even more so in 2022 due to increasing energy prices as a response to the Russian invasion of Ukraine.

Therefore, the aim of the present paper is to propose a proxy for the degree of anchoring of inflation expectations and to study the expectation formation mechanism of professionals in this context by analyzing co-moving factors with the degree of anchoring. Measures for the degree of anchoring of inflation expectations have already been considered on an aggregate level for the economy as a whole (Grishchenko *et al.*, 2019; Bems *et al.*, 2021; Binder *et al.*, 2023) but not at an individual forecaster level.[1] However-

[1]To the best of our knowledge, the only exception is the study by Binder *et al.* (2023), which considers deviations of individual inflation expectations in the root squared mean and examines the

ever, recent literature emphasizes the importance of heterogeneity among forecasters and suggests that forecasts of individuals offer important implications for policymakers beyond mean forecasts (Coibion *et al.*, 2019; Falck *et al.*, 2021; Binder *et al.*, 2023; Meeks and Monti, 2023). Therefore, the main contribution of the present paper is to extend this idea and to propose a measure on an individual level, which also enables us to dig deeper into the expectation formation mechanism behind. In doing so, we rely on both point and density forecasts for future inflation taken from the European Central Bank Survey of Professional Forecasters (ECB-SPF) and we construct an anchoring measure across different forecast horizons for each individual forecaster.

The Euro Area presents a particularly intriguing case for study due to the availability of data spanning the entire history of the monetary union and the recent modification of the inflation target in July 2021. An integral part of the new monetary policy strategy of the ECB is the inflation target of 2% over the medium term, which should provide an anchor for inflation expectations (ECB, 2021). The main difference compared to the previous strategy is the symmetry of the inflation target, which means that both negative and positive deviations are regarded as equally undesirable. This implies that the inflation target can now be interpreted as a point target instead of an upper limit as within the previous strategy.[2]

Having constructed a measure proxying the degree of anchoring of inflation expectations, we assess whether de-anchoring patterns can be observed over the different decades in the history of the monetary union. Therefore, we contribute to the literature on the anchoring of inflation expectations (Strohsal and Winkelmann, 2015; Łyziak and Paloviita, 2017; Natoli and Sigalotti, 2018; Buono and Formai, 2018; Hachula and

share of forecasters exceeding specific bounds. This study solely focuses on one characteristic of a de-anchoring of individuals. In the present paper we extend this and consider six different characteristics.

[2]Prior to the announcement of the new monetary policy strategy price stability has been defined by the ECB as an inflation rate of below, but close to, 2% over the medium term (ECB, 2011).

Nautz, 2018). Past research predominantly hinges on diverse regression methods to assess how inflation expectations respond to new information or shocks, yielding evidence of de-anchoring across various economies and time periods.

As the degree of anchoring crucially depends on the credibility of the central bank, we investigate the extent to which expectations related to the ECB's main policy instrument – its policy rate – are linked to the degree of anchoring. Furthermore, inflation depends on cost-push factors such as energy prices and labor costs. Therefore, we also examine whether the expectations on such factors might be responsible for a(n) (de-)anchoring of inflation expectations. As indicator of energy prices we rely on the price for Brent crude oil. Yet another factor of potential importance is the USD/EUR exchange rate, which may exert an influence on inflation as a depreciation of the euro results in increased import prices and heightened export demand. Both might lead to an inflation rise within the Euro Area. Hence, we study whether the degree of anchoring co-moves with forecasters' expectations regarding the stance of monetary policy and different cost-push factors. In doing so, we also use data from the ECB-SPF. Professional forecasters are not only surveyed by the ECB on their beliefs regarding future inflation, GDP growth, and unemployment but are also requested to provide their expectations regarding assumptions underlying these economic factors. In this context, they provide forecasts for the ECB's policy rate (i.e., the main refinancing operations rate), the Brent crude oil price, the USD/EUR exchange rate, and unit labor costs.

The main findings are as follows. First, we provide evidence in favor a de-anchoring of inflation expectations in several periods for the Euro Area. This basically confirms the existing literature and extends it for the most recent high-inflation period. Second, we demonstrate how these de-anchoring patterns can be linked to expectations regarding crude oil price, exchange rate, and unit labor cost changes. Third, we find that expectations regarding the monetary policy of the ECB contribute to the anchoring of inflation expectations, emphasizing the ECB's generally perceived credibility among professional forecasters. This applies not only to longer-term interest rate expectations but also becomes apparent in the case of short-term interest rate expectations.

The remainder of the paper is as follows. The next section briefly reviews the most relevant literature. Section 3 provides a detailed description of the survey data and our empirical strategy while Section 4 reports and discusses our main findings. Section 5 concludes.

# 2 Review of the Literature

This section briefly discusses the literature on anchoring of inflation expectations, which on the one hand studies whether (long-run) inflation expectations can be explained by any type of (macroeconomic) news relying on different regression approaches and on the other hand proposes proxies for the degree of anchoring of inflation expectations.

Related to the former strand of the literature, Jochmann *et al.* (2010) analyze the connection between long-term and short-term inflation expectations using daily data on inflation compensation computed from the term structure of real and nominal interest rates for the US from January 2003 to June 2008 and provide evidence against firmly anchored inflation expectations. Based on daily bond yield data Gürkaynak *et al.* (2010) examine whether inflation targeting is crucial for the anchoring of inflation expectations. In doing so, they compare two inflation targeters (i.e., the UK and Sweden) to the US as a non-inflation-targeter and conclude that a credible inflation target helps to anchor inflation expectations. Beechey *et al.* (2011) also extract inflation expectations from inflation-indexed assets and compare the anchoring of long-run inflation expectations in the US and the Euro Area for the sample period from June 2003 to December 2006. They argue that long-run inflation expectations are more firmly anchored in the Euro

Area than in the US.

Galati *et al.* (2011) rely on structural break tests showing that the sensitivity of long-run inflation expectations to news about inflation and other macroeconomic variables has increased during the global financial crisis for the US, the Euro Area, and the UK. They use two proxies for inflation expectations – survey-based measures and measures extracted from financial market instruments – and conclude that long-run inflation expectations may have become less firmly anchored during the crisis. Strohsal and Winkelmann (2015) also rely on daily inflation expectations derived from inflation-indexed government bonds for the period from January 2004 to February 2011 and regress these on macroeconomic news variables. However, they extend the approach to assess the degree of anchoring of inflation expectations by the use of an exponential smooth transition autoregressive (ESTAR) model, which allows for nonlinearity due to the deviation of past inflation expectations from the inflation target. Their findings indicate that the degree of anchoring varies substantially across the US, the Euro Area, the UK, and Sweden.

Scharnagl and Stapf (2015) use option-implied probability density functions of future inflation for the period from October 2009 to December 2013 and focus on the anchoring of inflation expectations in the Euro Area during the European sovereign debt crisis. They basically provide evidence supporting anchored inflation expectations, however, they also argue in favor of a growing uncertainty, which might reveal market participants' concerns about future extreme inflation or deflation. Łyziak and Paloviita (2017) study the anchoring of inflation expectations of both professional forecasters and consumers in the Euro Area relying on survey data for the quarterly sample period from 1999Q1 to 2015Q3 and also consider the presence of a structural break due to the global financial crisis after 2008Q2. They find that longer-term inflation expectations have become more sensitive to shorter-term expectations and to actual inflation in the post-crisis period. Based on these findings they argue in favor of a de-anchoring of inflation expectation in the Euro Area since the global financial crisis. Natoli and Sigalotti (2018) also examine the anchoring of inflation expectations in the Euro Area during the post-crisis period using inflation expectations extracted from inflation derivatives for a daily data set spanning from October 2009 and February 2015. They conclude that their results indicate a risk of downside de-anchoring of long-term inflation expectations.

Buono and Formai (2018) compare the anchoring of inflation expectations across different advanced economies relying on data taken from the survey of professional forecasters conducted by Consensus Economics for the period from October 1989 to October 2017. Their findings indicate that after the global financial crisis inflation expectations have been firmly anchored in the US and, to a lesser extent, also in the UK. For the Euro Area a de-anchoring has been observed shortly after the crisis and again from 2014. For Japan they find clear evidence in favor of a de-anchoring for the entire sample period.

Using US data on inflation-linked treasury securities Hachula and Nautz (2018) test whether inflation expectations are effected by macroeconomic news identified by their correlation with surprises from macroeconomic news announcements for a daily sample period from July 2009 to August 2016. They do not find any evidence of de-anchoring for the long run horizon but for the short run. The findings are mainly in line with the ones provided by Nautz *et al.* (2019) relying on data for US consumers inflation expectations taken from the Michigan Survey of Consumers for the monthly sample from April 1990 to December 2015.

The second strand of the literature refers to the establishment of anchoring measures. Based on data from surveys of professional forecasters for a sample period from January 1999 to June 2016 for the US and the Euro Area Grishchenko *et al.* (2019) construct a measure of the anchoring of inflation expectations relying on an estimated dynamic factor model of inflation featuring time-varying uncertainty. Their findings indicate that following the global financial crisis, inflation anchoring improved in the US, while a mild de-anchoring has been observed in the Euro Area. Bems *et al.* (2021) derive an anchoring measure based on survey data taken from Consensus Economics for 45 economies for a sample period from 1989 to 2017 and analyze the response of consumer prices to terms-of-trade shocks depending on the degree of anchoring. Beckmann and Czudaj (2023) rely on the same approach but extend the sample period to 2022 as well as the number of economies to 86 and shed some light on the correlation between the subindexes considered and their connection to impossible trinity indexes.

Armantier *et al.* (2022) suggest using so-called "strategic surveys" to assess whether inflation expectations are firmly anchored. They examine whether households revise their long-run inflation expectations after presenting them different economic scenarios as treatments and find that long-run inflation expectations were well anchored in the US in July 2019 as well as in August 2021. Binder *et al.* (2023) propose a "bounds anchoring" indicator, which is based on the idea that long-run inflation expectations should not deviate significantly from the target of 2%. In doing so, they consider individual long-run inflation expectations taken from the Federal Reserve SPF and assess whether the root mean-squared deviations exceed bounds of 0.2 or 0.5. Based on their concept they basically find that the share of professional forecasters not exceeding the bounds has increased in the US in the years following the target announcement of the Federal Open Market Committee (FOMC) in 2012, but they also argue that this trend has recently started to reverse.

The present study extends both strands of the literature by proposing a proxy for the degree of anchoring of inflation expectations on an individual forecasters level and by studying the expectation formation mechanism of professionals in this context while analyzing co-moving factors with the degree of anchoring. The main contribution lies in extending the idea put forward by Bems *et al.* (2021) to an individual level, which also enables us to shed more light on the expectation formation mechanism and potential reasons of (de-)anchoring. In doing so, we rely on data taken from the ECB-SPF, which is described in the next section.

# 3 Data and Empirical Methodology

## 3.1 Inflation Expectations

The data on inflation expectations has been taken from the ECB Survey of Professional Forecasters (ECB-SPF), which is available for the quarterly sample period from 1999Q1 to 2023Q3. The survey provides inflation forecasts as point and density forecasts for different forecast horizons $h$. In this study we rely on the so-called rolling horizon forecasts for the month one-year-ahead ($h = 1$) and two-years-ahead ($h = 2$) of the latest available observation as well as the longer term forecast ($h = 5$), which refers to four (five) calendar years ahead in the Q1 and Q2 (Q3 and Q4) waves of the survey. These forecasts have been provided by professional institutions from the Euro Area (i.e., major banks and research institutes) in the first month of each quarter as point forecasts and also as histograms. In case of the latter participants are requested to assign subjective probabilities to given intervals, into which the inflation rate rate might fall. The corresponding probability distributions enable us to assess individual forecasts for the entire distribution going beyond point forecasts. The availability of all these forecasts over different forecast horizons ($h = 1, 2, 5$) allows us to study the degree of anchoring across the short-term ($h = 1, 2$) and the medium-term ($h = 5$).

The individual point forecasts for the rate of inflation (as the percent per annum change in the harmonized index of consumer prices) are shown by the black points in Figure 1 for the three forecast horizons ($h = 1, 2, 5$). Cross-sectional mean forecasts across forecasters are visualized by red lines. The plots provide evidence in favor of heterogeneity, especially around the global financial crisis (2007-2009), the COVID-19 pandemic (2020-2021), and the high-inflation period thereafter. In addition, we clearly see larger fluctuations for short-term forecasts ($h = 1, 2$) than for medium-term forecasts ($h = 5$). It seems that short-term inflation forecasts are much more sensitive to shocks and news than medium-term forecasts, which basically fluctuated closely around the inflation target of 2%. This also becomes clear when directly comparing the cross-sectional means across forecast horizons as displayed in Panel (a) of Figure 2 and already provides a first indication for the degree of anchoring.

*** Insert Figure 1 about here ***

Panel (c) of Figure 2 illustrates the disagreement among forecasters by the cross-sectional standard deviations (SDs) across forecasters and shows that this is also larger for short-term forecasts ($h = 1, 2$) than for medium-term forecasts ($h = 5$) in general and especially large in the most recent high-inflation period. Panel (b) of Figure 2 takes the information available in the forecasters' probability distribution into account. Based on these we have computed individual standard deviations as proxies for the forecasters' individual uncertainty surrounding their inflation expectations. Panel (b) of Figure 2 plots cross-sectional means of these individual standard deviations for each horizon. We see that the uncertainty related to inflation has increased substantially over time and that it increases with the horizon.

*** Insert Figure 2 about here ***

These individual standard deviations have been computed from distributional forecasts by the 'mass-at-midpoint' approach following Abel *et al.* (2016) and Glas and Hartmann (2022):

$$\mu_{i,t,h} = 1/100 \sum_{s=1}^{S} p_{i,s,t,h} m_s, \tag{1}$$

$$\sigma^2_{i,t,h} = 1/100 \sum_{s=1}^{S} p_{i,s,t,h} (m_s - \mu_{i,t,h})^2, \quad \sigma_{i,t,h} = \sqrt{\sigma^2_{i,t,h}}, \tag{2}$$

where $\mu_{i,t,h}$ represents the mean forecast computed from the histogram forecasts, $\sigma^2_{i,t,h}$ denotes the individual variance, and $\sigma_{i,t,h}$, is the corresponding standard deviation. $m_s$ stands for the midpoint of each bin while $S$ is the number of bins. $p_{i,s,t,h}$ gives the subjective probabilities assigned to the bins, which sum up to 100, and $i$, $t$, $h$, and $s$ are indexes for individual forecaster, point in time, forecast horizon, and bin, respectively.[3]

In addition, we have also calculated individual forecasters' skewness ($\text{skew}_{i,t,h}$) and kurtosis ($\kappa_{i,t,h}$) as measures of asymmetry and heavy-tailness of the inflation forecasts:

$$\text{skew}_{i,t,h} = 1/100 \sum_{s=1}^{S} p_{i,s,t,h} [(m_s - \mu_{i,t,h})/\sigma_{i,t,h}]^3, \tag{3}$$

$$\kappa_{i,t,h} = 1/100 \sum_{s=1}^{S} p_{i,s,t,h} [(m_s - \mu_{i,t,h})/\sigma_{i,t,h}]^4. \tag{4}$$

## 3.2 Anchoring Measure

The different parameters characterizing the forecast distribution have been computed as outlined in the previous subsection to construct a proxy for the forecasters' degree of anchoring of inflation expectations. In doing so, we basically extend the work by

[3]In the ECB-SPF dataset, there were 0.1 percentage point gaps between the interior bins. These gaps were removed by expanding both the lower and upper boundaries of each bin by 0.05, a practice established in prior literature (Abel *et al.*, 2016; Glas and Hartmann, 2022). To calculate the midpoints, denoted as $m_s$, the bins in the left and right tails of the distribution were assumed to be twice as wide as the interior bins.

Bems *et al.* (2021), who derive an anchoring measure on an aggregated level for different economies using aggregated survey forecast data from Consensus Economics.

In their work, Bems *et al.* (2021) introduce an anchoring measure that utilizes three distinct features to characterize the level of anchoring. These features are computed by analyzing cross-sectional means and standard deviations across forecasters for various countries. We employ these same three subindexes, but we calculate them at the individual forecaster level to assess the anchoring degree for each forecaster. Furthermore, we expand the list of subindexes to six by incorporating parameters that describe the forecast distribution. The complete procedure is detailed in the following.

The first three subindexes follow the ideas by Bems *et al.* (2021). First, we derive the absolute deviation of individual inflation expectations from the ECB's inflation target:

$$\text{Index}_{1,i,t,h} = \sqrt{(E_{i,t}(\pi_{t+h}) - 2\%)^2}, \tag{5}$$

where $E_{i,t}(\pi_{t+h})$ represents inflation expectations of forecaster $i$ made in period $t$ for horizon $h$ with $h = 1, 2, 5$ years. This subindex is based on the principle that firmly anchored inflation expectations should remain in alignment with the inflation target.

Second, we compute the absolute variation of inflation expectations from the forecaster-specific time series mean:

$$\text{Index}_{2,i,t,h} = \sqrt{(E_{i,t}(\pi_{t+h}) - \overline{\pi}_{i,h})^2}, \tag{6}$$

where $\overline{\pi}_{i,h}$ gives the time series mean of inflation expectations for each forecaster $i$. The concept underpinning this subindex is that inflation expectations that are firmly anchored seldom require revisions by experts over time.

Third, we use the absolute difference of individual inflation expectations to the cross-sectional mean across forecasters as a measure of dispersion of inflation expectations:

$$\text{Index}_{3,i,t,h} = \sqrt{(E_{i,t}(\pi_{t+h}) - \overline{\pi}_{t,h})^2}, \tag{7}$$

where $\overline{\pi}_{t,h}$ gives the cross-sectional mean forecast across forecasters at each point in time. This measure is grounded in the notion that if professional forecasters have well-anchored expectations, they would exhibit a low disagreement regarding future inflation.

As the fourth, fifth, and sixth subindex, we additionally include the uncertainty, the skewness, and the kurtosis derived from density forecasts as outlined in the previous subsection:

$$\text{Index}_{4,i,t,h} = \sigma_{i,t,h}, \quad \text{Index}_{5,i,t,h} = \text{skew}_{i,t,h}, \quad \text{and} \quad \text{Index}_{6,i,t,h} = \kappa_{i,t,h}. \tag{8}$$

Lastly, the consolidation of these six anchoring subindexes into a single measure is carried out, as they collectively offer complementary insights into the degree of anchoring. Initially, individual measures are normalized across forecasters and time periods to achieve a zero mean and a unity variance:

$$\text{Standard Index}_{n,i,t,h} = -\frac{\left(\text{Index}_{n,i,t,h} - \overline{\text{Index}}_{n,h}\right)}{\sigma(\text{Index})_{n,h}}, \quad n = 1, \ldots, 6, \tag{9}$$

where $\overline{\text{Index}}_{n,h}$ and $\sigma(\text{Index})_{n,h}$ represent the sample average and standard deviation of the corresponding subindex across forecasters $i$ and periods $t$.

Furthermore, we invert the sign of each subindex in Eq. (9), so that in this context, an increase (or decrease) in the respective measure signifies a greater (or lesser) degree of anchoring. This adjustment facilitates a clear interpretation of our anchoring measure. Finally, we calculate the simple average of the six standardized subindexes to obtain our ultimate anchoring measure:

$$\text{Anchor}_{i,t,h} = \frac{1}{6}\sum_{n=1}^{6} \text{Standard Index}_{n,i,t,h}, \quad h = 1, 2, 5. \tag{10}$$

The individual anchoring measure constructed for each forecaster is shown in Panels (a), (b), and (c) in Figure 3 for each horizon ($h = 1, 2, 5$) by the black points while the averages across forecasters are illustrated by the red line in the corresponding plots and are compared to each other in Panel (d). First of all, in Panels (a), (b), and (c) we see some heterogeneity across forecasters, which underlines the importance to allow for the degree of anchoring on an individual level. Especially, the turbulent periods around the global financial crisis (2007-2009), the European sovereign debt crisis (2010-2013), the COVID-19 pandemic (2020-2021), and the Russian invasion of Ukraine (2022-2023) have resulted in a stronger disagreement regarding the level of anchoring of inflation expectations among professional forecasters. However, when looking at the cross-sectionals means compared in Panel (d), we also see large differences in the degree of anchoring between the shorter horizons ($h = 1, 2$) and the longer horizon ($h = 5$). It seems that the anchoring of inflation expectations is much more stable over the medium run ($h = 5$). At shorter horizons we observe periods, which can be characterized by a de-anchoring of inflation expectations. For the periods between the years 2008 and 2010, 2014 and 2016, as well as 2019 and 2023 the degree of anchoring has taken negative values for $h = 1, 2$, which can be seen as indication of a de-anchoring around the global financial crisis, the period of ultra-low interest rates, and the most recent high-inflation period.[4] These findings confirm and extend evidence of a (de)-anchoring provided in different periods in existing studies for the Euro Area (Galati *et al.*, 2011; Strohsal and Winkelmann, 2015; Scharnagl and Stapf, 2015; Łyziak and Paloviita, 2017; Natoli and Sigalotti, 2018; Buono and Formai, 2018; Grishchenko *et al.*, 2019). For instance, Buono and Formai (2018) find a de-anchoring shortly after the global financial crisis and starting from 2014 for the Euro Area. We confirm this finding and especially extend it by the most recent period.

[4]When comparing these findings with Figure 1 and Panel (a) of Figure 2, it becomes evident that the observed de-anchoring in these three periods differs in the direction of the de-anchoring. In the former two periods a decline of inflation expectations below the inflation target has been observed while in the latter period inflation expectations have increased substantially.

*** Insert Figure 3 about here ***

Over the medium run horizon the level of anchoring was negative for the first three years after the establishment of the monetary union. It seems that the ECB required a few years to gain enough credibility among professional forecasters. Beyond this point, the degree of anchoring at $h = 5$ remained relatively stable for a substantial period of time until a decline in anchoring has been observed more recently, beginning in 2019. However, we also see that the degree of de-anchoring is less substantial compared to the shorter horizons ($h = 1, 2$). Overall, we provide clear evidence in favor of a de-anchoring of inflation expectations in the most recent high-inflation period at each horizon. In the following we want to study whether the degree of (de-)anchoring can be explained by a co-movement with expectations regarding several variables, which are introduced in the next subsection.

## 3.3 Assumptions Expectations

Since 2002Q1 the ECB-SPF also includes expectations regarding assumptions underlying the expectations on economic factors such as inflation. In this context, professionals also provide forecasts for the ECB's policy rate (i.e., the main refinancing operations rate), the Brent crude oil price, the USD/EUR exchange rate, and the unit labor costs change per employee.

These forecasts are provided in a different horizon structure and are solely requested as point forecasts. The expectations regarding the policy rate, the Brent crude oil price, and the USD/EUR exchange rate are available for four consecutive quarters (denoted as $k = 1, 2, 3, 4$) as well as for the next calendar year (annual average, represented by $h = 1$) and the calendar year after the next one (annual average, $h = 2$).[5] Forecasts for

[5]The latter two horizons ($h = 1, 2$) have been included to the survey since wave 2010Q2.

the year-on-year unit labor costs change are only available since 2004Q3 for the current calendar year (annual average, denoted as $h = 0$), the next calendar year (annual average, $h = 1$), the calendar year after next (annual average, $h = 2$), and a longer term forecast ($h = 4/5$).[6]

The policy rate and the year-on-year unit labor costs change per employee are given in percent per annum. However, the Brent crude oil price is given in US dollar (USD) per barrel and the USD/EUR exchange rate is denominated in USD per one euro (i.e., an increase of the exchange rate represents an appreciation of the euro against the USD). Therefore, based on the survey data we have computed expected percentage changes for both:

$$E_{i,t}(\Delta op_{t+k}) = 100\frac{E_{i,t}(OP_{t+k}) - OP_t}{OP_t}, \quad E_{i,t}(\Delta e_{t+k}) = 100\frac{E_{i,t}(E_{t+k}) - E_t}{E_t}, \tag{11}$$

where $E_{i,t}(OP_{t+k})$ and $E_{i,t}(E_{t+k})$ stand for forecasts of the crude oil price and the USD/EUR exchange rate, respectively, made in period $t$ by forecaster $i$ and $k$ refers to a horizon of $k$-quarters-ahead. $OP_t$ and $E_t$ are the corresponding spot prices on the day the forecasts had to be submitted in the survey (the exact dates are published by the ECB). Daily spot prices for Brent crude oil prices and the daily spot USD/EUR exchange rate have been retrieved from Federal Reserve Economic Data (FRED).[7]

The individual forecasts for all four assumptions are provided in the Appendix (see Figures A.1 to A.4) while the cross-sectional means are displayed in Figure 4. Overall, we see that forecasts roughly show the some pattern across the different horizons. However, we also observe differences in expectations across horizons. For the policy rate we see that professionals have expected higher interest rates over the longer horizon ($h = 2$) compared to shorter horizons for nearly the entire sample period. Solely, in

[6]The latter is provided for the four-years-ahead (five-years-ahead) horizon in the Q1 and Q2 (Q3 and Q4) waves.

[7]The corresponding codes for the two series are: DCOILBRENTEU and DEXUSEU.

the latest sample period professionals started expecting policy rate cuts over the longer horizon ($h = 2$) compared to their expectations in the very short-run. Expectations for the exchange rate change are unsurprisingly much more volatile and show differences across the forecast horizons in several periods. For unit labor cost forecasts we observe that longer term forecasts are much more stable and do not seem to react strongly to news.

*** Insert Figure 4 about here ***

### 3.4 Empirical Methodology

Finally, we aim to examine expectation formation among professional forecasters in the context of the anchoring of inflation expectations. Therefore, based on our panel data set, which has been described in the previous subsections, we estimate the following model:

$$\text{Anchor}_{i,t,h} = \beta_1 E_{i,t}(i_{t+k}) + \beta_2 E_{i,t}(\Delta op_{t+k}) + \beta_3 E_{i,t}(\Delta e_{t+k}) + \beta_4 E_{i,t}(\Delta luc_{t+k}) + \xi_i + \varepsilon_{i,t} \tag{12}$$

where $\text{Anchor}_{i,t,h}$ measures the degree of anchoring of inflation expectations at period $t$ for forecaster $i$ over a horizon of $h$-years-ahead, $E_{i,t}(.)$ stands for expectations made in period $t$ by forecaster $i$ and $k$ refers to a horizon of $k$-quarters-ahead. $i_{t+k}$ denotes the policy rate of the ECB, i.e., the main refinancing operations rate, $\Delta op_{t+k}$ represents the percentage change in the Brent crude oil price between $t$ and $t+k$, $\Delta e_{t+k}$ gives the percentage change in the USD/EUR exchange rate between $t$ and $t+k$, and $\Delta luc_{t+k}$ is the year-on-year rate of change in labor costs per employee. $\xi_i$ and $\varepsilon_{i,t}$ denote time-invariant forecaster-specific fixed effects (FE) and idiosyncratic errors, respectively. The regression is conducted for $\text{Anchor}_{i,t,h}$ at the horizon $h = 1, 2, 5$ regressed on forecasts for the four factors made for four consecutive quarters ($k = 1, 2, 3, 4$) as well as the forecast for the next calendar year ($h = 1$) and the calendar year after next ($h = 2$). For $\Delta luc_{t+k}$ forecasts for four consecutive quarters ($k = 1, 2, 3, 4$) are not available but only the forecast for the current calendar year. Therefore, the latter is included in each specification for $k = 1, 2, 3, 4$. To also allow for variation over time due to the different crisis events experienced by the monetary union, we also estimate the regression model given by Eq. (12) for a rolling window with a window size of 20 quarters, which equals five years.

# 4 Empirical Findings

In this section we report and discuss our main findings, which are subdivided into two subsections referring to the estimations carried out for the entire available sample period and the time-varying rolling window estimation.

## 4.1 Full Sample Results

Full sample estimation results for the regression model given by Eq. (12) are reported in Tables 1 to 3 for the anchoring measure at different horizons ($h = 1, 2, 5$). Table 1 provides the estimated coefficients for $h = 1$, which, first of all, indicate that expectations regarding the stance of monetary policy seem to increase the degree of anchoring significantly (at least at the 10% level), when considering policy rate expectations within one year ($k = 1, 2, 3, 4$). This finding is plausible as the expectation of a tightening of monetary policy can be seen as the belief in the credibility of the ECB, which tries to achieve its main objective of price stability. It also shows that expectations regarding a change in monetary policy over the short-run horizon (i.e., for the next quarters) co-move with the anchoring of inflation expectations for a horizon of one year. The effect is the strongest for the one-quarter-ahead horizon and decreases slightly for higher intra-year-horizons. However, the results differ substantially when considering the estimated policy rate expectation coefficients for horizons of one- and two-years-ahead ($h = 1, 2$). In this case the coefficients turn out to be significantly negative and even higher in magnitude. This would imply that expected raises of the policy rate over horizons of one or two years reduce the anchoring of inflation expectations. This finding can also be rationalized by two explanations. First, the necessity to increase the policy rate for a longer period of time might coincide with a persistent deviation of the actual inflation rate from the target of the central bank, which could result in a lower degree of anchoring. Second, when interest rate increases are expected to hold for a longer period of time, this might raise concerns of a recession among the forecasters, which might result in a deflation fear also decreasing the degree of anchoring.[8]

*** Insert Table 1 about here ***

Turning to the coefficient estimates for expectations regarding different cost-push factors in Table 1 provides evidence in favor of de-anchoring tendencies in the Euro Area. An expected price increase of Brent crude oil as one important production factor lowers the degree of anchoring significantly. This finding is highly significant (at 1%) and robust across all horizons of expectations. The same basically holds for an expected increase in unit labor costs as another important production factor. The latter also decreases the degree of anchoring significantly while the magnitude of the effect is much

[8]However, it should also be noted that another explanation for the different findings regarding policy rate expectations across the different horizons ($k = 1, 2, 3, 4$ vs. $h = 1, 2$), might simply be caused by the fact that the horizons $h = 1, 2$ have been included to the survey since wave 2010Q2 as already mentioned in Section 3.3. We will shed some light on the effect of the different sample sizes in the rolling window estimation conducted in Section 4.2.

stronger compared to the coefficients for Brent crude oil price change expectations. But again, the findings are relatively robust across all horizons of expectations. The role of exchange rate expectations for the anchoring of inflation expectations is theoretically not clear-cut as both an appreciation and a depreciation of the domestic currency can result in a de-anchoring. An expected appreciation of the euro against the USD (i.e., an increase of the USD/EUR exchange rate) should coincide with expectations of falling import prices and export demand, which both result in an expected decrease of the general price level in the economy. Vice versa, an expected depreciation of the euro should correspond to an expected increase of the general price level. However, a de-anchoring of inflation expectations can occur into both directions. Whether an expected exchange rate change results in a de-anchoring or even supports the anchoring might depend on the size of the expected change and the current level of the exchange rate. In the same vein, the coefficient estimates also do not provide a clear picture. In most cases the exchange rate expectation coefficient is insignificant. Solely in the very short-run ($k = 1, 2$) we observe a significantly positive relationship while it is the opposite for the longest horizon ($h = 2$).

The corresponding findings for the degree of anchoring over a horizon of two-years-ahead ($h = 2$) are shown in Table 2 and basically verify all observations discussed above for the one-year-ahead horizon. The results are robust in terms of coefficient estimates, their significance levels, and the explanatory power of the models.

*** Insert Table 2 about here ***

However, when looking at the regression results for the degree of anchoring over a horizon of five-years-ahead ($h = 5$) reported in Table 3 we see clear differences. Expectations regarding crude oil price changes and unit labor cost changes seem not to play any role for the anchoring of inflation expectations in the medium-run. The corresponding coefficients turn out to be insignificantly different from zero in all cases. Especially, for crude oil price expectations this is plausible as the crude oil price is usually quite volatile while these short-term fluctuations are of minor importance for inflation expectations over the longer horizon. In contrast, for exchange rate expectations we do find some significant coefficients indicating a de-anchoring. Most strikingly, expectations regarding the stance of monetary policy seem to increase the anchoring of inflation expectations as the corresponding coefficients are positive in all cases while they are highly significant for the intra-year-horizons ($k = 1, 2, 3, 4$). This shows that short-term interest rate expectations even contribute to the anchoring of inflation expectations over the longer term.

*** Insert Table 3 about here ***

Overall, we provide evidence for a de-anchoring of inflation expectations over shorter horizons ($h = 1, 2$) due to expectations of higher production costs attributed to crude oil prices and compensations for employees. Over the medium-run horizon ($h = 5$) we generally observe less evidence in favor of a de-anchoring. Expectations regarding crude oil price and unit labor cost changes seem not to play any role over the medium-run while exchange rate expectations might be responsible for a de-anchoring in this case. At all horizons expectations of a tightening of monetary policy seem to increase the degree of anchoring.

### 4.2 Sub-Sample Analysis

In this subsection we check whether the findings presented in the previous subsection are robust over the entire sample period, which was characterized by dramatic crises and several changes in monetary policy in the Euro Area. The rolling window estimation results for our regression model provided by Eq. (12) for a window size of 20 quarters are visualized in Figures 5 to 8. These show time series diagrams plotting the coefficient estimates over time and marking significance at the 5% level with red points. Each plot visualizes one of the four coefficient estimates across different specifications: we have considered inflation anchoring over the three horizons ($h = 1, 2, 5$) and assumptions expectations over the horizons of one-quarter-ahead ($k = 1$) and one-year-ahead ($h = 1$). The time series for the latter begin later as the corresponding expectations are only available since wave 2010Q2.[9]

The time-varying coefficient for expectations regarding the policy rate is illustrated in Figure 5 and shows for anchoring horizons of $h = 1, 2$ that an expected increase of the policy rate significantly coincides with an increase in the degree of inflation anchoring over most of the sample period (see Panels (a) to (d) in Figure 5). Solely at the end of the sample period we also observe significantly negative coefficients, which are not surprising considering that in this period we have observed a de-anchoring of inflation expectations due to the substantial increase in actual inflation (see Figures 1 and 3) together with an increase in interest rate expectations in response to the latter (see Panel (a) in Figure 4). This puts the finding of a negative policy rate expectation coefficient for the longer term horizons ($h = 1, 2$) reported in Tables 1 and 2 into perspective. In contrast, considering anchoring over the medium-run ($h = 5$), the corresponding policy rate expectations coefficients turn out to be positive and statistically significant in particular in the latest

[9]The rolling window estimation results for assumptions expectations over other horizons ($k = 2, 3, 4$ and $h = 2$) are available upon request.

period (see Panels (e) and (f) in Figure 5). This implies that professionals belief that the expected tightening of monetary policy in this period contributes to the anchoring of inflation expectations but only in the medium-run ($h = 5$).

*** Insert Figure 5 about here ***

Figure 6 illustrates the time-varying coefficient for crude oil price expectations. These are significantly negative for most of the sample period implying a de-anchoring of inflation expectations due to expected fluctuations in the crude oil price, which is especially observed for the years since 2015. The latter period was characterized by a sharp supply-driven fall in crude oil prices, which have contributed to deflation fears around this period in the Euro Area. The time-varying coefficient for exchange rate expectations provided in Figure 7 shows that the contribution of exchange rate expectations to the anchoring of inflation expectations was insignificant for most of the sample period. Solely, for the medium-run horizon ($h = 5$) we find evidence for a de-anchoring due to exchange rate expectations in the most recent high-inflation period (see Panels (e) and (f) in Figure 7). Finally, the time-varying coefficient for labor cost expectations is visualized in Figure 8 and provides evidence in favor of a de-anchoring of inflation expectations in several periods but also shows significantly positive coefficients in same cases.

*** Insert Figures 6 to 8 about here ***

Overall, the findings for the full sample period discussed in Section 4.1 are confirmed by most of the rolling window estimates and can be summarized as follows. First, we provide evidence in favor a de-anchoring of inflation expectations in several periods across different horizons in the Euro Area. This basically confirms the existing literature and extends it for the most recent high-inflation period. Second, we show how these de-anchoring patterns can be attributed to expectations regarding crude oil price, exchange rate, and unit labor cost changes. Third, we also show that the monetary policy of the ECB generally contributes to the anchoring of inflation expectations and is, therefore, regarded as credible by professional forecasters. In the most recent high-inflation period this especially holds when considering anchoring over the medium run horizon ($h = 5$). However, this effect is not restricted to interest rate expectations over longer horizons but is already manifested by expectations in the very short run (i.e., for the upcoming quarters).

# 5 Concluding Remarks

The present study contributes to the existing literature by proposing an anchoring measure considered on an individual level computed based on different characteristics of point and density forecasts derived from the ECB-SPF. This measure helps us to assess whether inflation expectations are firmly anchored at different points in time and enables us to analyze co-movements of the anchoring with professional forecasters' expectations regarding the stance of monetary policy and different cost-push factors, which include the crude oil price, the USD/EUR exchange rate, and labor costs.

The main findings are as follows. First, we find de-anchoring patterns for the Euro Area in several periods. Second, we show that these patterns coincide with expectations regarding crude oil price, exchange rate, and unit labor cost changes. Third, we provide evidence that expectations regarding the monetary policy of the ECB generally contribute to the anchoring of inflation expectations and show that the policy of the ECB is generally regarded as credible by professional forecasters. This does not solely hold when referring to longer term interest rate expectations but becomes already evident for interest rate expectations over the very short run.

The anchoring measure proposed in this study provides another useful tool for central banks to monitor the degree of anchoring in real-time and to better analyze factors being responsible for a potentially observed de-anchoring. This may help central banks to decide about the future path of monetary policy, which is especially important and challenging in the current period. A promising path for future research would be to extend the proposed anchoring measure by distinguishing in the direction of de-anchoring.

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Figure 1: **Individual inflation expectations**

The plots illustrate quarterly Euro Area inflation forecasts for each forecaster (in percent per annum) by the black dots. These are shown for different horizons $h$ (one-year-ahead, two-years-ahead, and five-years-ahead) for the entire period from 1999Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Cross-sectional averages across forecasters are visualized by a red line.

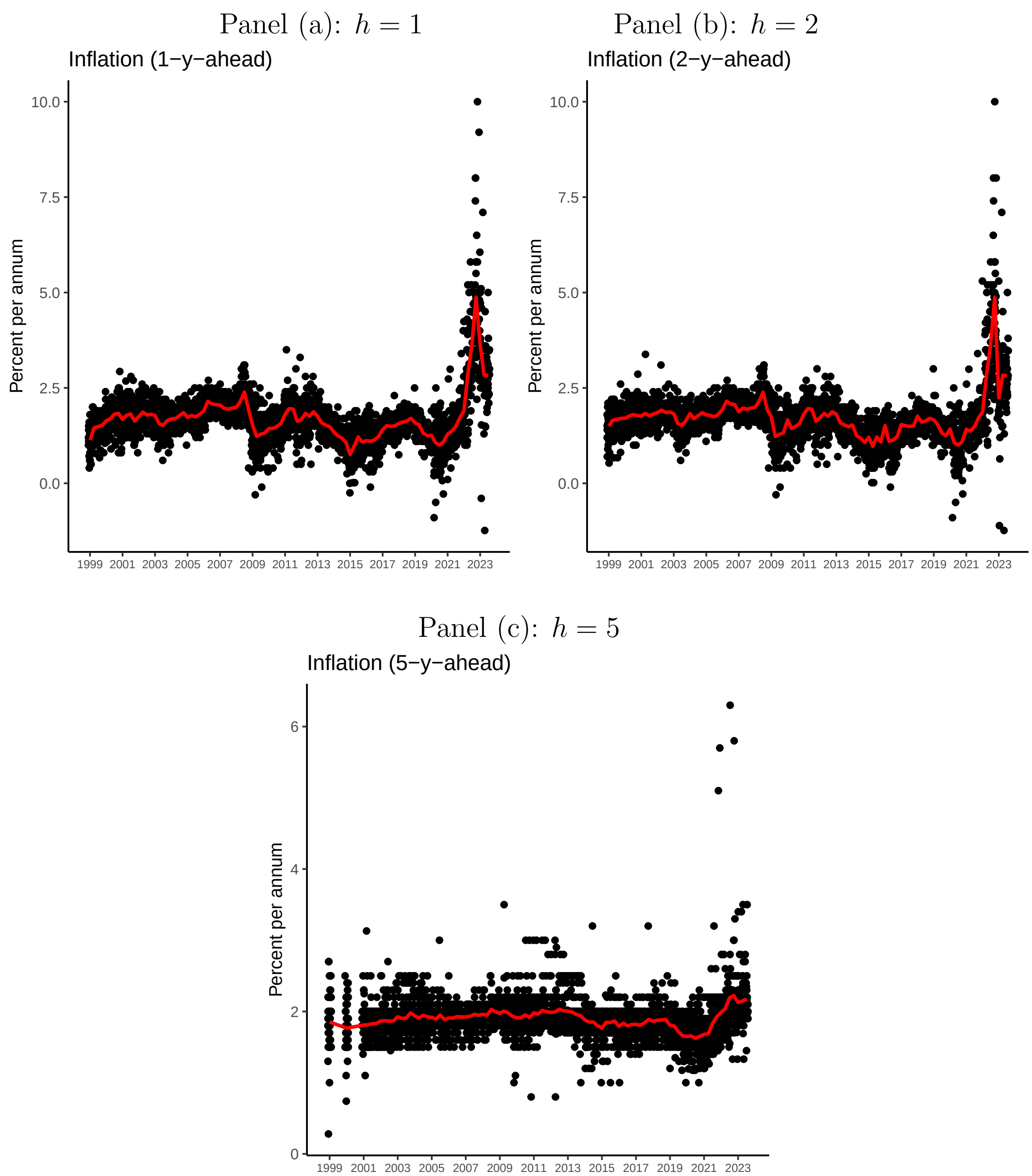
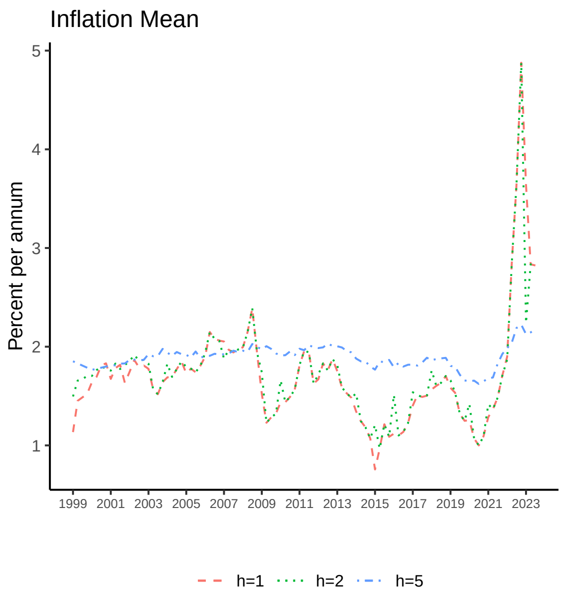


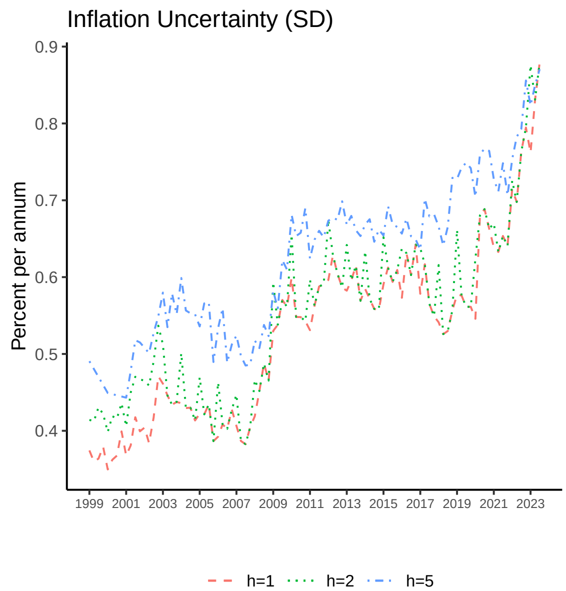
Figure 2: **Aggregated inflation expectations**

The plots illustrate aggregated inflation expectations for different horizons $h$ (one-year-ahead, two-years-ahead, and five-years-ahead) for the entire period from 1999Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Panel (a) shows cross-sectional means of point forecasts across forecasters. Panel (b) provides cross-sectional means of individual standard deviations (SDs) computed from the individual density forecasts, which exhibits the ex-ante uncertainty across forecasters. Panel (c) gives cross-sectional standard deviations (SDs) of point forecasts across forecasters, which measure the disagreement across forecasters.

Panel (a): Cross-sectional means




Panel (b): Cross-sectional means of SDs




Panel (c): Cross-sectional SDs

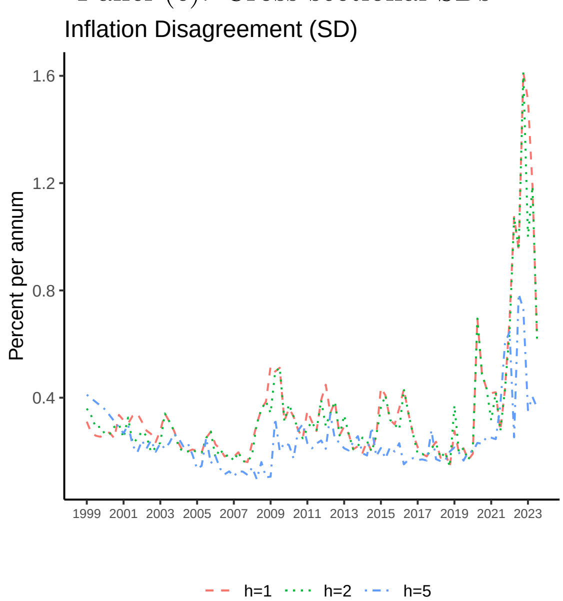


Figure 3: **Anchoring measure**

Panels (a), (b), and (c) visualize the anchoring measure on an individual level for each forecaster by the black dots for different horizons $h$ (one-year-ahead, two-years-ahead, and five-years-ahead) for the period from 1999Q1 to 2023Q3. The red lines illustrate the corresponding cross-sectional means across forecasters. Panel (d) compares these across the three horizons $h$.

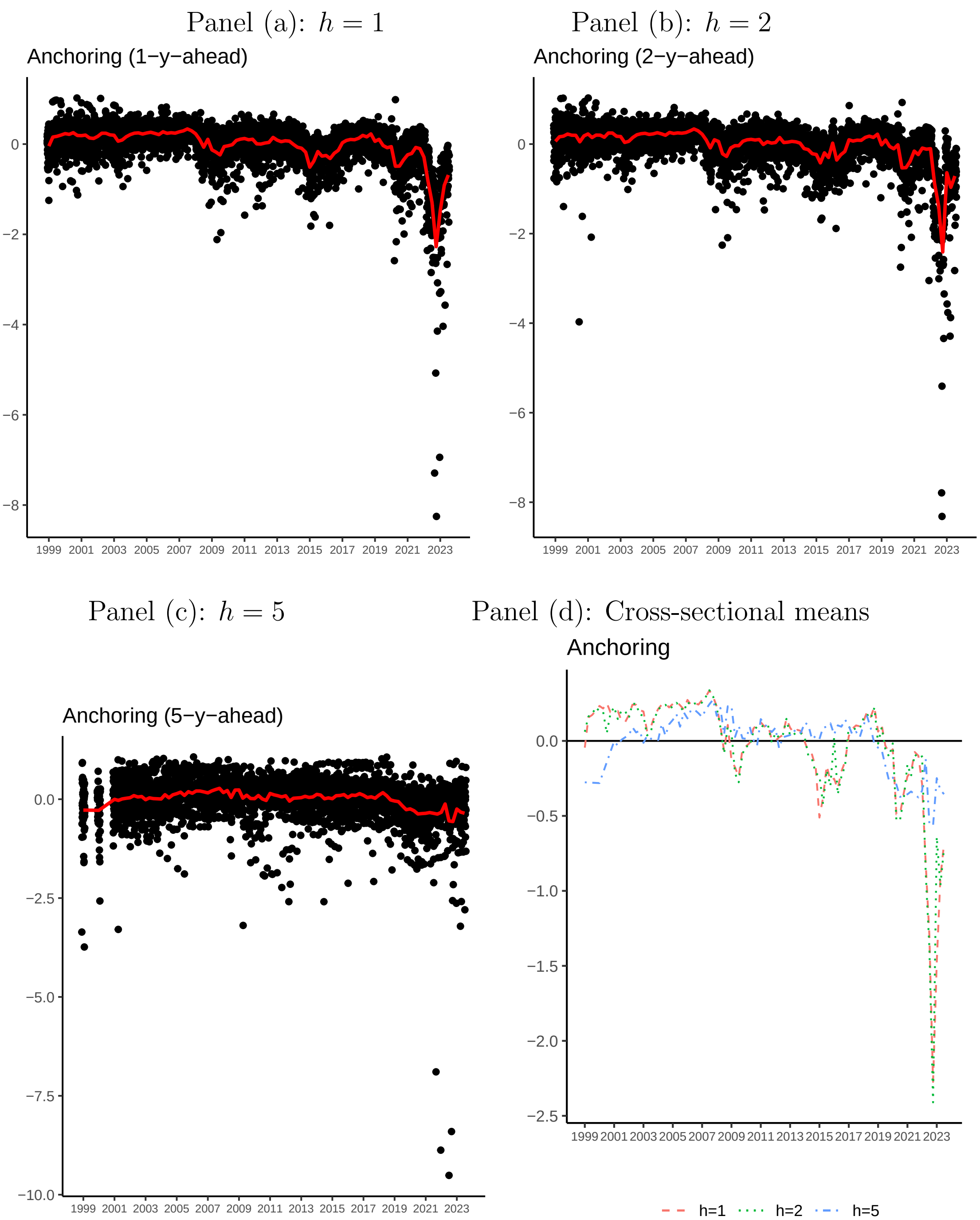


Figure 4: **Aggregate expectations**

The plots compare the cross-sectional means of point forecasts for four different variables across forecasters for each horizon for the period from 2002Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. The plots include forecasts for the main refinancing operations rate of the ECB (Panel (a)), the Brent crude oil price change (Panel (b)), the USD/EUR exchange rate change (Panel (c)), and the unit labor costs change per employee (Panel (d)).

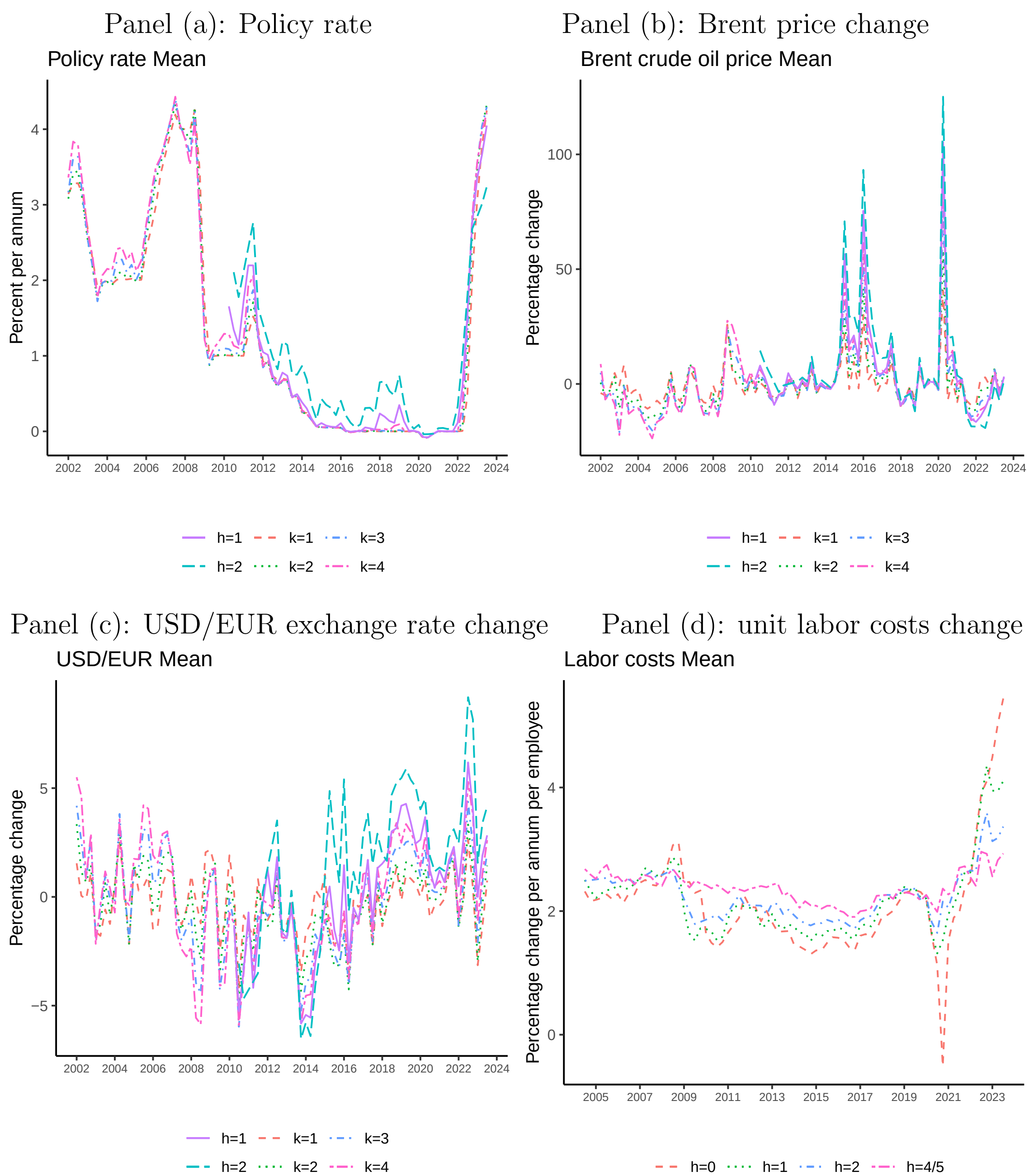
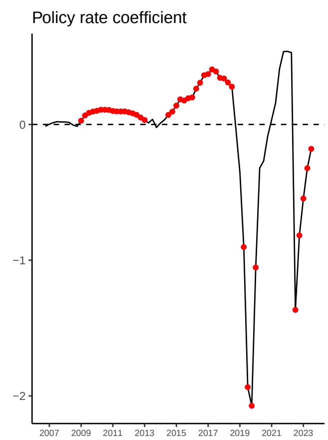


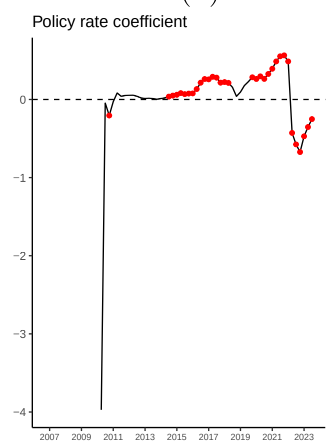
Figure 5: **Time-varying policy rate coefficient**

The plots visualize rolling window coefficient estimates of the policy rate for the regression of the anchoring measure on the expectations regarding the policy rate, the Brent crude oil price change, the USD/EUR rate change, and the unit labor costs change. The window size is 20 quarters. E.g., $h = 1$ vs. $k = 1$ refers to a regression of the anchoring over horizon $h = 1$ regressed on the regressor variables over horizon $k = 1$, where $h$ stands for years and $k$ for quarters. The black line shows the coefficient estimate and the red dot indicates that the coefficient is significantly different from zero at the 5% level.

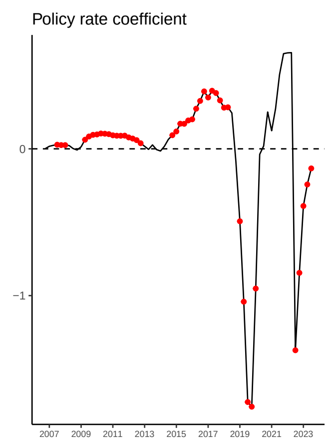
Panel (a): $h = 1$ vs. $k = 1$



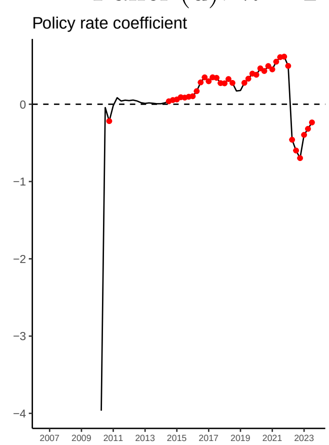

Panel (b): $h = 1$ vs. $h = 1$



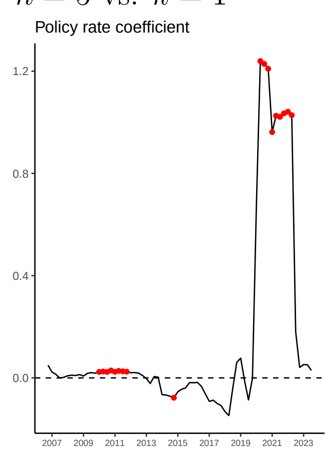

Panel (c): $h = 2$ vs. $k = 1$



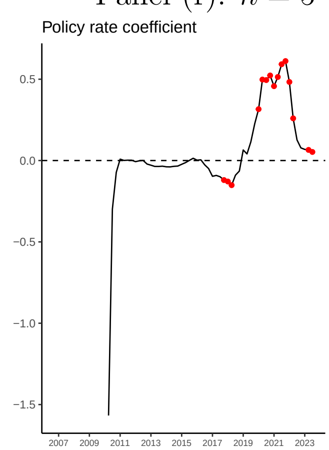

Panel (d): $h = 2$ vs. $h = 1$




Panel (e): $h = 5$ vs. $k = 1$



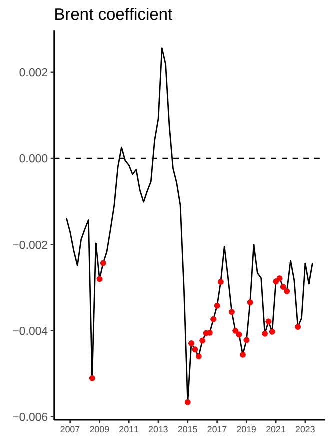

Panel (f): $h = 5$ vs. $h = 1$



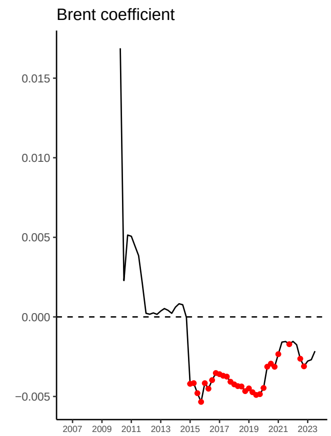
## Figure 6: **Time-varying Brent coefficient**

The plots visualize rolling window coefficient estimates of the Brent change for the regression of the anchoring measure on the expectations regarding the policy rate, the Brent crude oil price change, the USD/EUR rate change, and the unit labor costs change. The window size is 20 quarters. E.g., $h = 1$ vs. $k = 1$ refers to a regression of the anchoring over horizon $h = 1$ regressed on the regressor variables over horizon $k = 1$, where $h$ stands for years and $k$ for quarters. The black line shows the coefficient estimate and the red dot indicates that the coefficient is significantly different from zero at the 5% level.

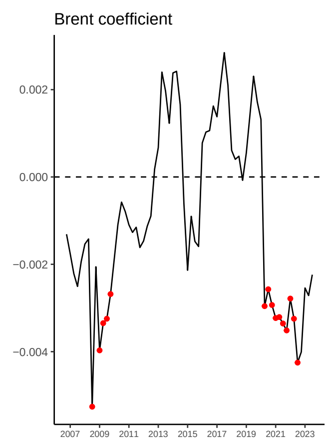
Panel (a): $h = 1$ vs. $k = 1$



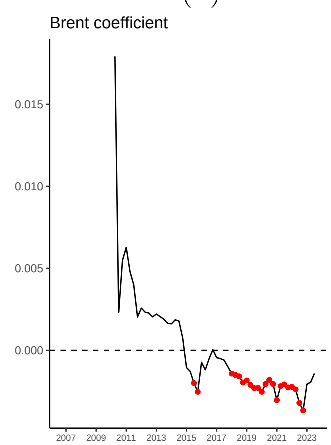

Panel (b): $h = 1$ vs. $h = 1$



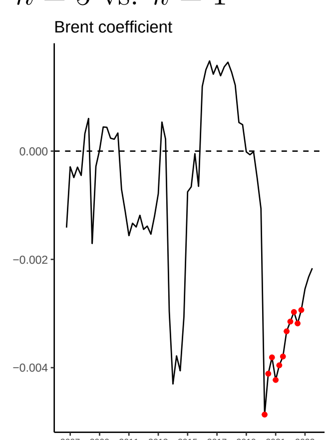

Panel (c): $h = 2$ vs. $k = 1$



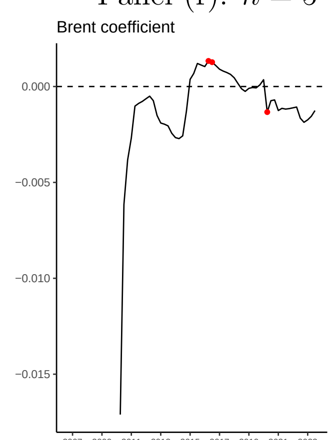

Panel (d): $h = 2$ vs. $h = 1$




Panel (e): $h = 5$ vs. $k = 1$




Panel (f): $h = 5$ vs. $h = 1$



## Figure 7: **Time-varying USD/EUR coefficient**

The plots visualize rolling window coefficient estimates of the USD/EUR change for the regression of the anchoring measure on the expectations regarding the policy rate, the Brent crude oil price change, the USD/EUR rate change, and the unit labor costs change. The window size is 20 quarters. E.g., $h = 1$ vs. $k = 1$ refers to a regression of the anchoring over horizon $h = 1$ regressed on the regressor variables over horizon $k = 1$, where $h$ stands for years and $k$ for quarters. The black line shows the coefficient estimate and the red dot indicates that the coefficient is significantly different from zero at the 5% level.

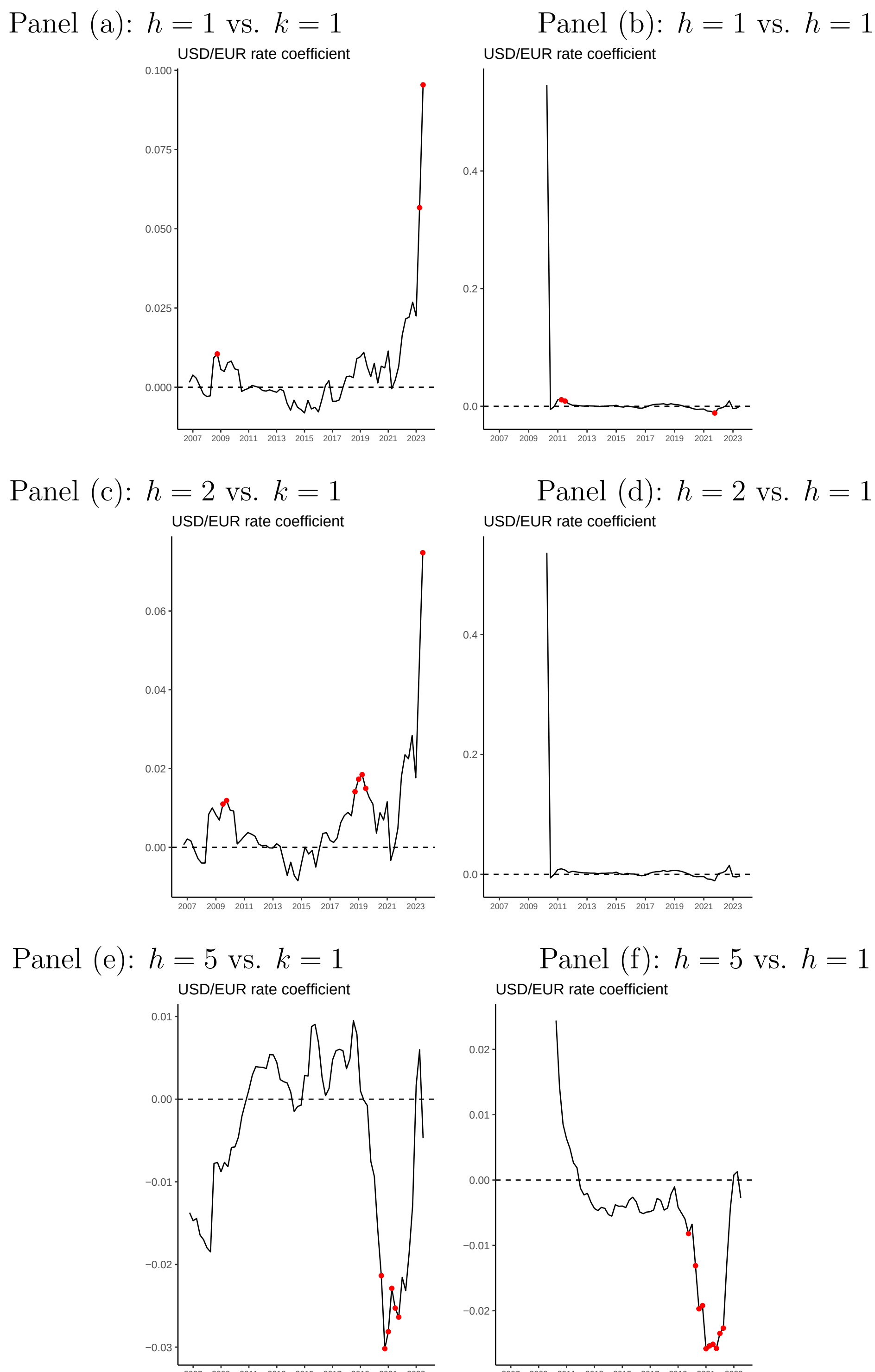


Figure 8: **Time-varying labor cost coefficient**

The plots visualize rolling window coefficient estimates of the labor cost change for the regression of the anchoring measure on the expectations regarding the policy rate, the Brent crude oil price change, the USD/EUR rate change, and the unit labor costs change. The window size is 20 quarters. E.g., $h = 1$ vs. $k = 1$ refers to a regression of the anchoring over horizon $h = 1$ regressed on the regressor variables over horizon $k = 1$, where $h$ stands for years and $k$ for quarters. The black line shows the coefficient estimate and the red dot indicates that the coefficient is significantly different from zero at the 5% level.

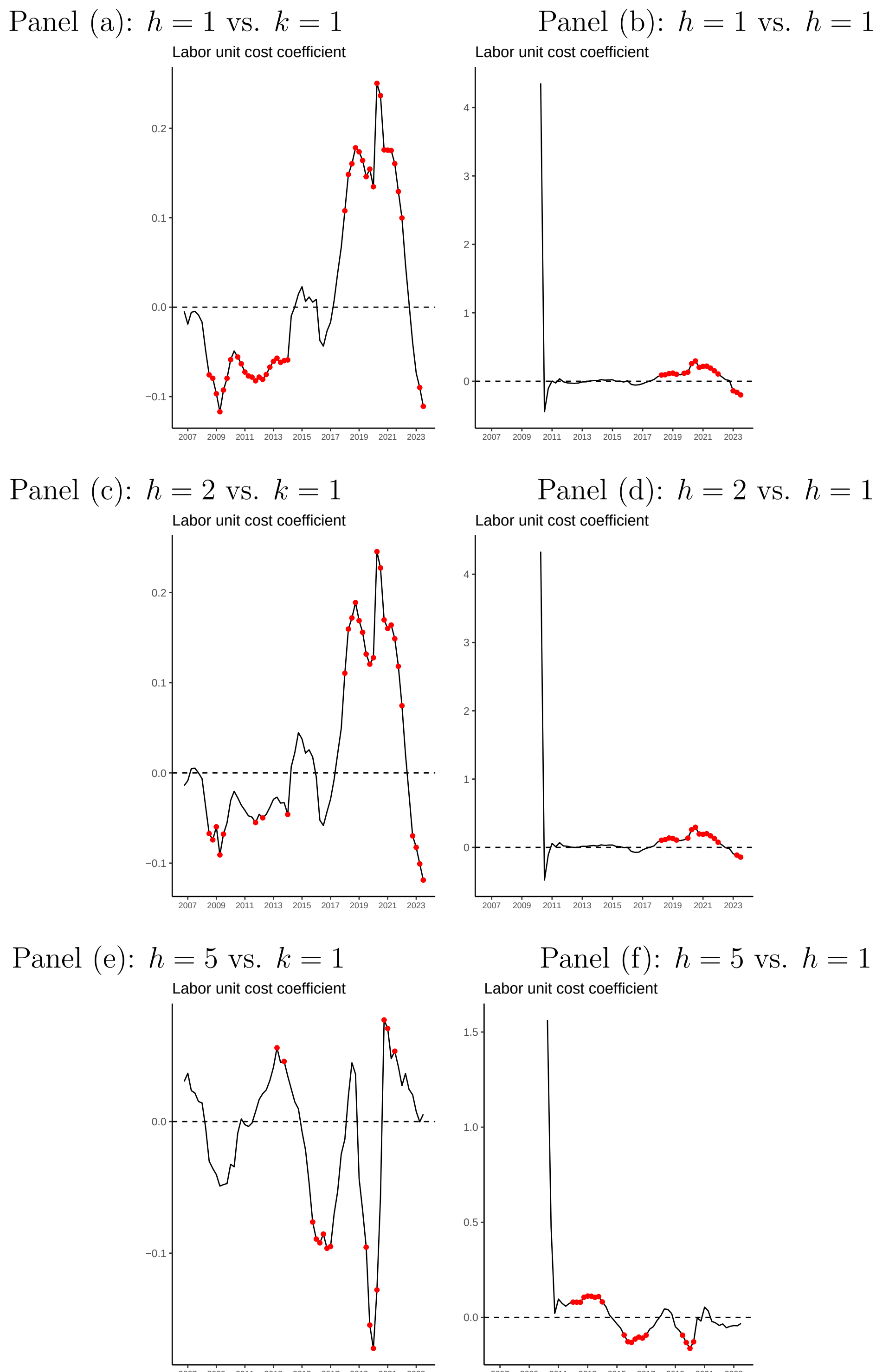


Table 1: **Anchoring regression results for $h = 1$**

| | $k = 1$ | $k = 2$ | $k = 3$ | $k = 4$ | $h = 1$ | $h = 2$ |
|---|---|---|---|---|---|---|
| $E_{i,t}(i_{t+k})$ | 0.0650 | 0.0439 | 0.0339 | 0.0268 | -0.1077 | -0.1775 |
| SE | (0.0152) | (0.0153) | (0.0158) | (0.0157) | (0.0341) | (0.0402) |
| $p$-value | [0.0000] | [0.0040] | [0.0321] | [0.0890] | [0.0016] | [0.0000] |
| $E_{i,t}(\Delta op_{t+k})$ | -0.0043 | -0.0042 | -0.0037 | -0.0033 | -0.0051 | -0.0037 |
| SE | (0.0015) | (0.0011) | (0.0009) | (0.0007) | (0.0008) | (0.0008) |
| $p$-value | [0.0035] | [0.0002] | [0.0000] | [0.0000] | [0.0000] | [0.0000] |
| $E_{i,t}(\Delta e_{t+k})$ | 0.0164 | 0.0091 | 0.0049 | -0.0014 | -0.0013 | -0.0104 |
| SE | (0.0075) | (0.0049) | (0.0034) | (0.0024) | (0.0039) | (0.0040) |
| $p$-value | [0.0296] | [0.0653] | [0.1519] | [0.5560] | [0.7285] | [0.0090] |
| $E_{i,t}(\Delta luc_{t+k})$ | -0.1568 | -0.1447 | -0.1384 | -0.1338 | -0.2424 | -0.2363 |
| SE | (0.0453) | (0.0420) | (0.0396) | (0.0361) | (0.0750) | (0.1035) |
| $p$-value | [0.0006] | [0.0006] | [0.0005] | [0.0002] | [0.0013] | [0.0227] |
| FE | yes | yes | yes | yes | yes | yes |
| $\overline{R}^2$ | 0.2653 | 0.2591 | 0.2565 | 0.2523 | 0.4162 | 0.3972 |
| $N \times T$ | 1569 | 1564 | 1559 | 1550 | 983 | 783 |

*Note:* The table provides coefficient estimates, heteroskedasticity and autocorrelation robust (HAC) standard errors (SE) according to Arellano (1987), $p$-values, adjusted $R^2$s ($\overline{R}^2$) and the number of observations ($N \times T$) for the following regression model:

$$\text{Anchor}_{i,t,h} = \beta_1 E_{i,t}(i_{t+k}) + \beta_2 E_{i,t}(\Delta op_{t+k}) + \beta_3 E_{i,t}(\Delta e_{t+k}) + \beta_4 E_{i,t}(\Delta luc_{t+k}) + \xi_i + \varepsilon_{i,t}$$

where $\text{Anchor}_{i,t,h}$ measures the degree of anchoring of inflation expectations at period $t$ for forecaster $i$ over a horizon of $h$-years-ahead, $E_{i,t}(.)$ stands for expectations made in period $t$ by forecaster $i$ and $k$ refers to a horizon of $k$-quarters-ahead. $i_{t+k}$ denotes the policy rate of the ECB, i.e., the main refinancing operations rate, $\Delta op_{t+k}$ represents the percentage change in the Brent crude oil price between $t$ and $t+k$, $\Delta e_{t+k}$ gives the percentage change in the USD/EUR exchange rate between $t$ and $t+k$, and $\Delta luc_{t+k}$ is the year-on-year rate of change in unit labor costs per employee. $\xi_i$ and $\varepsilon_{i,t}$ denote time-invariant forecaster-specific fixed effects (FE) and idiosyncratic errors, respectively. The regression is conducted for $\text{Anchor}_{i,t,h}$ at the horizon $h = 1$ (one-year-ahead) regressed on forecasts for the four factors made for four consecutive quarters ($k = 1, 2, 3, 4$) as well as the forecast for the next calendar year (annual average, $h = 1$) and the calendar year after next (annual average, $h = 2$). For $\Delta luc_{t+k}$ forecasts for four consecutive quarters ($k = 1, 2, 3, 4$) are not available but only the forecast for the current calendar year (annual average). The latter is included in each specification for $k = 1, 2, 3, 4$.

Table 2: **Anchoring regression results for $h = 2$**

| | $k=1$ | $k=2$ | $k=3$ | $k=4$ | $h=1$ | $h=2$ |
|---|---|---|---|---|---|---|
| $E_{i,t}(i_{t+k})$ | 0.0664 | 0.0483 | 0.0403 | 0.0341 | -0.0980 | -0.1495 |
| SE | (0.0161) | (0.0160) | (0.0163) | (0.0161) | (0.0330) | (0.0370) |
| $p$-value | [0.0000] | [0.0026] | [0.0135] | [0.0339] | [0.0031] | [0.0001] |
| $E_{i,t}(\Delta op_{t+k})$ | -0.0033 | -0.0029 | -0.0023 | -0.0022 | -0.0034 | -0.0025 |
| SE | (0.0013) | (0.0010) | (0.0008) | (0.0007) | (0.0007) | (0.0007) |
| $p$-value | [0.0105] | [0.0047] | [0.0032] | [0.0011] | [0.0000] | [0.0002] |
| $E_{i,t}(\Delta e_{t+k})$ | 0.0145 | 0.0070 | 0.0038 | -0.0016 | -0.0014 | -0.0092 |
| SE | (0.0065) | (0.0041) | (0.0032) | (0.0025) | (0.0036) | (0.0038) |
| $p$-value | [0.0264] | [0.0853] | [0.2394] | [0.5364] | [0.7016] | [0.0169] |
| $E_{i,t}(\Delta luc_{t+k})$ | -0.1463 | -0.1349 | -0.1294 | -0.1259 | -0.1990 | -0.2317 |
| SE | (0.0424) | (0.0395) | (0.0375) | (0.0354) | (0.0431) | (0.0665) |
| $p$-value | [0.0006] | [0.0007] | [0.0006] | [0.0004] | [0.0000] | [0.0005] |
| FE | yes | yes | yes | yes | yes | yes |
| $\overline{R}^2$ | 0.2635 | 0.2553 | 0.2525 | 0.2470 | 0.3757 | 0.3811 |
| $N \times T$ | 1564 | 1559 | 1554 | 1545 | 981 | 783 |

*Note:* The table provides coefficient estimates, heteroskedasticity and autocorrelation robust (HAC) standard errors (SE) according to Arellano (1987), $p$-values, adjusted $R^2$s ($\overline{R}^2$) and the number of observations ($N \times T$) for the following regression model:

$$\text{Anchor}_{i,t,h} = \beta_1 E_{i,t}(i_{t+k}) + \beta_2 E_{i,t}(\Delta op_{t+k}) + \beta_3 E_{i,t}(\Delta e_{t+k}) + \beta_4 E_{i,t}(\Delta luc_{t+k}) + \xi_i + \varepsilon_{i,t}$$

where $\text{Anchor}_{i,t,h}$ measures the degree of anchoring of inflation expectations at period $t$ for forecaster $i$ over a horizon of $h$-years-ahead, $E_{i,t}(.)$ stands for expectations made in period $t$ by forecaster $i$ and $k$ refers to a horizon of $k$-quarters-ahead. $i_{t+k}$ denotes the policy rate of the ECB, i.e., the main refinancing operations rate, $\Delta op_{t+k}$ represents the percentage change in the Brent crude oil price between $t$ and $t+k$, $\Delta e_{t+k}$ gives the percentage change in the USD/EUR exchange rate between $t$ and $t+k$, and $\Delta luc_{t+k}$ is the year-on-year rate of change in unit labor costs per employee. $\xi_i$ and $\varepsilon_{i,t}$ denote time-invariant forecaster-specific fixed effects (FE) and idiosyncratic errors, respectively. The regression is conducted for $\text{Anchor}_{i,t,h}$ at the horizon $h = 2$ (two-years-ahead) regressed on forecasts for the four factors made for four consecutive quarters ($k = 1, 2, 3, 4$) as well as the forecast for the next calendar year (annual average, $h = 1$) and the calendar year after next (annual average, $h = 2$). For $\Delta luc_{t+k}$ forecasts for four consecutive quarters ($k = 1, 2, 3, 4$) are not available but only the forecast for the current calendar year (annual average). The latter is included in each specification for $k = 1, 2, 3, 4$.

Table 3: **Anchoring regression results for $h = 5$**

| | $k = 1$ | $k = 2$ | $k = 3$ | $k = 4$ | $h = 1$ | $h = 2$ |
|---|---|---|---|---|---|---|
| $E_{i,t}(i_{t+k})$ | 0.0328 | 0.0338 | 0.0330 | 0.0284 | 0.0089 | 0.0162 |
| SE | (0.0098) | (0.0103) | (0.0102) | (0.0107) | (0.0167) | (0.0175) |
| $p$-value | [0.0009] | [0.0010] | [0.0013] | [0.0079] | [0.5938] | [0.3562] |
| $E_{i,t}(\Delta op_{t+k})$ | -0.0008 | 0.0007 | 0.0005 | 0.0001 | 0.0002 | 0.0002 |
| SE | (0.0014) | (0.0008) | (0.0007) | (0.0008) | (0.0010) | (0.0008) |
| $p$-value | [0.5772] | [0.3915] | [0.4957] | [0.8909] | [0.8763] | [0.8187] |
| $E_{i,t}(\Delta e_{t+k})$ | -0.0047 | -0.0073 | -0.0063 | -0.0046 | -0.0094 | -0.0050 |
| SE | (0.0037) | (0.0031) | (0.0026) | (0.0025) | (0.0027) | (0.0023) |
| $p$-value | [0.1980] | [0.0173] | [0.0163] | [0.0609] | [0.0006] | [0.0285] |
| $E_{i,t}(\Delta luc_{t+k})$ | -0.0217 | -0.0205 | -0.0201 | -0.0194 | -0.0349 | -0.0388 |
| SE | (0.0196) | (0.0213) | (0.0211) | (0.0221) | (0.0213) | (0.0312) |
| $p$-value | [0.2691] | [0.3361] | [0.3408] | [0.3798] | [0.1021] | [0.2148] |
| FE | yes | yes | yes | yes | yes | yes |
| $\overline{R}^2$ | 0.3886 | 0.3887 | 0.3901 | 0.3904 | 0.3854 | 0.3739 |
| $N \times T$ | 1243 | 1238 | 1236 | 1231 | 821 | 661 |

*Note:* The table provides coefficient estimates, heteroskedasticity and autocorrelation robust (HAC) standard errors (SE) according to Arellano (1987), $p$-values, adjusted $R^2$s ($\overline{R}^2$) and the number of observations ($N \times T$) for the following regression model:

$$\text{Anchor}_{i,t,h} = \beta_1 E_{i,t}(i_{t+k}) + \beta_2 E_{i,t}(\Delta op_{t+k}) + \beta_3 E_{i,t}(\Delta e_{t+k}) + \beta_4 E_{i,t}(\Delta luc_{t+k}) + \xi_i + \varepsilon_{i,t}$$

where $\text{Anchor}_{i,t,h}$ measures the degree of anchoring of inflation expectations at period $t$ for forecaster $i$ over a horizon of $h$-years-ahead, $E_{i,t}(.)$ stands for expectations made in period $t$ by forecaster $i$ and $k$ refers to a horizon of $k$-quarters-ahead. $i_{t+k}$ denotes the policy rate of the ECB, i.e., the main refinancing operations rate, $\Delta op_{t+k}$ represents the percentage change in the Brent crude oil price between $t$ and $t+k$, $\Delta e_{t+k}$ gives the percentage change in the USD/EUR exchange rate between $t$ and $t+k$, and $\Delta luc_{t+k}$ is the year-on-year rate of change in unit labor costs per employee. $\xi_i$ and $\varepsilon_{i,t}$ denote time-invariant forecaster-specific fixed effects (FE) and idiosyncratic errors, respectively. The regression is conducted for $\text{Anchor}_{i,t,h}$ at the horizon $h = 5$ (five-years-ahead) regressed on forecasts for the four factors made for four consecutive quarters ($k = 1, 2, 3, 4$) as well as the forecast for the next calendar year (annual average, $h = 1$) and the calendar year after next (annual average, $h = 2$). For $\Delta luc_{t+k}$ forecasts for four consecutive quarters ($k = 1, 2, 3, 4$) are not available but only the forecast for the current calendar year (annual average). The latter is included in each specification for $k = 1, 2, 3, 4$.

# Appendix

Figure A.1: **Individual policy rate expectations**

The plots visualize quarterly forecasts for the main refinancing operations rate of the ECB for each forecaster (in percent per annum) by the black dots. These are shown for different horizons $k$ (one- to four-quarters-ahead) and $h$ (one- and two-years-ahead) for the period from 2002Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Cross-sectional averages across forecasters are visualized by a red line.

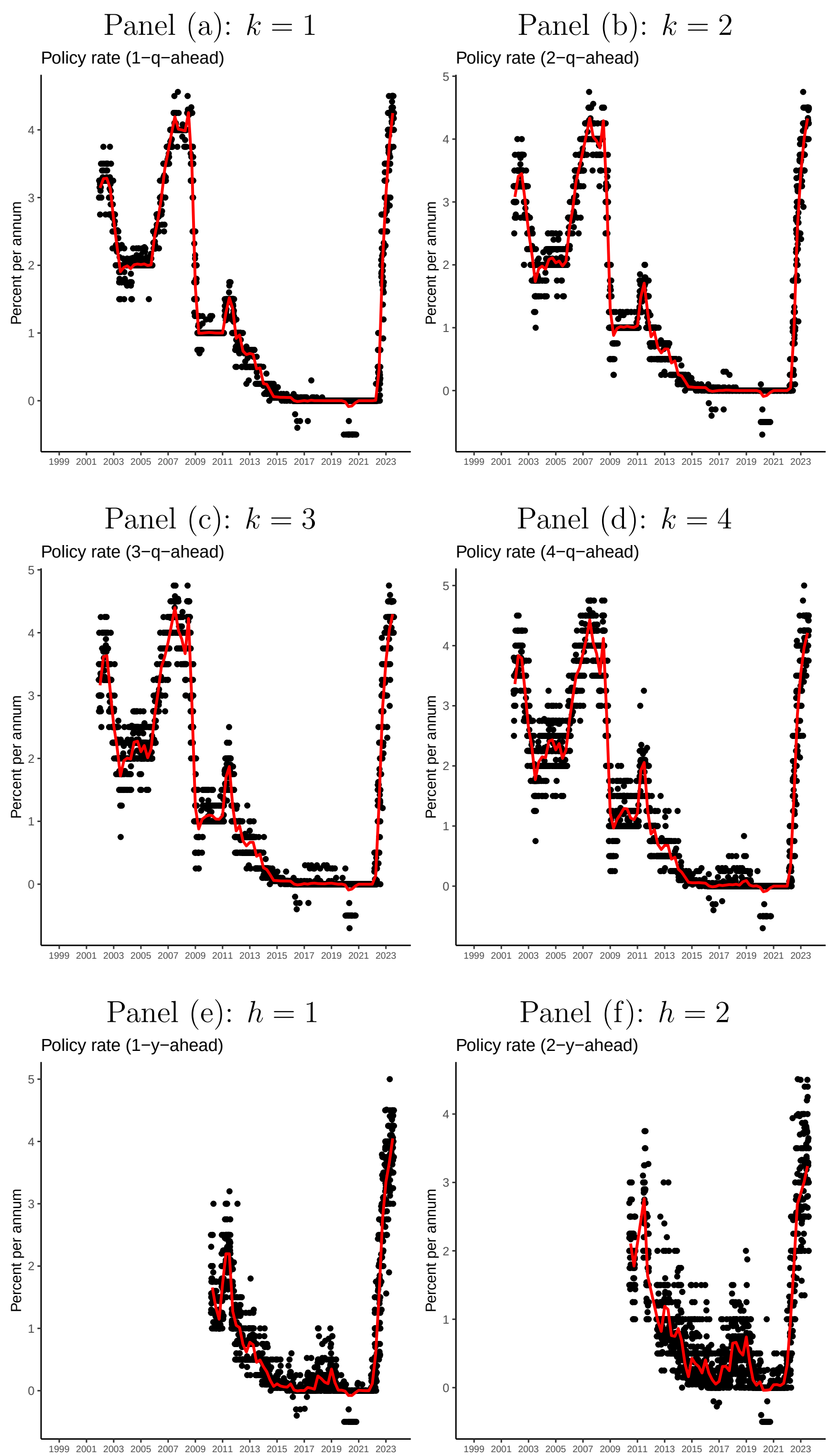


Figure A.2: **Individual Brent price change expectations**

The plots visualize quarterly forecasts for the Brent crude oil price change for each forecaster (computed as percentage change of the Brent forecast relative to the spot rate on the day the forecast had to be submitted) by the black dots. These are shown for different horizons $k$ (one- to four-quarters-ahead) and $h$ (one- and two-years-ahead) for the period from 2002Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Cross-sectional averages across forecasters are visualized by a red line.

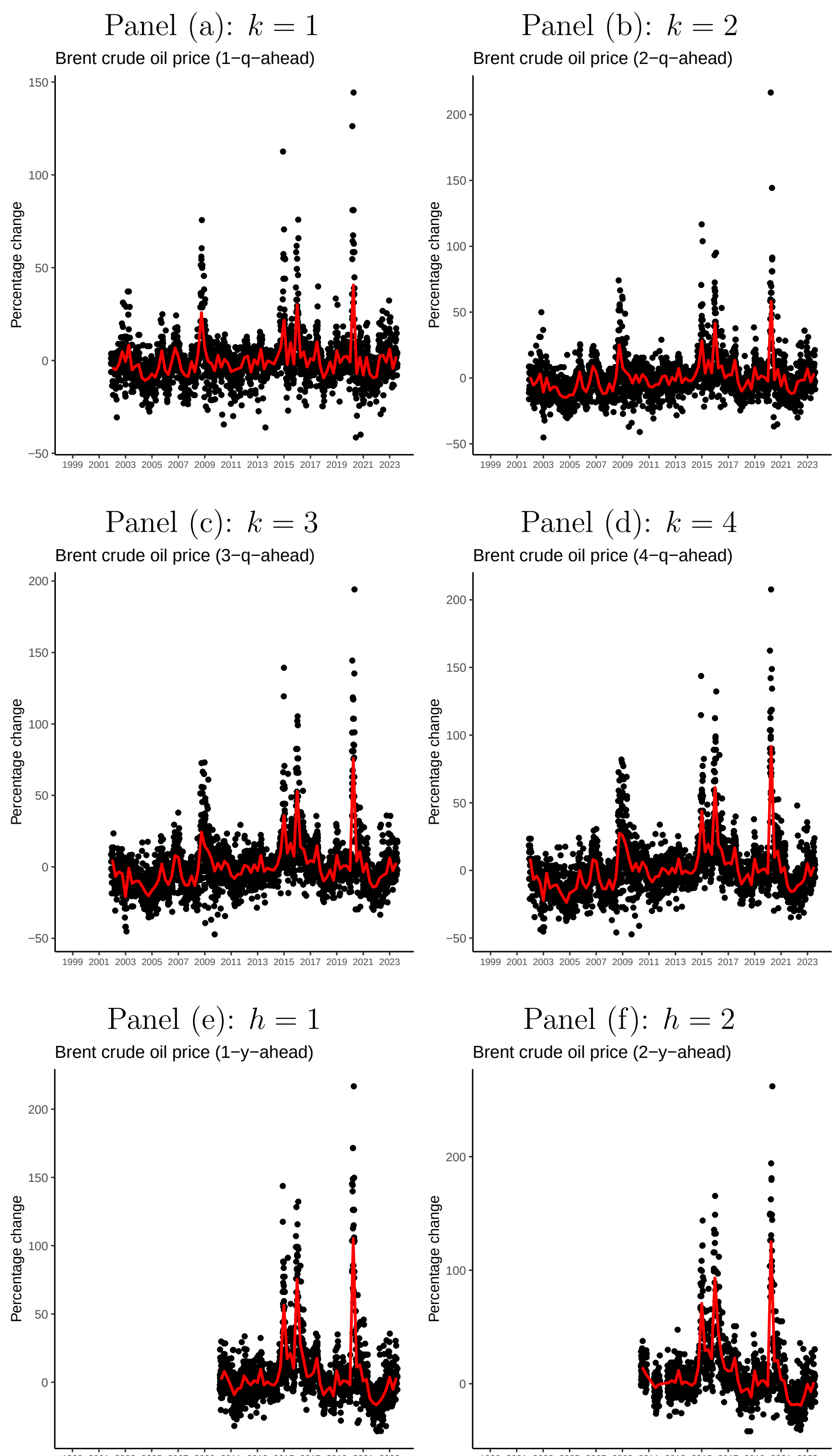


Figure A.3: **Individual USD/EUR exchange rate change expectations**

The plots visualize quarterly forecasts for the USD/EUR exchange rate change for each forecaster (computed as percentage change of the USD/EUR forecast relative to the spot rate on the day the forecast had to be submitted) by the black dots. These are shown for different horizons $k$ (one- to four-quarters-ahead) and $h$ (one- and two-years-ahead) for the period from 2002Q1 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Cross-sectional averages across forecasters are visualized by a red line.

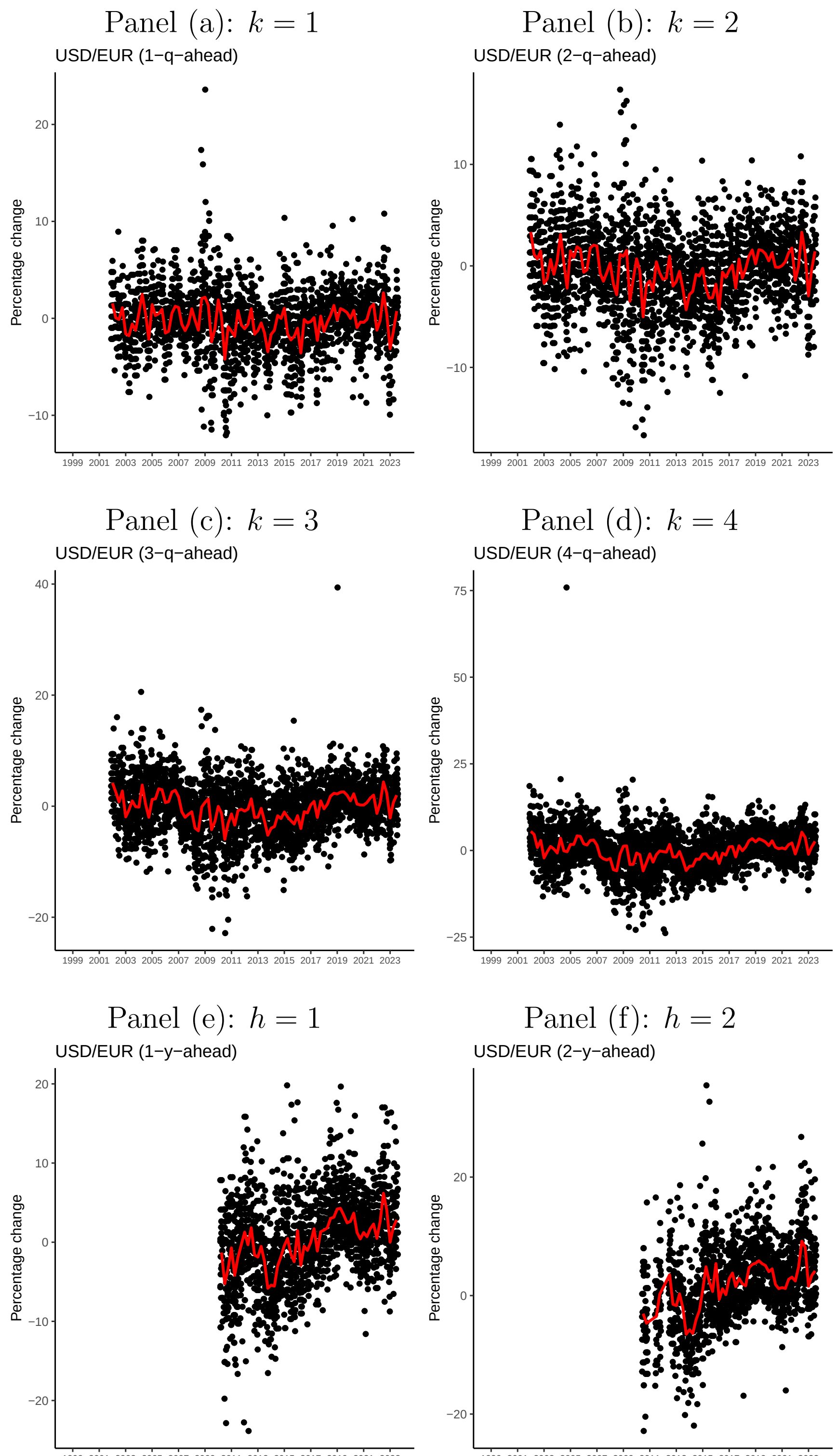


Figure A.4: **Individual unit labor costs change expectations**

The plots visualize quarterly forecasts for the unit labor costs year-on-year rate of change per employee for each forecaster by the black dots. These are shown for different horizons $h$ (current calendar year, next calendar year, calendar year after next, and longer term forecast) for the period from 2004Q3 to 2023Q3 taken from the ECB Survey of Professional Forecasters. Cross-sectional averages across forecasters are visualized by a red line.