

Technical Paper

Anchoring of survey-based inflation expectations: Risk assessment relative to the inflation target

02/2025

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Non-technical summary

A firm anchoring of longer-term inflation expectations among households, businesses, and investors not only enhances the effectiveness of monetary policy. It also reflects strong confidence in the central bank's ability to maintain inflation close to its target. The literature highlights various characteristics of well-anchored expectations, such as a proximity to the inflation target or a low degree of uncertainty surrounding them. Another important characteristic is whether individuals perceive significant risks of deviations from the inflation target, either upwards or downwards. Well-anchored expectations should exhibit a balanced risk outlook. In this paper, we develop novel measures to assess the risk outlook of participants in surveys of economic experts.

Our main contribution lies in the development of survey-based measures that evaluate how professional forecasters perceive risks relative to the inflation target, which serves as the central benchmark for well-anchored expectations. We thereby lay out in more detail results in a recent article in the Bundesbank's July 2025 Monthly Report (Deutsche Bundesbank, [2025](#)). Existing risk measures do not explicitly focus on the inflation target. Instead, they typically indicate whether a forecaster believes that her own forecast turns out to be too high or too low in retrospect, without directly linking this assessment to the inflation target.

Using data from the European Central Bank's Survey of Professional Forecasters (SPF), we find that during the financial crisis, experts perceived a risk of inflation exceeding the target in the medium to longer term. Between 2014 and 2017, and particularly during the Covid-19 pandemic, they instead identified a risk of inflation falling below the target. Following Russia's invasion of Ukraine, our measures indicate that forecasters perceived historically high risks of inflation rising above the target. In contrast, existing risk measures would not have captured the pronounced increase in below-target inflation risks during the pandemic, nor would they have identified any risks to the anchoring of expectations during the recent inflation surge. Most recently, risks have subsided, although some concerns remain regarding inflation staying above the target in the medium to longer term.

Nichttechnische Zusammenfassung

Eine feste Verankerung der längerfristigen Inflationserwartungen von Haushalten, Unternehmen und Investoren erhöht nicht nur die Wirksamkeit der Geldpolitik. Sie spiegelt auch ein starkes Vertrauen in die Fähigkeit der Zentralbank wider, die Inflation nahe ihrem Ziel zu halten. Die Literatur hebt verschiedene Merkmale gut verankerter Erwartungen hervor, wie etwa die Nähe zum Inflationsziel oder ein geringes Maß an Unsicherheit. Ein weiteres wichtiges Merkmal ist, ob Individuen signifikante Risiken von Abweichungen vom Inflationsziel – sowohl nach oben als auch nach unten – wahrnehmen. Bei gut verankerten Erwartungen sollte die Risikoeinschätzung ausgewogen ausfallen. In diesem Papier entwickeln wir neuartige Messgrößen, um die Risikoeinschätzungen von Teilnehmern an Umfragen unter Wirtschaftsexperten zu bewerten.

Unser Hauptbeitrag liegt in der Entwicklung von Messgrößen, die bewerten, wie professionelle Prognostiker Risiken im Verhältnis zum Inflationsziel wahrnehmen. Dabei liegt unser Schwerpunkt auf der expliziten Relation zum Inflationsziel, das als zentraler Maßstab für gut verankerte Erwartungen dient. Wir führen damit detaillierter Ergebnisse aus, die jüngst in einem Sonderaufsatz des Monatsberichts der Deutschen Bundesbank vom Juli 2025 erschienen sind (Deutsche Bundesbank, 2025). Bestehende Risikomaße konzentrieren sich nicht explizit auf das Inflationsziel. Stattdessen zeigen bisherige Maße typischerweise an, ob ein Prognostiker glaubt, dass sich seine eigene Einschätzung rückblickend als zu hoch oder zu niedrig erweisen könnte, unabhängig davon, wo seine Einschätzung im Vergleich zum Inflationsziel liegt.

Anhand von Daten aus der Umfrage der Europäischen Zentralbank unter professionellen Prognostikern (Survey of Professional Forecasters, SPF) zeigen wir, dass Experten während der Finanzkrise ein Risiko wahrnahmen, dass die Inflation mittelfristig bis langfristig das Ziel überschreiten könnte. Zwischen 2014 und 2017 und insbesondere während der Covid-19-Pandemie identifizierten sie hingegen ein Risiko, dass die Inflation unter das Ziel fallen könnte. Nach der Invasion der Ukraine durch Russland zeigen unsere Messgrößen, dass Prognostiker historisch hohe Risiken einer Inflation über dem Ziel wahrnahmen. Im Gegensatz dazu hätten bestehende Risikomaße weder den deutlichen Anstieg der Risiken für eine unter dem Ziel liegende Inflation während der Pandemie erfasst, noch Risiken für die Verankerung der Erwartungen während des jüngsten Inflationsanstiegs identifiziert. In jüngster Zeit haben sich die Risiken abgeschwächt, obwohl weiterhin Bedenken bestehen, dass die Inflation mittelfristig bis langfristig über dem Ziel bleiben könnte.

Anchoring of Survey-Based Inflation Expectations: Risk Assessment Relative to the Inflation Target

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July, 2025

Abstract

We propose novel measures to evaluate the risk profile of longer-term inflation expectations, using data on inflation probabilities from the ECB's Survey of Professional Forecasters (SPF). Unlike existing indicators, these measures specifically incorporate the central bank's inflation target. This allows for a more precise assessment of forecasters' perceptions of risks to the central bank's ability to achieve its target. Consequently, these measures provide a valuable additional criterion for assessing the degree of expectation anchoring. In contrast to other metrics, our measures indicate that, between 2014 and 2017 as well as during the Covid-19 crisis, professional forecasters saw the risk that inflation could undershoot the target in the longer term. Moreover, our indicators suggest that, following Russia's invasion of Ukraine, survey participants perceived a risk of inflation overshooting the target four to five years ahead.

Keywords: Inflation, Expectations, Monetary Policy, Survey of Professional Forecasters

JEL Classification: E31 , E58

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The views expressed in this paper are those of the authors only and do not necessarily reflect the views of the Deutsche Bundesbank or the Eurosystem. The authors thank Stephan Kohns, Christina Gerberding, Petra Adolf, and Christian Offermanns for useful comments.

1 Introduction

A robust anchoring of economic agents' longer-term inflation expectations enhances the effectiveness of monetary policy and reflects a high degree of trust in a central bank's ability to achieve its inflation target. The academic literature has proposed various criteria to determine whether inflation expectations are well-anchored. Most notably, longer-term expectations should align closely with the inflation target, exhibit little uncertainty, and remain largely unaffected by short-term disturbances, such as realised inflation shocks or elevated short-term inflation expectations. Another sign of weak anchoring is the perception among private agents of significant upward or downward risks to achieving the target over the longer term – as discussed in a recent article in the Bundesbank's July 2025 Monthly Report (Deutsche Bundesbank, 2025).

In this paper, we focus on the risk balance of professional forecasters. Our main contribution is the development of survey-based indicators that assess the risk outlook of experts relative to the inflation target – the central benchmark for expectation anchoring. Existing measures of risk assessment do not specifically account for the inflation target. Instead, they typically focus on the risks surrounding a forecaster's individual point forecast, i.e., they indicate the direction in which the forecaster believes her own forecast most likely to be wrong.

Using data from the ECB's Survey of Professional Forecasters (SPF), we find that the risk of upward de-anchoring of inflation expectations increased during the financial crisis. Between 2014 and 2017, and in particular during the Covid-19 pandemic, our indicators signal discernible downward de-anchoring risks. More recently, we document that forecasters perceived historically large upside risks during the inflationary episode following Russia's invasion of Ukraine. Standard measures of risk assessment, by contrast, would not have detected the rise in downside risks during the Covid-19 pandemic, nor would they have signaled any risks to the anchoring of expectations during the inflationary episode. Most recently, these risks have subsided, although some upside risks remain.

The remainder of the paper is structured as follows: Section 2 provides a brief review of the literature. Section 3 describes the data and methodology. Section 4 presents the results, and Section 5 concludes.

2 Literature Review

Reaching back to the academic discussion on the effectiveness of inflation targeting (see Svensson, 2010 for an overview), several papers developed methods to assess the anchoring of expectations. In an application to survey data, Kumar et al. (2015) evaluate several anchoring indicators, fo-

cusing on firms.¹ Subsequent studies have adapted variations of these indicators to analyse professional forecasters' expectations. Two notable studies on the anchoring of ECB's SPF expectations are Lyziak and Paloviita (2017) and Corsello et al. (2021).² Both studies use the sensitivity of longer-term expectations to actual inflation (surprises) or short-term expectations – a measure also employed by Kumar et al. (2015). Additionally, they assess the alignment of expectations with the inflation target.³ Their results show that the anchoring of SPF expectations weakened slightly during the 2013 disinflation process. While our measures differ in definition, we also find signs of downward de-anchoring risk during this period.

Most of these studies focus on point forecasts. In contrast, our approach centres on the probability distributions of experts' forecasts because they allow for an investigation of their risk assessments. A related study by Dovern and Kenny (2017) also utilises the probability distributions from the ECB's SPF, deriving the first four aggregate moments from individual forecasters' distributions and testing for structural breaks. In line with previous studies and our results, they document that forecasters perceived higher risks for below target inflation rates over the long-term following the financial and sovereign debt crisis. However, their methodology differs from ours: they construct aggregate moments by averaging individual moments. We instead first aggregate individual probability distributions across forecasters and then derive moments. Both methods differ in their informational content. For example, individual forecasters' distributions might all exhibit zero skewness but be located far apart. Averaging individual skewness values would yield zero aggregate skewness, whereas deriving skewness from the aggregate distribution accounts for the dispersion across the location of forecasters' distributions.

Beyond academic research, the anchoring of SPF expectations has featured prominently in policy discussions. The ECB employs the Balance of Risk Indicator (BORI), which is also based on the probability distributions of survey respondents (see ECB, 2017, 2019). The BORI is defined as the mean of the aggregate probability distribution minus the average point forecast. Because the point forecast serves as a proxy for the mode or median of the distribution according to forecasters (Allayioti et al., 2024), the BORI can be interpreted as the direction in which a forecaster believes her own forecast most likely to be wrong.⁴ A positive BORI indicates a

¹At the aggregate level, anchored expectations should be close to the target on average and exhibit a low dispersion across respondents. At the individual level, anchored expectations should be associated with low uncertainty and undergo only small revisions between survey waves. Last, anchored expectations should not react to transitory fluctuations of inflation, i.e., the sensitivity of longer-term expectations to inflation surprises or short-term expectations should be small.

²Many studies investigate the anchoring of inflation expectations (see also Bems et al., 2021, Naggert et al., 2023, or Binder et al., 2022). For the sake of brevity, we focus on those with a clear focus on the ECB SPF.

³Lyziak and Paloviita (2017) examine the relevance of the ECB inflation target and ECB economic projections for determining expectations. Greater relevance of the inflation target intuitively signals stronger anchoring. Corsello et al. (2021) analyze the level of long-term expectations that they investigate for break points, i.e., a shift of the perceived inflation target.

⁴For a symmetric distribution the mode would be identical with the mean. The more asymmetric the distribution,

prevalence of upward risks and a negative value a prevalence of downward risks. Although the BORI is simple and robust, it has limitations in assessing the degree of anchoring to the inflation target. Specifically, the BORI indicates balanced risks (i.e., it is close to zero) if the mean of the probability distribution and the average point forecast are close, even if both are far from the inflation target. This limitation has been evident in the recent episode of high inflation. To address this, we propose novel measures that explicitly use the inflation target as the reference point for assessing risks of de-anchoring.

3 Data and Methodology

Our analysis is based on the ECB’s SPF, a quarterly survey of professional forecasters in the euro area. The survey, conducted since 1999, provides institution-specific panel data and offers a rich dataset for empirical analysis.

The survey includes a section on inflation expectations at different horizons. For the analysis of anchoring, we focus on medium- (two years ahead) and longer-term (four to five years ahead) horizons. Since longer-term inflation expectations were initially surveyed only annually, our sample ranges from Q1 2001 to Q2 2025. Expectations are surveyed in two ways. First, respondents are asked for their point forecast. Second, they are asked to provide a probability distribution, i.e., they apply probabilities to several intervals of possible inflation outcomes. Each interval spans 0.5 percentage points.⁵ The individual probability distributions are then aggregated to an average across forecasters for each interval. Figure 1 shows the probability distribution of longer-term inflation expectations as a histogram. The distribution clusters around the interval containing the inflation target but also exhibits sizable probabilities outside the target bin, indicating the risks forecasters see for achieving the target.⁶

We investigate the risk assessment around the inflation target more formally using three measures.⁷ The simplest one is the difference between the probabilities of high inflation (above 2.2%) and low inflation (below 1.8%) outcomes. Historically, economic experts’ longer-term expectations have aligned closely around the inflation target, thus, the chosen thresholds of “below 1.8” and “above 2.2” have been infrequently selected. This measure only relies on information from the tails of the distribution and can directly be calculated from the histogram without requiring any assumptions about the underlying distribution. It has also been employed by

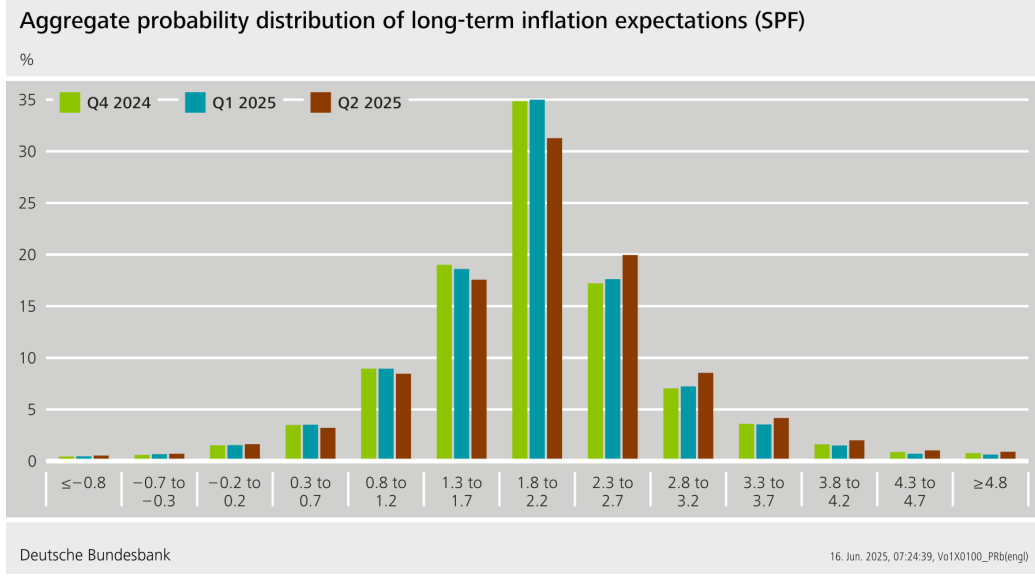
the greater the risk indicator.

⁵Currently, these are 11 intervals of length 0.5 percentage points and two open intervals: less than -0.8%, -0.7 to -0.3%, -0.2 to 0.2%, 0.3 to 0.7%, 0.8 to 1.2%, 1.3 to 1.7%, 1.8 to 2.2%, 2.3 to 2.7%, 2.8 to 3.2%, 3.3 to 3.7%, 3.8 to 4.2%, 4.3 to 4.7%, and more than 4.8%.

⁶Often risk is associated with forecasters’ uncertainty, which can be measured by the standard deviation of the probability distribution. This measure is “directionless” and not inherently related to anchoring. In contrast, the risk balance of expectations has a directional component, as it can be tilted either upwards or downwards, providing more informative insights for policymakers.

⁷We provide a conceptual illustration of our measures in the appendix.

FIGURE 1



Allayioti et al. (2024) with slightly different bounds.

$$\gamma_{t,t+h}^{\text{balance}} = \sum_i p_{t,t+h}^i - \sum_j p_{t,t+h}^j \text{ with } i \in \{2.5, 3, 3.5, 4, 4.5, 5\} \quad (1)$$

$$j \in \{-1, -0.5, 0, 0.5, 1, 1.5\},$$

where $p_{t,t+h}^k$ denotes the probability assigned to the aggregate interval with mid-point k in survey period t for horizon h .

In addition to the simple difference of probabilities for high and low outcomes, we introduce two novel measures: the risk relative to the inflation target and the skewness relative to the inflation target. Both measures require an assumption about the underlying distribution. A simple yet robust approach is to assume that the entire probability mass is concentrated at the mid-point μ^k of an interval.⁸ This approach allows to calculate the moments of the distribution. The risk relative to the target is defined as the difference between the mean of the aggregate probability distribution and the inflation target π^* . It is conceptually similar to the BORI used by the ECB. However, the BORI subtracts the average point forecast $\bar{\pi}_{t,t+h}$ from the mean of the probability distribution, rather than the inflation target. By using the inflation target as the reference point, our measure directly assesses whether expectations are anchored to the target, whereas the BORI only evaluates risks relative to the respective point forecast.

$$\gamma_{t,t+h}^{\text{indicator}} = \sum_{k=1}^K p_{t,t+h}^k \mu^k - \pi^* \quad (2)$$

⁸Note that the two open intervals need to be treated as closed for this approach. Specifically, we use -1 and 5% as the mid-points of these intervals. To ensure that our results do not depend on the distributional assumption, we also experimented with other approaches, like assuming a generalized beta distribution.

$$\gamma_{t,t+h}^{BORI} = \sum_{k=1}^K p_{t,t+h}^k \mu^k - \bar{\pi}_{t,t+h} .$$

Our indicator for skewness relative to the inflation target uses the whole probability distribution rather than just its centre. This measure indicates whether participants view inflation rates above the target as more likely than rates below it. In contrast, the standard formulation of skewness uses the mean as the reference point and, thus, does not explicitly account for the location of the inflation target. Similar to the BORI, the standard skewness could indicate a balanced risk assessment even if forecasters place a high probability to values above the inflation target.

$$\gamma_{t,t+h}^{skew} = \sum_{k=1}^K p_{t,t+h}^k (\mu^k - \pi^*)^3 / \tilde{\sigma}_{t,t+h}^3 \quad (3)$$

with $\tilde{\sigma}_{t,t+h}^2 = \sum_{k=1}^K p_{t,t+h}^k (\mu^k - \pi^*)^2 .$

Last, the inflation target needs to be defined. As of the publication of the ECB strategy review in Q3 2021, the inflation target is defined as 2% symmetrically. Prior to this, it was described as “*below, but close to 2% over the medium term*”. The ECB provided numerical guidance on this matter in 2003 by describing expectations in the range of 1.7 to 1.9% as firmly anchored (ECB, 2003). For our calculations to take a stance on whether a given expectation level is consistent with the target, accordingly, we define the inflation target as:

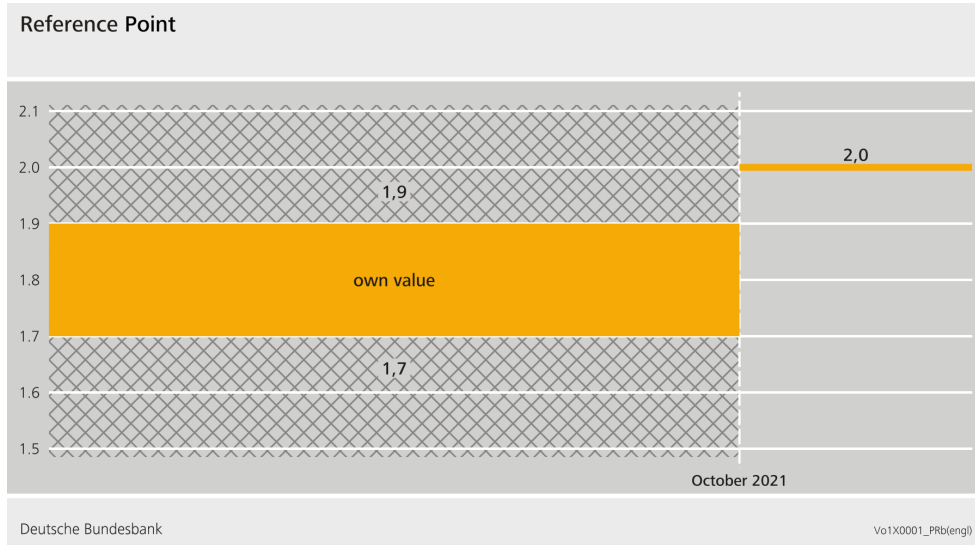
$$\pi^* = \begin{cases} 1.7 & \text{if } \pi^e < 1.7 & \text{until Q3 2021,} \\ \pi^e & \text{if } 1.7 \leq \pi^e \leq 1.9 & \text{until Q3 2021,} \\ 1.9 & \text{if } \pi^e > 1.9 & \text{until Q3 2021,} \\ 2 & \text{after Q3 2021 .} \end{cases}$$

As illustrated in Figure 2, prior to Q3 2021, we consider expectations to be on target if they fall within the range of 1.7 to 1.9%. If not, we use the upper or lower bound of the target corridor as the relevant inflation target, depending on whether the expectation is below or above the corridor. This provides a conservative assessment of deviations compared to simply using e.g. 1.8%. After Q3 2021, the inflation target is set at 2%.⁹

Last, note that in Q4 2024, the SPF was adjusted to reflect the new 2% inflation target established during the strategy review 2020/2021. The bins in the SPF questionnaire were shifted such that 2% became the mid-point of a bin rather than its lower bound, see Figure 1. Unfortunately, no survey wave employed both interval definitions simultaneously. Thus, there is a break in the survey which does, however, not pose a problem for our risk indicators. We check the sensitivity of our measures to this break by transforming the distributions surveyed

⁹We also used slightly different definitions of the inflation target before Q3 2021, e.g., setting it to 1.9%. Our core insights do not depend on this choice.

FIGURE 2



under the old definition into the new definition by fitting a cubic spline to the cumulative distribution function. The counterfactual results for earlier waves yield risk indicators that are highly correlated with those calculated from the originally surveyed distributions (correlation coefficients exceed 0.98 for all measures). These results lead to the same policy conclusions. For our calculations, we use the original data rather than applying the transformation.

4 Results

Figure 3 displays the mean of the point forecasts for medium- and longer-term inflation expectations. The period of low expected inflation between 2014 and 2017 stands in contrast to the period of high expected inflation in 2022 and 2023. During this recent episode, longer-term expectations did not materially deviate from the inflation target. Moreover, expectations for both horizons quickly returned to values close to 2%. Hence in terms of their level, expectations were anchored throughout 2022 and 2023. Nonetheless, forecasters may have perceived risks of expectations deviating from the target. A stricter interpretation of anchoring would require not only that the level of expectations remains close to the target but also that expectations do not imply any significant risks of deviation.

Panels A and B of Figure 4, present our three risk indicators for medium- and longer-term inflation expectations (dark blue, light blue, and gray lines) and contrast them with the ECB's BORI (black line).¹⁰ While the BORI remains balanced for most periods, our indicators

¹⁰Our medium-term measures fluctuate more than our longer-term measures, reflecting their greater sensitivity to economic news.

FIGURE 3

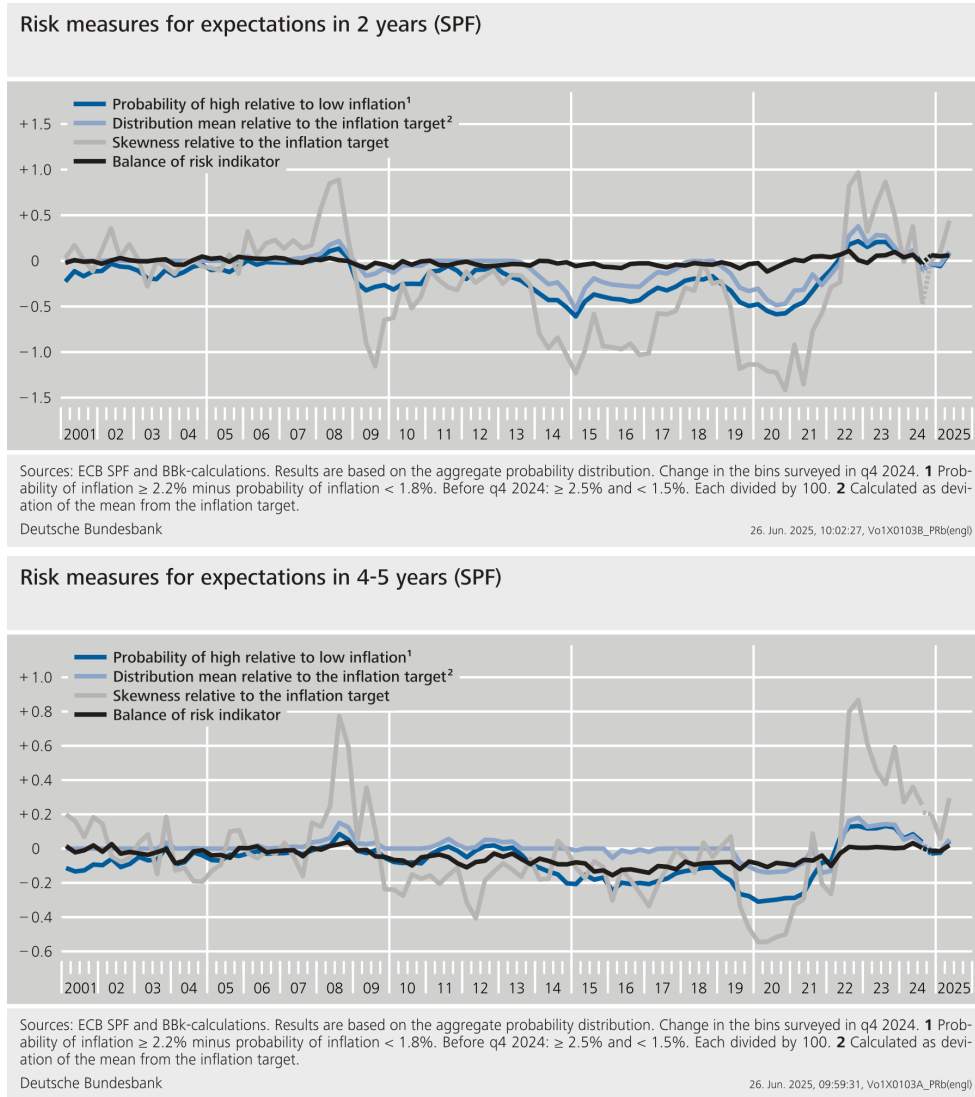


highlight several episodes of elevated upward or downward risks. During the financial crisis in 2008, all our risk measures rose, indicating that experts perceived increased risks of exceeding the inflation target. This risk assessment reversed during the sovereign debt crisis, followed by a period until 2017 in which experts anticipated persistent downward risks, consistent with other findings in the literature. This period coincided with the policy rate reaching the effective lower bound. The assessment of downward risks peaked during the Covid-19 pandemic, which severely disrupted economic activity. During the inflation surge following Russia's invasion of Ukraine, our indicators reached record highs for upside risks. However, during the same period, the BORI implied a neutral risk outlook. This result contrasts not only with our measures but also with other anchoring measures based on the SPF, such as the indicator in Allayioti et al. (2024).¹¹ Most recently, our risk measures have declined to a more neutral outlook, although some upside risks remain according to SPF experts.

The recent increase in upside risks stems from a shift in probability mass towards higher expected inflation rates. Figure 1 illustrates the probability distribution of longer-term expectations for the last three quarters (see the appendix for medium-term expectations). In the most

¹¹The authors document elevated risk of de-anchoring based on a measure that combines the deviation of the average point forecast from the target with the dispersion of point forecasts across individual participants (the approach is taken from Naggert et al., 2023).

FIGURE 4



recent quarter, forecasters assigned less probability to values below the inflation target and more to values above it. While the shift cannot be attributed to a single event, respondents' remarks suggest that factors such as the announcement of large defence spending by the German government and anticipated trade tensions may have contributed to the increased perceived likelihood of higher inflation rates. As a result, all indicators rose. The skewness relative to the target is particularly sensitive to such shifts, as intervals further from the target receive greater weight.

5 Conclusion

In this paper, we present novel measures for the risk profile of survey-based inflation expectations which link forecasters' risk assessment explicitly to the inflation target. Existing measures of

survey participants’ risk assessments do not adequately account for the inflation target, and their results can be misleading. Using data from the ECB’s SPF, we find that participants perceived a risk of inflation undershooting the target in the longer term during the sovereign debt crisis and the Covid-19 pandemic, and a risk of inflation persistently exceeding the target following Russia’s invasion of Ukraine.

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A Appendix

FIGURE 5

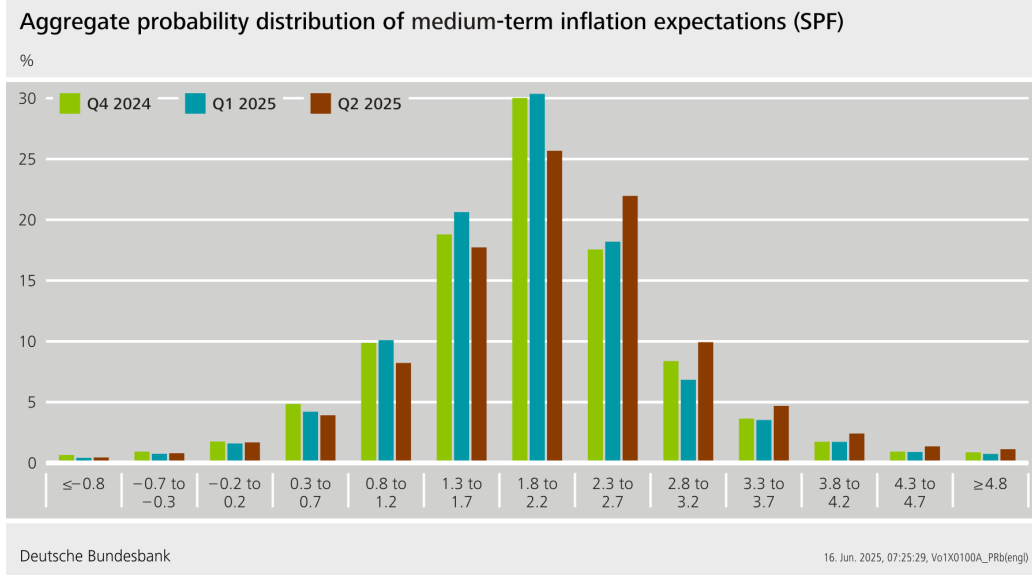


Figure 6 illustrates our measures and their differences by comparing different symmetrical and skewed distributions with modes at and off the inflation target. The measure of the risk balance $\gamma^{balance}$ that subtracts the sum of probabilities assigned to inflation rates below 1.8% from the sum of probabilities assigned to rates higher than 2.2% just reflects the shaded areas for each distribution, i.e., the tails of the distribution. Moreover, we use the risk indicator $\gamma^{indicator}$ defined as the mean of the probability distribution minus the inflation target of 2%. For the first distribution this measure would be zero and, thus, indicate balanced risks. However, for the second distribution that is shifted to the right, the measure is positive, indicating upward de-anchoring risk. Beyond these two measures we calculate yet another one: the skewness relative to the inflation target γ^{skew} . Its distinction from the normal skewness becomes clear from the third and fourth distribution displayed. Both are right skewed and have the same statistical skewness. However, taking the inflation target into account shows that for the third distribution we have upward de-anchoring risks while the fourth distribution signals downward de-anchoring risks.

FIGURE 6

