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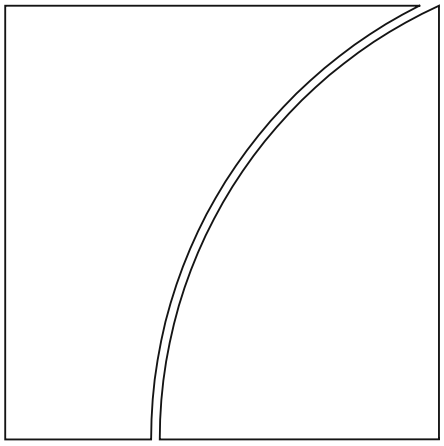

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Monetary and Economic Department

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Keywords: Inflation expectations.

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Inflation expectations anchoring: new insights from micro evidence of a survey at high-frequency and of distributions[1]

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Abstract

We shed new light on the anchoring of long-term euro area inflation expectations since the crisis by using micro evidence from a new survey at high (weekly) frequency. We find that long-term inflation expectations remained well anchored to the ECB's inflation aim, which has acted as a focal point. By contrast, we find no evidence that professional forecasts (reported by Consensus Economics) acted as focal points. But there are subtle signs of long-term inflation expectations not being perfectly well-anchored. Using measures based on the distribution of inflation expectations from a quarterly survey, namely uncertainty based on the full distribution, the probability of expected long-term inflation lying between 1.5% and 2.5%, and the effect of short-term on long-term deflation risk, we find that long-term euro area inflation expectations have remained well-anchored, and have become better-anchored between 2011 and 2018.

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1. Introduction

Inflation expectations have been identified in the policy debate and the research literature as a key driver of the observed low inflation (see eg Bernanke, 2010; Draghi, 2014). A key question for monetary authorities is whether since the crisis, long-term inflation expectations have remained firmly anchored to the central bank's inflation target. Answering this question requires investigating changes in the patterns of inflation expectations and their formation mechanism.

In the literature, there is no consensus on the process through which agents form expectations. Commonly used measures of inflation expectations do not provide a uniform response to this question, particularly for medium- and long term horizons. In the euro area, for example, there is a visible difference in the level of inflation expectations between survey measures and measures extracted from financial markets. Moreover, inflation expectations extracted from market data suggest some changes in behaviour around the crisis, which is hard to detect with survey data collected at low frequency. Another noteworthy difference is observed in the course of 2019, when market-based measures of long-term inflation expectations fell sharply, while survey based measures remained stable. The fall in the former raised concerns that inflation expectations might be de-anchoring, based on a growing belief that the ECB's policy space was significantly reduced at the zero lower bound. A different view emphasises that the decline in these indicators might reflect falling inflation risk premia rather than declining expectations, and emphasises the stability of survey measures (Coeuré, 2019).

This discussion highlights how important it is for policymakers to get a better understanding of the different behaviour of alternative measures of inflation expectations. We shed new light on the behaviour of short- and long-term euro area inflation expectations since the crisis by using micro evidence from a new type of survey at high (weekly) frequency. This survey has been conducted since July 2010 among economists, financial analysts and statisticians at De Nederlandsche Bank (DNB, the Dutch central bank). Participants answer every week a questionnaire about their short- and long-term expectations of euro area HICP inflation. The high frequency of our survey allows us to use methods that in the literature have been applied to high-frequency data on market based expectations measures. In addition, survey participants also answer once per quarter questions about the entire distribution of their inflation expectations. Only few surveys of professional forecasters provide information about the probability distribution of individuals' inflation expectations, including the Survey of Professional Forecasters for the euro area (eg Rich and Tracy, 2018), the Bank of England survey of external forecasters (Boero et al., 2008), and the Survey of Professional Forecasters (D'Amico and Orphanides, 2008) and the Federal Reserve Bank of New York Survey of Consumer Expectations (Bruine de Bruin et al., 2011) for the United States.

We use several methods to study whether long-term euro area inflation expectations of DNB survey respondents have been well-anchored. One of the methods we employ to do so is to study whether long-term DNB survey expectations responded to inflation data surprises. The responses of long-term inflation expectations to macroeconomic data surprises is a common measure for the anchoring of inflation expectations (Gürkaynak et al., 2007; Beechey, Johannsen and Levin, 2011). If long-term expectations are well-anchored, they should not respond to data surprises.

We also study whether long-term inflation expectations of DNB survey respondents have been well-anchored by investigating whether changes in long-term DNB survey expectations responded to changes short-term DNB survey expectations. Such an approach has been considered eg in Buono and Formai (2018). We also study whether there has been heterogeneity across survey respondents in these reactions. Heterogeneity in inflation expectations formation may matter for the anchoring of inflation expectations. Busetti et al. (2017) find that under heterogeneity in inflation expectations formation, a sequence of negative shocks may lead inflation to deviate from target and reinforce a de-anchoring of expectations.

Moreover, we investigate whether the ECB's inflation aim has acted as a focal point for DNB survey expectations. As an alternative focal point, we also test the role of Consensus survey inflation expectations, which are included in the information set available to DNB survey participants.

Furthermore, we study the distribution of inflation expectations, and consider two measures of the anchoring of long-term inflation expectations based on the full distribution from the quarterly DNB survey, namely uncertainty, and the effect of short-term on long-term deflation risk.

We consider uncertainty about long-term inflation expectations as a distributions-based measure of the anchoring of long-term inflation expectations (Dovern and Kenny, 2017). Moreover, we consider the survey-based probability of future inflation being in a certain range that is consistent with inflation target as a measure of anchoring, in particular the probability of expected long-term inflation lying between 1.5% and 2.5%, as proposed by Grishchenko et al. (2019). Relatedly, Mehrotra and Yetman (2014) consider the precision around forecasts of the level of inflation as a measure of the anchoring of inflation expectations.

Second, we consider the effect of short-term on long-term deflation risk from the DNB survey as a measure of the anchoring of long-term inflation expectations. A related measure has been applied to deflation risk derived from market-based inflation options in Galati et al. (2016), who consider Granger-causality between short-term and long-term deflation risk. A related measure has also been applied to deflation risk derived from market-based inflation options in Natoli and Sigalotti (2017), who study the tail co-movements between short- and long-term distributions of inflation expectation. It is also related to a measure in Cecchetti et al. (2015), who analyse the tail co-movement between the moments of short- and long-term distributions of inflation expectations derived from market-based inflation options. Here we apply this measure (the effect of short-term on long-term deflation risk) using deflation risk derived from survey-based distributions of inflation expectations, rather than using market-based measures of deflation risk.

We also investigate whether DNB survey respondents pay attention to inflation data surprises in their short-term expectations, to examine whether they incorporate new information. There is little analysis on whether data surprises affect the expectations of professional survey respondents, both for short- and long-term expectations, due to the low frequency of most professional surveys. An exception is Clements (2012), who finds for the Philadelphia Fed Survey of Professional Forecasters (SPF) that professional forecasters taken as a group do not always update their estimates of the current state of the economy to reflect the latest releases of revised estimates of key data. By contrast, a large literature exists on whether financial market expectations pay attention to data releases, due to the availability of financial market data at high frequency (daily and intra-day) (see eg Fleming and Remolona, 1997;

Gürkaynak et al., 2010; Beechey et al., 2011). Due to the high (weekly) frequency of the DNB survey, it allows us to study this question. We find that short-term DNB survey expectations incorporate news about inflation data releases.

Using the weekly survey, we find that long-term inflation expectations remained well anchored to the ECB's inflation aim, which has acted as a focal point. By contrast, we find no evidence that professional forecasts (reported by Consensus Economics) acted as focal points. But for one of the approaches we follow, namely tests of the reaction of long-term inflation expectations to short-term expectations, there are subtle signs of long-term inflation expectations not being perfectly well-anchored. We also find that notwithstanding the relative homogeneity of the sampled population, there is some evidence of heterogeneity in the anchoring of long-term inflation expectations. We also find evidence that short-term DNB survey expectations incorporate news about inflation data releases.

Using measures based on the distribution of inflation expectations, namely uncertainty based on the full distribution, the probability of expected long-term inflation lying between 1.5% and 2.5%, and the effect of short-term on long-term deflation risk, we find that long-term inflation expectations have remained well-anchored, and have become better-anchored at the end of the sample period in 2018 compared with the start of the sample period in 2011.

The remainder of the paper is organised as follows. Section 2 introduces the DNB inflation expectations survey. Section 3 presents the method and results. Finally, Section 4 concludes.

2. DNB inflation expectations survey

Since July 2010, participants in the DNB inflation expectations survey answer a questionnaire about their short- and long-term expectations of euro area HICP inflation every week on Monday. In addition, participants are asked questions about the distribution of their inflation expectations once per quarter.

The survey has two novel features compared to existing surveys. First, the weekly frequency is higher than the frequency of other surveys of professional forecasters, which typically ranges from monthly to semi-annual. Secondly, participants in our survey are provided with common information sets. In particular, together with the questionnaire, participants receive each week an update of relevant data related to inflation in the euro area, which includes data releases on HICP inflation for the euro area as a whole and the four main economies that were published during the previous week, a table with the latest Consensus forecasts for euro area HICP inflation, and a graph with current and past actual euro area HICP inflation.

The quarterly information on the distribution of expectations allows tracking changes in the higher moments of expectations – in particular uncertainty – over time.

During a pilot version of the survey, from 2009 to 2010, participants included employees from the Dutch central bank, university students and academics from the Netherlands. Participants were, as much as practically possible, motivated to submit their subjective beliefs by means of rewards linked to the ex-post accuracy of their expectations.

The combination of a homogeneous set of participants, a common information set and a high frequency allows to focus on mechanisms of expectations formation and their heterogeneity in the wake of a crisis, a period characterized by high uncertainty. In particular, we can study more carefully some aspects of expectation formation, such as how inflation expectations depend on realized inflation data and surprises; whether and how the anchoring of expectations change with a crisis; and the role of focal points, such as ECB's inflation aim or professional forecasters' inflation predictions.

Short-term and long-term mean DNB survey expectations are shown in Graph 1. For long-term DNB survey expectations, these are the direct survey responses. For short-term DNB survey expectations, we interpolate between the current-year, π_{it}^{c}, and next-year, π_{it}^{n}, survey responses, in order to obtain a constant-horizon short-term expectation, π_{it}^{ST}, according to

$$\pi_{it}^{ST} = (1 - \frac{(m-1)}{11})\pi_{it}^{c} + \frac{(m-1)}{11}\pi_{it}^{n} \quad (1)$$

with m=1,…,12, and m=1 for January (this is when the survey expectations for the current year and the next year each switch to the following year), m=2 for February etc. π_{it}^{ST} is referred to as short-term DNB survey expectations in the remainder of this paper

There is no consensus in the literature on the process through which agents form inflation expectations. Commonly used measures extracted from surveys or financial markets do not provide a uniform answer. In the euro area, for example, there is a visible difference in the level and variance between these two types of measures (see Graphs 2 and 3). Both survey-based measures and financial market based measures of inflation expectations have advantages and draw-backs (for a discussion see Galati et al., 2011). A main disadvantage of survey-based measures is that they are usually only available at low frequency. Moreover, they are usually quite persistent. A main disadvantage of financial market based measures is that they are usually affected by risk and liquidity premia. Moreover, they are usually quite volatile.

Due to the high (weekly) frequency, DNB survey expectations provide a new tool to derive inflation expectations, which are more volatile than the standard low-frequency survey-based expectations, and less volatile than the financial market-based measures.

A comparison of long-term DNB survey inflation expectations with long-term inflation expectations based on Consensus surveys is shown in Graph 2. Long-term inflation expectations based on financial market prices, namely breakeven inflation rates based on government bond yields, and forward inflation rates based on inflation swaps, are shown in Graph 3. In both cases we show 5-year/5-year forward inflation rates commonly used as a measure of monetary policy credibility. We can see that while being in a similar range compared to the Consensus survey-based expectations the DNB survey expectations indeed show more movement, and are less volatile than the financial market-based measures.

In addition to the weekly questions about their inflation expectations, participants in the DNB survey are asked questions about the distribution of their short-term and long-term euro area inflation expectations once per quarter. Survey respondents are asked to assign probabilities to J=10 intervals *j*, *j=1,…,J*. These intervals are defined as <0.0, [0.0,.5[, [.5,1.0[, [1.0,1.5[, [1.5,2.0[, [2.0,2.5[, [2.5,3.0[, [3.0,3.5[, [3.5,4.0], and >4.0, in percent, where [,] denotes a closed interval, and [, [denotes an interval closed on the left and open on the right. Examples of DNB survey

responses for the distribution of long-term inflation expectations are shown in Graph 4. Graph 5 shows the mean of short-term and long-term deflation risk from the DNB survey over the sample period. Long-term deflation risk, dr_{it}^{LT}, is obtained directly from survey responses. Short-term deflation risk at a constant horizon, dr_{it}^{ST}, is obtained by interpolating between survey responses for current-year deflation risk, dr_{it}^{c}, and next-year deflation risk, dr_{it}^{n}, according to

$$dr_{it}^{ST} = (1 - \frac{(q-1)}{3})dr_{it}^{c} + \frac{(q-1)}{3}dr_{it}^{n} \quad (2)$$

with q=1,…,4, and q=1 for the first quarter, q=2 for the second quarter etc.

3. Method and results

We analyse inflation expectations formation by means of panel data estimation over the period June 2010 to December 2018 and with around 25 respondents per week.

To test whether long-term DNB survey expectations are well-anchored or not, we first estimate whether they respond to changes in inflation,

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta\Delta\pi_t + \varepsilon_{it} \quad (3)$$

Here, $\Delta\pi_{it}^{LT}$ are weekly changes in long-term DNB survey expectations of respondent *i* in week *t*, and $\Delta\pi_t$ are weekly changes in euro area HICP inflation (for the weeks in which new HICP inflation data are released, and zero otherwise). The hypothesis is that if long-term expectations are well-anchored, they should be unresponsive to short-term developments in actual inflation, hence the estimate of β should not be significantly different from 0. We also include survey individual fixed effects (α_i) to control for any observed or unobserved time-invariant heterogeneity among survey respondents. We use fixed effects within-group panel estimation. We use robust standard errors in this and all other regressions in this paper. The estimation period is 28 June 2010 to 10 December 2018, using weekly data. We also estimate another variant of equation (3) where we replace weekly changes in euro area HICP inflation by weekly changes in the flash estimate of euro area HICP inflation, $\Delta\pi_t^{flash}$. The results are also shown in Table 1.

We also test whether long-term DNB survey expectations respond to surprises in inflation, as measured by actual euro area HICP inflation minus median Bloomberg survey expectations, π_t^{sur}, according to

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta\pi_t^{sur} + \varepsilon_{it} \quad (4)$$

This empirical specification is similar to that typically used in the empirical literature on inflation expectations anchoring that relies on high-frequency market-based measures of inflation expectations. We also estimate equation (4) when replacing surprises in euro area HICP inflation by surprises in the flash estimate of euro area HICP inflation, $\pi_t^{flash,sur}$ since there is evidence that flash data releases for inflation have a bigger impact on financial market-based inflation expectations compared to the final data releases (Garcia and Werner, 2018). The results are shown in Table 2.

We find evidence for long-term DNB survey expectations being well-anchored on all these measures presented in Tables 1 and 2. There are no significant reactions of changes in long-term DNB survey expectations to changes in inflation, or in the flash estimate of inflation. Similarly, there are no significant reactions of changes in

long-term DNB survey expectations to surprises in inflation, or in the flash estimate of inflation.

We also test whether the ECB's inflation aim of close to but below 2% has acted as focal point for long-term DNB survey expectations, by estimating

$$\pi_{it}^{LT} = c + \varepsilon_{it} \quad (5)$$

using pooled OLS regression with robust standard errors. The results are shown in Table 3. We find that the ECB's inflation aim has acted as focal point for long-term DNB survey expectations, especially after the euro area sovereign debt crisis, where we cannot reject that the mean of long-term DNB survey expectations equals 2%. This is the case even though the mean short-term DNB inflation expectations were well below 2% after the euro area crisis, at around 1.25%. But in the period including the euro area sovereign debt crisis, mean long-term DNB survey expectations were slightly (around 25 basis points) above 2%.

Consensus survey expectations could act as an alternative focal point for the formation of inflation expectations of DNB survey respondents. To test this hypothesis, we test whether changes in long-term Consensus survey inflation expectations affect changes in long-term DNB survey inflation expectations,

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta\Delta\pi_t^{Cons,LT} + \varepsilon_{it} \quad (6)$$

where $\pi_t^{Cons,LT}$ are long-term Consensus survey inflation expectations available at the time of the DNB survey in week *t*. We also estimate equation (6) for changes in short-term Consensus survey inflation expectations. The results are shown in Table 4. We find that Consensus surveys, which are provided to survey respondents as part of a common information set, do not act as focal points for long-term DNB survey expectations. There are no significant reactions of changes in long-term DNB survey expectations to changes in either long-term or short-term Consensus survey expectations.

As a further test of whether long-term DNB survey expectations are well-anchored or not, we also estimate whether they respond to short-term DNB survey expectations,

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta\Delta\pi_{it}^{ST} + \varepsilon_{it} \quad (7)$$

where $\Delta\pi_{it}^{ST}$ are weekly changes in short-term DNB survey expectations, again using fixed effects within-group panel estimation. This is a common test of expectations anchoring in the literature. The hypothesis here is that if long-term inflation expectations are well-anchored to the central bank's inflation target, they should be unresponsive to changes in short-term inflation expectations, which reflect changing views of the short-term economic outlook. The results are shown in Table 5. We find subtle signs of not perfectly well-anchored long-term inflation expectations for the group of survey respondents as a whole. The coefficient of changes in long-term DNB survey expectations on changes in short-term DNB survey expectations is significant, but only at the 10% significance level, and it only has a small value of around 0.08. This is consistent with results on subtle signs of change in anchoring properties of long-term inflation expectations found in other papers for the euro area, eg Galati, Gorgi, Zhou and Moessner (2018).

We also study possible heterogeneity in the response of long-term DNB survey expectations to changes in short-term DNB survey expectations, by allowing the coefficient on changes in short-term DNB survey expectations to vary by respondent,

$$\Delta\pi_{it}^{LT} = \alpha_i + \beta_i \Delta\pi_{it}^{ST} + \varepsilon_{it} \quad (8)$$

The results for the coefficients β_i suggests that, notwithstanding a fairly homogenous panel of survey participants and a common information set, there is some heterogeneity in the response of long-term to short-term DNB inflation expectations (see Graph 6). We find some evidence of heterogeneity in the anchoring properties across survey respondents on this measure.

Next, we study the anchoring of long-term inflation expectations by considering three measures based on the full distribution of inflation expectations from the quarterly DNB survey, namely uncertainty, the probability of future euro area inflation being in a range that is consistent with the inflation target as a measure of anchoring, and the effect of short-term deflation risk on long-term deflation risk. The underlying idea is that changes in the higher moments of the distribution of long-term inflation expectations could foreshadow changes in the anchoring of the mean of the distribution.

In the quarterly DNB survey about the distribution of inflation expectations, survey respondents are asked to assign probabilities to J=10 intervals *j*, *j=1,…,J*, defined as <0.0, [0.0,.5[, [.5,1.0[, [1.0,1.5[, [1.5,2.0[, [2.0,2.5[, [2.5,3.0[, [3.0,3.5[, [3.5,4.0], and >4.0, in percent, as described above. We construct a histogram of the aggregate distribution of inflation expectations by a linear combination of the histograms of the individual distributions, with equal weights. The frequency assigned by respondent *i* to interval *j* at horizon *h* and time *t* is denoted by $f_{it}^{j,h}$. The frequency of the aggregate histogram in each interval *j*, $f_t^{j,h}$, is then calculated according to (see Krueger and Nolte, 2016)

$$f_t^{j,h} = \frac{1}{N}\sum_{i=1}^{N} f_{it}^{j,h} \quad (9)$$

where $f_t^{j,h}$ is the frequency assigned in the aggregated histogram at time *t* to inflation being in interval *j* at horizon *h*, and N is the number of respondents to the survey questions about the distribution of inflation expectations.

The full distribution, that is the aggregate of the individuals' distributions, is different from the distribution of the survey responses for individuals' point expectations, since it includes both individual uncertainty and disagreement between individuals about point expectations. We quantify uncertainty about future inflation based on the aggregate full distribution of inflation expectations. Uncertainty over expectations at horizon *h* is calculated from the aggregate histogram according to

$$\mu_t^h = \sum_{j=1}^{J} \pi_t^j f_t^{j,h} \quad (10)$$

$$\sigma_t^{unc,h} = \sqrt{\sum_{j=1}^{J} \left(\pi_t^j - \mu_t^h\right)^2 f_t^{j,h}} \quad (11)$$

where $f_t^{j,h}$ is the frequency assigned in the aggregated histogram at time *t* to inflation being in interval *j* at horizon *h*; π_t^j is the midpoint of the interval *j* of the histogram. That is, we assume that the probability mass in each interval is concentrated at its midpoint. For the open intervals at either end of the distribution, we truncate the distribution by assuming that the interval has the same size as the other intervals, of 0.5pp. Both these assumption are based on D'Amico and Orphanides (2008). μ_t^h is the mean of the inflation expectations based on the aggregate histogram, at time *t* and horizon *h*.

Graph 7 shows the time series of uncertainty about long-term inflation expectations derived from the DNB survey according to equation (11). We can see that uncertainty has fallen slightly over the sample period. This measure therefore points to long-term inflation expectations having become better-anchored over the sample period.

Next, we consider the survey-based probability of future euro area inflation being in a certain range that is consistent with the inflation target as a measure of anchoring, in particular the probability of expected long-term inflation lying between 1.5% and 2.5% (as in Grishchenko et al., 2019). This probability, ptr_t^{LT}, is calculated as the sum of the frequencies assigned in the aggregated histogram at the long-term horizon at time *t* to inflation being in the two intervals *j=5* and *j=6*, which together make up the interval between 1.5% and 2.5%, according to

$$\mathrm{ptr}_t^{LT} = \sum_{j=5}^{6} \mathrm{f}_t^{j,h} \tag{12}$$

Graph 8 shows the time series of the probability ptr_t^{LT} of expected long-term inflation lying between 1.5% and 2.5% derived from the DNB survey according to equation (12). We can see that this probability has increased slightly over the sample period. This measure therefore also points to long-term inflation expectations having become better-anchored over the sample period.

Next, we study the effect of short-term deflation risk on long-term deflation risk from the DNB survey as a measure of the anchoring of long-term inflation expectations. To test whether long-term DNB survey expectations are well-anchored or not, we estimate whether changes in long-term deflation risk respond to changes in short-term deflation risk derived from the DNB survey,

$$\Delta \mathrm{dr}_{it}^{LT} = \alpha_i + \beta \Delta \mathrm{dr}_{it}^{ST} + \varepsilon_{it} \tag{13}$$

where $\Delta \mathrm{dr}_{it}^{LT}$ are quarterly changes in long-term deflation risk, and $\Delta \mathrm{dr}_{it}^{ST}$ are quarterly changes in short-term deflation risk, again using fixed effects within-group panel estimation. The results are shown in Table 6. We find that changes in short-term deflation risk have no significant effect on changes in long-term deflation risk from the DNB survey, which also suggests that long-term euro area inflation expectations have remained well-anchored.

Finally, to test whether short-term DNB survey expectations incorporate news about inflation data releases, we perform the regressions of equations (3), (4) and (6), but replacing long-term DNB survey expectations by short-term DNB survey expectations as dependent variable. The results are shown in Tables 7 to 9. We find evidence that short-term DNB survey expectations incorporate news about inflation data releases. Changes in short-term DNB survey expectations react significantly to changes in the flash estimate of inflation (where most of the news occurs), but not in inflation (where information is often already stale) (Table 7). Similarly, changes in short-term DNB survey expectations react significantly to surprises in the flash estimate of inflation, but not in inflation (Table 8). Finally, changes in both short-term and long-term Consensus surveys significantly affect changes in short-term DNB survey expectations (Table 9).

4. Conclusions

We shed new light on the behaviour of short- and long-term euro area inflation expectations since the crisis by using micro evidence from a new type of survey at high (weekly) frequency. These data allow to shed new light on the different dynamics of professional forecasters' inflation expectations, as reflected in survey measures of inflation expectations, and market-based measures. Overall, we find that long-term inflation expectations remained well anchored to the ECB's inflation aim, which has acted as a focal point. By contrast, we find no evidence that professional forecasts (reported by Consensus Economics) acted as focal points. But there are some subtle signs of long-term inflation expectations not being perfectly well-anchored. These changes are much more nuanced than those found in empirical exercises that rely on market-based measures of inflation expectations.

Using measures based on the distribution of inflation expectations, namely uncertainty based on the full distribution, the probability of expected long-term inflation lying between 1.5% and 2.5%, and the effect of short-term on long-term deflation risk, we find that long-term inflation expectations have remained well-anchored, and have become better-anchored at the end of the sample period in 2018 compared with the start of the sample period in 2011.

Moreover, we find that short-term DNB survey expectations incorporate news about inflation data releases.

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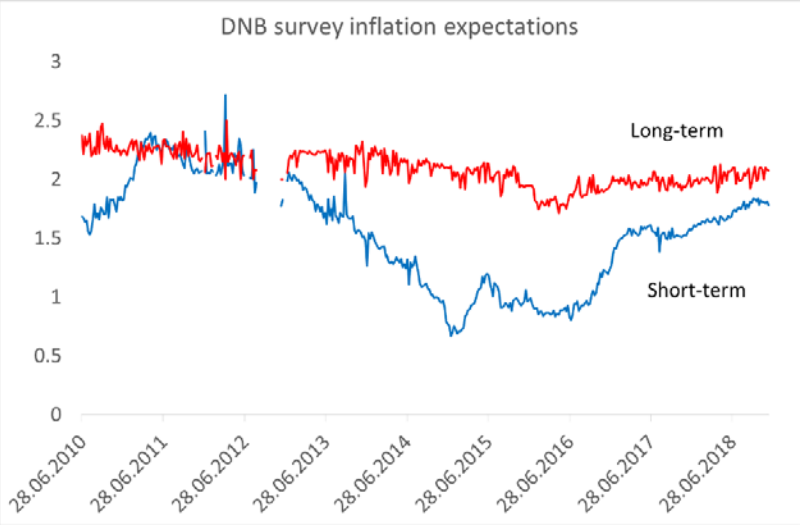
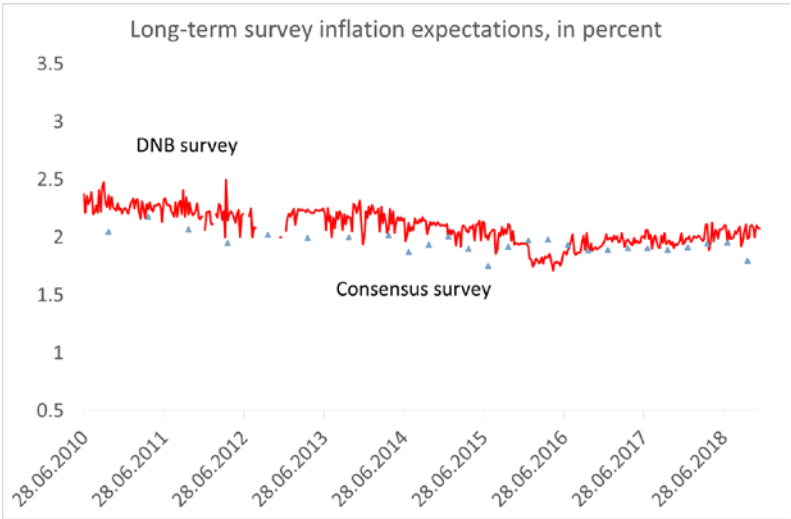
Graphs

Euro area inflation expectations from DNB survey, in percent — Graph 1

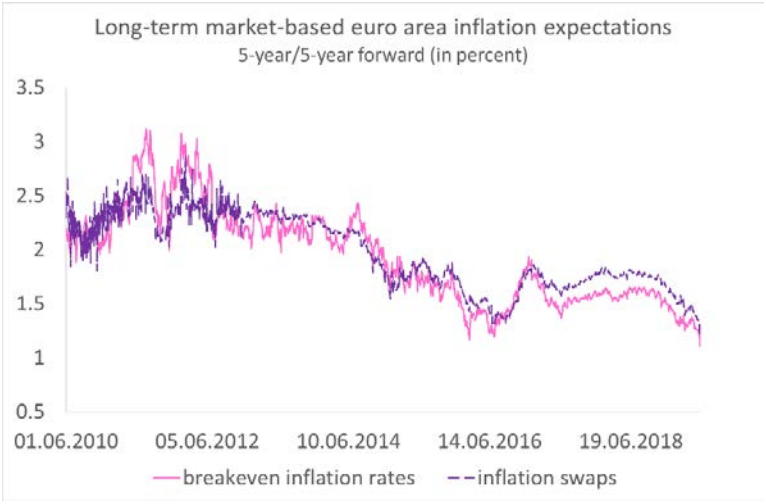


Long-term survey-based euro area inflation expectations, in percent — Graph 2



Long-term market-based euro area inflation expectations, in percent

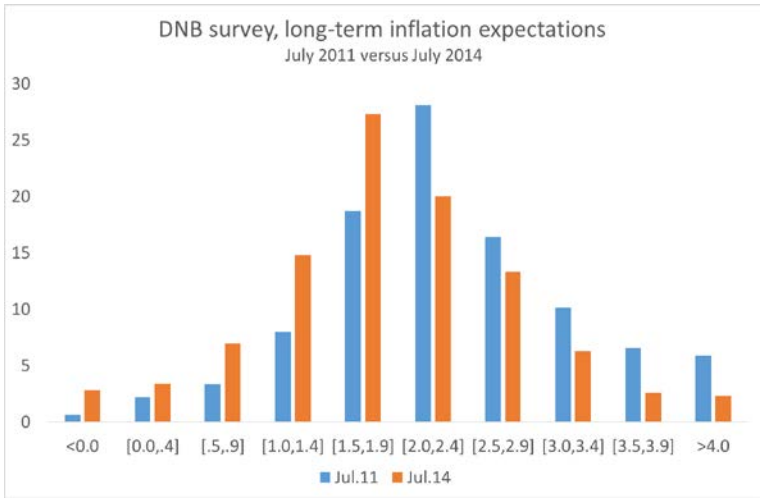
Graph 3



Note: For break-even inflation rates, average for France and Germany.

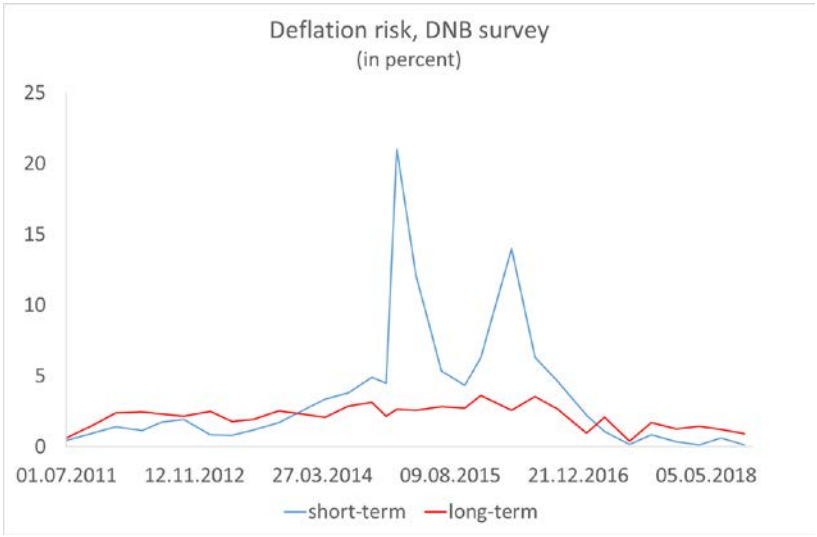
Examples of distributions of long-term inflation expectations from DNB survey, in percent

Graph 4

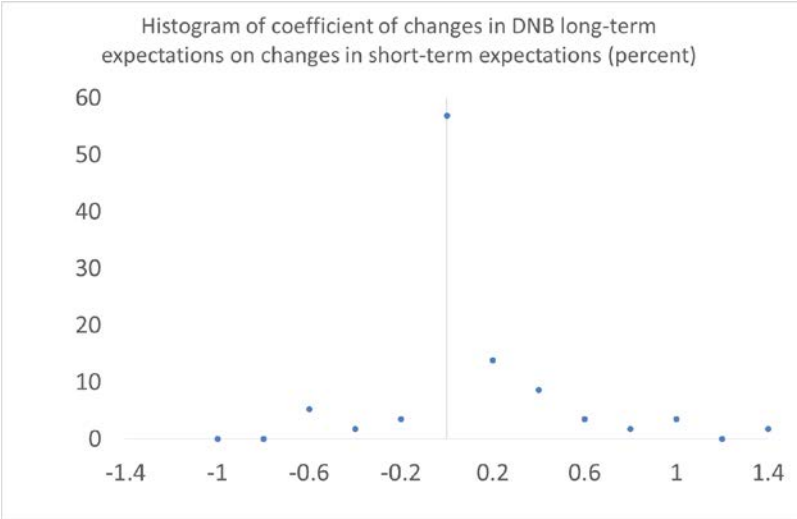


Euro area deflation risk from DNB survey

Graph 5

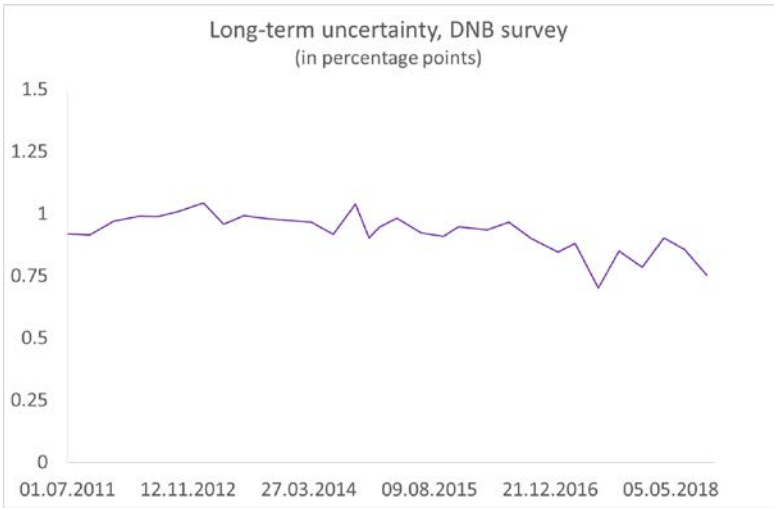


Graph 6



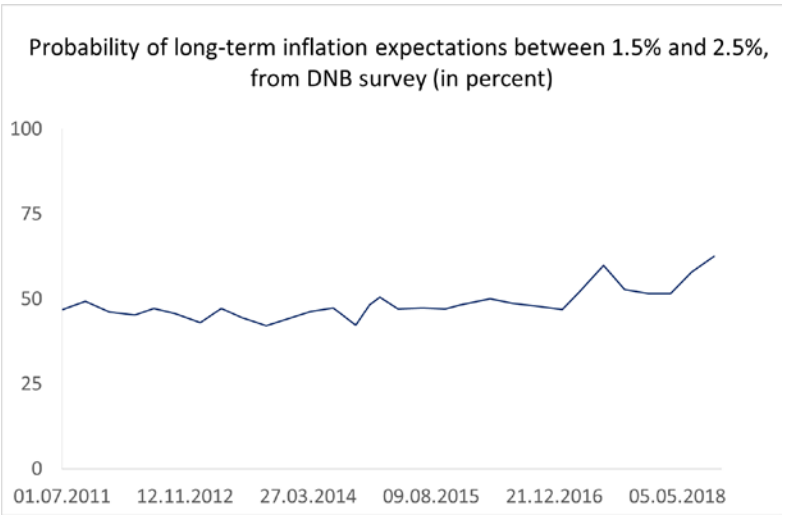
Uncertainty about long-term euro area inflation expectations derived from DNB survey

Graph 7



Probability of expected long-term inflation lying between 1.5% and 2.5% from DNB survey

Graph 8



Tables

Effects of changes in inflation on changes in long-term DNB survey inflation expectations

Table 1

Dependent variable: $\Delta\pi^{LT}$		
$\Delta\pi$	0.0013	-
$\Delta\pi^{flash}$	-	0.0064
No. of observations	7266	7266

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors.

Effects of inflation surprises on changes in long-term DNB survey inflation expectations

Table 2

Dependent variable: $\Delta\pi^{LT}$		
π^{sur}	-0.0764	-
$\pi^{flash,\ sur}$	-	0.0181
No. of observations	1761	1656

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors. Inflation surprises relative to median Bloomberg survey expectations.

Role of the ECB's inflation aim

Table 3

Dependent variable: π^{LT}			
	Full sample period	Including euro area crisis[1]	Post euro area crisis[2]
const	2.097***	2.232***	2.007***
Wald test of const=2 (p-value)	0.0000	0.0000	0.3279
No. of obs.	8821	3530	5291

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly data. [1] Including euro area sovereign debt crisis, 28 Jun 2010-31 Dec 2013; [2] Post-euro area sovereign debt crisis, 6 Jan 2014 -10 Dec 2018. Pooled OLS regression; robust standard errors.

Effects of changes in Consensus survey on changes in long-term DNB survey inflation expectations

Table 4

Dependent variable: $\Delta\pi^{LT}$		
$\Delta\pi^{Cons,ST}$	0.0552	-
$\Delta\pi^{Cons,LT}$	-	0.0623
No. of observations	7266	7266

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors. Using latest available Consensus survey.

Effects of changes in short-term DNB survey inflation expectations on changes in long-term DNB survey inflation expectations

Table 5

Dependent variable: $\Delta\pi^{LT}$	
$\Delta\pi^{ST}$	0.0755*
No. of observations	7266

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors.

Effects of changes in short-term DNB survey deflation risk on changes in long-term DNB survey deflation risk

Table 6

Dependent variable: Δdr^{LT}	
Δdr^{ST}	0.009
No. of observations	369

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 2011Q3-2018Q4, quarterly changes. Fixed effects within-group panel regression; robust standard errors.

Effects of changes in inflation on changes in short-term DNB survey inflation expectations

Table 7

Dependent variable: $\Delta\pi^{ST}$		
$\Delta\pi$	0.0037	-
$\Delta\pi^{flash}$	-	0.0730***
No. of observations	7414	7414

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors.

Effects of inflation surprises on changes in short-term DNB survey inflation expectations

Table 8

Dependent variable: $\Delta\pi^{ST}$		
π^{sur}	0.0573	-
$\pi^{flash,\ sur}$	-	0.1018***
No. of observations	1798	1689

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors. Inflation surprises relative to median Bloomberg survey expectations.

Effects of changes in Consensus survey on changes in short-term DNB survey inflation expectations

Table 9

Dependent variable: $\Delta\pi^{ST}$		
$\Delta\pi^{Cons,ST}$	0.0916***	-
$\Delta\pi^{Cons,LT}$	-	0.1339*
No. of observations	7414	7414

***, ** and * represent significance at the 1%, 5% and 10% levels. Sample period: 28 June 2010-10 December 2018, weekly changes. Fixed effects within-group panel regression; robust standard errors. Using latest available Consensus survey.

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