Targeting Inflation from Below: How Do Inflation Expectations Behave?*

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Inflation targeting (IT) had originally been introduced as a device to bring inflation down and stabilize it at low levels. Given the current environment of persistently weak inflation in many advanced economies, IT central banks must now bring inflation up to target. This paper tests to what extent inflation expectations are anchored in such circumstances, by comparing across periods when inflation is around target, (persistently) high, or (persistently) weak. It finds that under persistently low inflation, inflation expectations are not as well anchored as when inflation is around target: inflation expectations are more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. This suggests that central banks should expect inflation expectations to behave differently than was the case previously, when inflation was often remarkably close to target in many advanced economies.

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1. Introduction

When inflation targeting (IT) was first introduced in New Zealand in 1989, its aim was to reduce and stabilize inflation, and to anchor

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inflation expectations at lower levels, given that inflation had been running at double-digit rates for much of the late 1970s and the 1980s. Subsequent adopters of IT, such as Canada in 1991 or the United Kingdom in 1992, also intended to bring inflation down, to make it less volatile, and to anchor inflation expectations at a lower level.

In contrast, more recently, the Bank of Japan adopted IT following an extended period of subdued inflation, with the declared intention to bring inflation up to target and to boost inflation expectations. In a similar vein, in 2012, the U.S. Federal Reserve announced an inflation objective in a situation where headline inflation stood slightly above the new goal but core inflation had been substantially below for a considerable amount of time. Also, following the global financial crisis, a number of countries that had already adopted IT were (and, at the time of writing, several of them still are) faced with a prolonged period of below-target inflation.

Although designed to *lower* inflation and inflation expectations, IT is now charged with the objective to *raise* them, a challenge that has not yet been studied extensively.[1] Questions that are of particular interest are whether the formation of inflation expectations differs when inflation is (persistently) weak from when inflation is at or above target, and whether there is a risk that inflation expectations become disanchored. Benhabib, Schmitt-Grohé, and Uribe (2002) and more recently Armenter (2014), for instance, show that at the zero lower bound, low-inflation expectations can become self-fulfilling. In a similar vein, Busetti et al. (2014) show how a series of deflationary shocks can unanchor inflation expectations.

Naturally, given the historical background of IT, the existing literature has mostly studied the performance of IT in bringing inflation down, stabilizing it, and anchoring inflation expectations. In contrast, much less is known about how IT performs if inflation is

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[1]At the same time, there is an ongoing debate about the optimal level of inflation targets under low inflation. Several authors (Blanchard, Dell'Ariccia, and Mauro 2010; Ball 2014) have proposed raising inflation targets from the currently common level of around 2 percent to a new level of 4 percent, in order to reduce the likelihood of hitting the zero lower bound (ZLB). The question has been discussed critically, for instance, by McCallum (2011), Walsh (2011), and Coibion, Gorodnichenko, and Wieland (2012), but has generally been met with resistance by central bankers (e.g., Bernanke 2010).

below target, and persistently so. Since we have recently seen low inflation for prolonged periods in a number of advanced economies, sufficient amounts of data have accrued that now allow us to provide some empirical evidence that can address these questions. This paper studies to what extent inflation expectations are anchored in different inflation regimes—in normal times, under high (and possibly persistently high) inflation, and if inflation is weak (and persistently so). It employs monthly inflation expectations as provided by Consensus Economics for ten IT countries, covering the time between the adoption of IT and December 2014. Based on these data, the paper tests (i) the extent to which inflation expectations depend on lagged, realized inflation, (ii) the extent to which forecasters disagree, and (iii) how inflation expectations are revised in response to news about inflation.

The key finding of the paper is that under persistently low inflation, some disanchoring of inflation expectations occurs compared to situations where inflation is around target. Evidence for this comes from all three tests: inflation expectations are more dependent on lagged inflation; forecasters tend to disagree more; and inflation expectations get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. This evidence suggests that central banks should expect inflation expectations to behave differently than was the case previously, when inflation was often remarkably close to target in many advanced economies. Still, even under persistently low inflation, expectations in the IT countries studied here are generally better anchored than they were in Japan over its period of prolonged weak inflation.

The paper proceeds as follows: section 2 provides an overview of the related literature. The data are explained in section 3. The current environment of weak inflation in advanced economies is discussed in section 4. Section 5 presents the empirical evidence regarding the behavior of inflation expectations, and section 6 concludes.

2.   Literature Review

There is a large empirical literature on the effects of IT. Since IT had been designed with a view to taming inflation and inflation expectations, this has been the focus of most previous contributions. The two main aspects of this literature are (i) the effect on inflation

and (ii) the effect on inflation expectations. We will briefly review each (for a more detailed summary of the relevant literature and its placement in the broader context of central bank communication, see Blinder et al. 2008).

2.1   The Effect on Inflation

Despite the fact that IT is viewed as a success by IT central banks, and even though inflation has typically been lower and more stable following the adoption of inflation targets, there is still a vigorous debate on the merits of IT. There has been early supportive evidence (King 2002 for the United Kingdom, and Kuttner and Posen 1999 for Canada and the United Kingdom), and Bleich, Fendel, and Rülke (2012) show that the introduction of IT has significantly shifted the reaction functions of central banks toward inflation stabilization. Still, others have questioned whether there is a causal link between IT and inflation developments, pointing to various complications in any empirical analysis of this question.

One complication is a possible endogeneity issue, whereby the decision to adopt IT is not independent of country fundamentals (Mukherjee and Singer 2008; Samarina and De Haan 2014). Ball and Sheridan (2005) pointed out that countries that adopted IT often had above-average inflation prior to adoption. They argue that this affects the empirical evidence, showing that once mean reversion in inflation is allowed for by controlling for the initial level of inflation, the decline in inflation is similar for targeters and non-targeters—a result that is shared by Willard (2012).

Another complication is the identification of a control group. Mishkin and Schmidt-Hebbel (2007), for instance, argue that inflation targeters do not show a performance superior to that of a group of successful non-targeters. Still, even when using advanced econometric methodologies such as propensity score matching to address this issue, the evidence remains inconclusive: Vega and Winkelried (2005) conclude that IT has had the desired effect, whereas Lin and Ye (2007) come to the opposite conclusion.[2]

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[2]Other complications arise because the start of IT needs to be defined (for instance, as the announcement date, as in Bernanke et al. 1999, or as the implementation date, as in Ball and Sheridan 2005), and because the classification of inflation targeters is not always clear (Kuttner 2004).

One reason for the inconclusive findings could be that several countries in the usual control group have adopted other forms of quantitative targets. Fatas, Mihov, and Rose (2007) argue that the quantification matters more than the type of the target, since they find that inflation, exchange rate, and monetary targets are all linked to lower inflation. Also, IT might be more successful under some circumstances—Alpanda and Honig (2014) and Samarina, Terpstra, and de Haan (2014) find little evidence for the success of IT overall but identify substantial effects of IT in emerging economies.

2.2   The Effect on Inflation Expectations

Also the evidence regarding the effect of IT on inflation expectations is inconclusive. Johnson (2003) predicts expected inflation in IT countries based on a model of expectation determination prior to the adoption of IT, and finds that actual inflation expectations are substantially lower than their predicted values. Comparing targeting with non-targeting countries, Johnson (2002) provides evidence of a relative reduction in inflation expectations in the IT countries, while Levin, Natalucci, and Piger (2004) show that long-term inflation forecasts depend on past inflation in the control group but not in the IT group. Gürkaynak, Levin, and Swanson (2010) and Davis (2014) find inflation expectations to be less responsive to news in IT countries than in the respective control groups.

While these studies suggest a better anchoring of inflation expectations in IT countries, other evidence does not confirm these findings. Castelnuovo, Nicoletti-Altimari, and Rodriguez-Palenzuela (2003) find that long-term inflation expectations are well anchored in all countries in their sample except Japan, regardless of whether the central bank has an inflation target or not. Also, Pierdzioch and Rülke (2013) show that forecasters in IT countries often scatter their inflation forecasts away from the inflation target.

Another strand of this literature has studied the effects of IT, or central bank transparency more generally, on *disagreement* among inflation forecasters. Capistran and Timmermann (2009) show that disagreement in inflation expectations rises with the level and the variance of the inflation rate, such that we might expect less disagreement under IT (if having an inflation target contributes to reducing and stabilizing inflation). Swanson (2006) finds that with

the increased transparency of the U.S. Federal Reserve, the dispersion across private-sector forecasters of U.S. interest rates has declined, a finding that is supported at the international level in Dovern, Fritsche, and Slacalek (2012). Crowe (2010) tests whether IT promotes convergence to lower forecast errors, and points out that convergence occurs in all countries because of mean reversion, but that the adoption of IT leads to greater convergence. Ehrmann, Eijffinger, and Fratzscher (2012) identify IT as one of various transparency measures that effectively reduce disagreement among inflation forecasters.

Other evidence is less conclusive. Cecchetti and Hakkio (2010) report only small effects, and Capistran and Ramos-Francia (2010) detect them only for developing countries. Siklos (2013) studies forecaster disagreement across many different forecast types, including those prepared by central banks and international institutions, as well as survey-based forecasts conducted among households and businesses. He finds that central bank transparency in general is associated with an *increase* in forecast disagreement, but that the adoption of IT has little effect on forecast disagreement.

To summarize, it appears that the case for IT is far from settled. Most longitudinal analyses find that inflation is reduced and more stable, and that inflation expectations fall and are better anchored after the adoption of an inflation target, whereas cross-sectional comparisons often conclude that similar results have also been obtained in other countries. In other words, it appears that while IT has lived up to its promise, it is not unique in delivering low and stable inflation and well-anchored inflation expectations.

This paper adds a new dimension to the analysis by studying the performance of IT in different circumstances, namely when inflation is weak (and persistently so), as opposed to times when inflation is around target, or when inflation is high (and persistently so).

3. Data

For the empirical analysis, we use data on inflation expectations provided by Consensus Economics, which are based on surveys among professional forecasters and are available for a reasonably long history in a comparable fashion across countries. The same database has been used in several related studies, such as Crowe

(2010), Dovern, Fritsche, and Slacalek (2012), Ehrmann, Eijffinger, and Fratzscher (2012), and Davis (2014).

Since the recent episode of weak inflation has been largely an advanced-economy phenomenon, we restrict the analysis to the advanced economies in the data set. Also, since we are, inter alia, interested in studying forecaster disagreement, the set of countries is restricted to those where individual forecaster data are available.

Also, we will only include IT countries, and do therefore need a corresponding classification of countries. Beyond the set of central banks that are officially classified as inflation targeters, we also include the current monetary policy regimes of the Federal Reserve, the Swiss National Bank, and the European Central Bank (ECB) in the IT category. These central banks currently have a quantified inflation objective—while they are not inflation targeters sensu stricto, the quantification of the inflation objective should provide a similar anchor for inflation expectations.

Accordingly, the data set spans the following ten economies: Australia, Canada, the euro area, New Zealand, Norway, Spain (prior to joining the European Monetary Union), Sweden, Switzerland, the United Kingdom, and the United States. We also include Japan, even prior to its adoption of IT, to provide a comparator country, given its long-lasting experience of weak inflation.

The data are monthly, and the mean inflation forecasts are available since January 1990 (with the exception of the euro area, for which forecasts start in December 2002). We use the data as of the month when the quantified inflation objective was adopted (as in Ball and Sheridan 2005), according to the central bank websites. Alternatives would have been the announcement date (as in Bernanke et al. 1999) or a later date to allow for the fact that central banks need to build up credibility for their target (e.g., Goldberg and Klein 2011 for the ECB), or to cater to the fact that the Bank of England gained independence only after introducing its target (Gürkaynak, Levin, and Swanson 2010). Choosing the adoption date places us in the middle of these alternatives.

The sample ends in December 2014. Note, however, that we end the sample for Spain in December 1998, i.e., with the formation of the European Monetary Union. The reason for this is that there are no country-specific inflation targets—the ECB defines price stability for the euro area as a whole, and because of relatively persistent

inflation differentials across the euro-area countries (Angeloni and Ehrmann 2007), it is not clear how the euro-area objective would translate into national inflation expectations. This procedure also ensures that the euro area is not double-counted once data for the euro-area aggregate are available.

Table 1 provides information on the data availability by country. On average, the data set comprises seventeen forecasters per country and month, but there is some variation, with a minimum of four and a maximum of thirty-four respondents. Survey participation is relatively smaller in Norway, with nine forecasters on average, whereas the number of forecasters in the euro area, the United Kingdom, and the United States is relatively large, with at least twenty-five on average.

In the Consensus Economics survey, respondents are asked to provide their forecasts for consumer price inflation. For a robustness analysis, we also use the forecasts for real GDP growth. Forecasts are provided for the current and the next calendar year. This implies that the forecast horizon decreases over the course of a given year— while a current-calendar-year forecast in January spans effectively an entire year, the forecasting problem in December is much simpler, since much of the year's data are already realized and released. In the empirical analysis, we will therefore control for the forecast horizon by including month fixed effects where relevant.

It is also important to note that the forecasting horizon of our data is rather short. Mehrotra and Yetman (2014) have shown that longer-term forecasts are better anchored than shorter-term forecasts, which is intuitive because the central bank should be able to bring inflation to target over longer horizons, whereas in the short run, the long lags in the transmission of monetary policy make it more likely that inflation deviates from target. This should be mirrored in the short-term inflation expectations that we study here.

We sourced the actual consumer price inflation rates from the national statistical offices via Haver Analytics.[3] The central bank

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[3]We use consumer price index (CPI) inflation rates for all countries, in line with the concept that is forecasted in the Consensus Economics survey, even if the inflation target relates to a different price concept (such as the Harmonised Index of Consumer Prices (HICP) in the euro area). Results are robust to using the alternative inflation concept.

Table 1. Coverage of the Data Set

Country	Sample				No. of Forecasters			
	Start Date: Mean Forecasts	Start Date: Individual Data	End Date	Monthly Obs.	Avg.	Min.	Max.	
Australia	1993:M3	1993:M3	2014:M12	262	17	4	21	
Canada	1991:M2	1991:M2	2014:M12	287	15	11	19	
Euro Area	2002:M12	2002:M12	2014:M12	145	28	22	34	
New Zealand	1990:M3	1994:M12	2014:M12	298	13	6	17	
Norway	2001:M3	2001:M3	2014:M12	166	9	5	12	
Spain	1994:M11	1995:M1	1998:M12	50	12	7	15	
Sweden	1993:M1	1995:M1	2014:M12	264	13	6	18	
Switzerland	2000:M1	2000:M1	2014:M12	180	13	6	17	
United Kingdom	1992:M10	1992:M10	2014:M12	267	25	16	34	
United States	2012:M1	2012:M1	2014:M12	36	29	24	33	
Japan	1990:M1	1990:M1	2014:M12	300	17	5	25	

Notes: The table provides an overview of the coverage of the Consensus Economics forecast data set. The figures for "Monthly Observations" are calculated for the mean forecast.

Table 2. Summary Statistics

	Obs.	Mean	St. Dev.	Min.	Max.
Inflation	1955	1.936	1.306	−1.834	7.669
Current-Calendar-Year Expectations	1955	2.105	1.136	−0.640	5.975
Next-Calendar-Year Expectations	1955	2.183	0.764	−0.061	5.050
Low Inflation	1955	0.248	0.432	0	1
Low Inflation, at Least Six Months	1955	0.199	0.399	0	1
Low Inflation, at Least Nine Months	1955	0.173	0.378	0	1
Low Inflation, at Least Twelve Months	1955	0.158	0.364	0	1

Notes: The table shows summary statistics for CPI inflation, for inflation expectations, and for dummy variables that cover periods of low inflation. Statistics are for the regression sample, i.e., without Japan.

policy rates were taken from central bank websites, as were the levels of the central banks' inflation targets.[4]

Table 2 provides some information on the inflation outcomes of the IT sample (i.e., excluding Japan) and the corresponding inflation expectations. Inflation has been 1.9 percent, which is very closely reflected in inflation expectations—current-calendar-year expectations amount to 2.1 percent, and next-calendar-year expectations to 2.2 percent. Interestingly, inflation expectations are more stable than actual inflation, and expectations for the longer forecast horizon are more stable than the current-calendar-year expectations.

Another type of data is required for testing for the extent to which inflation expectations respond to news about realized inflation. For that purpose, we follow the standard in the announcement literature (e.g., Andersen et al. 2003) and calculate the surprise

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[4]Unfortunately, variation in the inflation targets is only very small (they range from 1 percent to 3 percent, with 56 percent of all observations corresponding to a target of 2 percent, and another 30 percent of observations to a target of 2.5 percent), preventing us from testing whether relatively higher targets attenuate the findings that inflation expectations are not anchored as well under low inflation.

component contained in the release of CPI inflation by deducting the expectation of the announcement from the actual announcement value. As is common in this literature, we have obtained data on the expectations of the macroeconomic releases from a survey among financial market participants conducted by Bloomberg, and we use the median response as our measure of expectations. We ensure that the data release is appropriately assigned to the relevant Consensus Economics forecast round; i.e., we test whether the inflation forecasts respond to the data release that occurs just before the survey is conducted.

4.   The Current Environment of Weak Inflation in Advanced Economies

Following the global financial crisis, inflation developments in advanced economies have surprised many economists, in two different ways. First, as documented by the International Monetary Fund (2013), there has been a period of "missing disinflation": based on previous relationships, given the depth of the recession, inflation should have declined much more strongly than it actually did. This period has been analyzed, inter alia, by Gordon (2013), Murphy (2014), Coibion and Gorodnichenko (2015), and Del Negro, Giannoni, and Schorfheide (2015).

Second, inflation has more recently surprised to the downside. While policymakers have pointed this out (e.g., Macklem 2014), little research has tried to understand the drivers of inflation dynamics in this period, with the notable exceptions of Ferroni and Mojon (2014) and Friedrich (2014).

Figure 1 provides some evidence that the developments in advanced economies' inflation rates in 2013 were indeed surprising to economists. Panel A shows how the 2013 calendar-year forecasts gathered by Consensus Economics were revised over the course of 2013 (by comparing the mean forecasts for a given country c provided in January with those provided in December 2013: $E_{c,December2013}(\pi_{c,2013}) - E_{c,January2013}(\pi_{c,2013})$. In most countries, inflation forecasts were revised downward, and in many cases substantially so. To check this finding, panel B shows the corresponding revisions to GDP growth forecasts (ordered as in panel A, i.e., by the magnitude of the revision in inflation forecasts). While inflation forecasts were consistently revised down over the course

Figure 1. 2013 Forecast Revisions

Percentage points   A. Inflation

Percentage points   B. Real GDP Growth
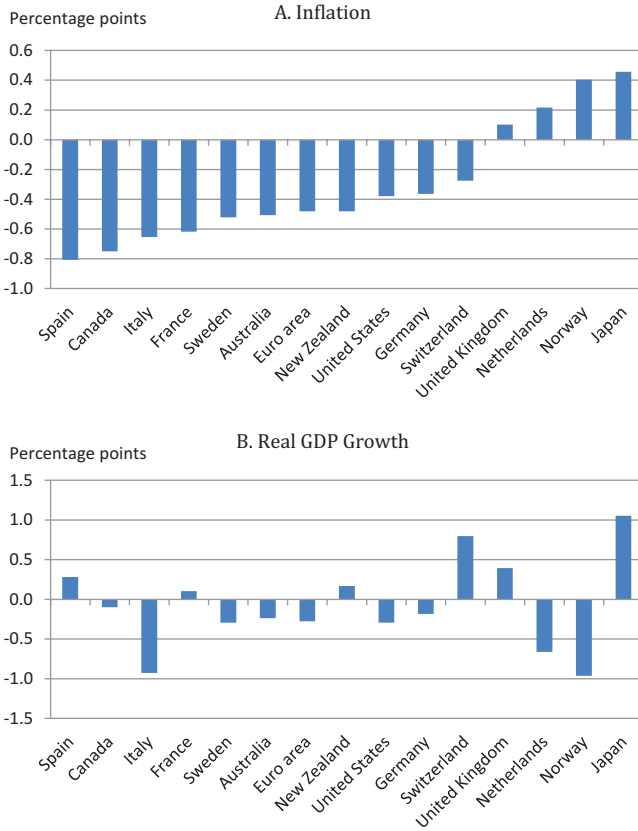
Notes: The figure shows the revisions to the mean Consensus Economics forecasts for 2013 inflation (panel A) and 2013 real GDP growth (panel B) between the forecasts conducted in January 2013 and December 2013. For the euro area, the figure covers the aggregate as well as the five largest euro-area countries.

of the year, this is not true for GDP growth forecasts, confirming that inflation forecasts were not revised down as a consequence of downward revisions to economic activity.[5] Rather, the evolution of inflation itself seems to have surprised forecasters.

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[5]Looking at the evolution of oil prices or the Consensus Economics oil price forecasts, it is apparent that the downward revisions to inflation expectations were not driven by oil prices either.

Figure 2. Weak Inflation in Advanced Economies

A. Number of Months with Inflation below Target Since 2009

B. Maximum Number of Consecutive Months with Inflation below Target Since 2009
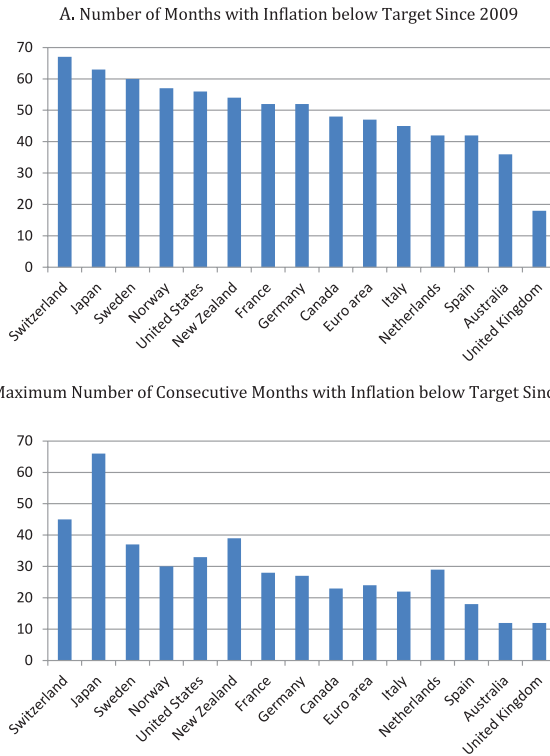
Notes: The figure shows the number of months with inflation below target since 2009 (panel A) and the maximum number of consecutive months with inflation below target since 2009 (panel B), by country. For the euro area, the figure covers the aggregate as well as the five largest euro-area countries.

Overall, the period following the global financial crisis can be characterized as one of weak inflation. This is illustrated in panel A of figure 2, which shows the number of months that inflation has been below target since 2009 in the various countries. This was the case for 69 percent of all observations (74 percent since 2012). The most extreme cases are Switzerland and Japan, where inflation has been below the definition of price stability in sixty-seven and sixty-three out of the seventy-two months in that period, respectively. On the other side of the spectrum is the United Kingdom, with

only eighteen out of seventy-two months with below-target infla-
tion. Furthermore, inflation has been below target by substantial
amounts. The average gap between inflation and its target has been
–0.4 percentage points since 2009 and –0.7 percentage points since
2012.

Not only has inflation been low on average, it has also been low
in a persistent manner. This is illustrated in panel B of figure 2,
which shows the maximum number of consecutive months for which
inflation has been below target since 2009 in each country. Obvi-
ously, the outliers are again Switzerland and Japan, with inflation
below the objective in forty-five and sixty-three out of the seventy-
two months, respectively, but many other countries have also seen
persistently weak inflation, with New Zealand, Norway, Sweden, and
the United States all having had thirty or more consecutive months
with inflation below target.

At the end of the sample, inflation was below target in fourteen
of the fifteen countries considered in the figure, suggesting that the
episode of weak inflation is still ongoing at the time of writing this
paper.

5.   The Anchoring of Inflation Expectations

The hypothesis to be studied in this paper is the extent to which
inflation expectations are anchored, comparing across different infla-
tion environments. We will perform three types of tests for the
anchoring of expectations. The first examines the extent to which
inflation expectations depend on lagged, realized inflation; the sec-
ond studies disagreement across forecasters; and the third tests the
extent to which inflation expectations get revised in response to
inflation news.

5.1   Dependence on Realized Inflation

If inflation expectations were perfectly anchored at target, they
should not move away from the target, regardless of the current infla-
tion rate that is observed in the economy. Such a degree of anchoring
is most likely not observed in the data (especially given that we are
studying short-term inflation expectations), but the example clarifies

that a valid test for the anchoring of inflation expectations is the degree to which they depend on the inflation rates that are observed in the economy. This type of test has a long tradition in the related literature and has, for instance, been employed in Levin, Natalucci, and Piger (2004). The regression underlying these tests is as follows:

$$E_{c,t}(\pi_{c,t+h}) = \alpha_c + \beta_1 \pi_{c,t-1} + \beta_2 D_{c,t}^l + \beta_3 D_{c,t}^l \pi_{c,t-1} + \beta_4 D_{c,t}^h$$
$$+ \beta_5 D_{c,t}^h \pi_{c,t-1} + \varepsilon_{c,t}, \tag{1}$$

where $E_{c,t}(\pi_{c,t+h})$ denotes the mean inflation expectations for country c over the forecast horizon h (i.e., the next-calendar-year forecasts), collected in the Consensus Economics survey conducted in month t. α_c are country fixed effects.[6] $D_{c,t}^l$ is a dummy variable for times of (persistently) low inflation, and $D_{c,t}^h$ is a dummy variable for periods when inflation is (persistently) high. The models are estimated by ordinary least squares. We calculate Driscoll and Kraay (1998) standard errors, which allow for heteroskedasticity, autocorrelation up to a maximum lag order of 12, and cross-sectional correlation.[7]

The corresponding results are provided in table 3. The first column reports results from a regression that does not differentiate across different inflation episodes, and shows that inflation expectations are somewhat backward looking, which is not surprising, given the short forecasting horizon. In the subsequent estimations, we distinguish different inflation episodes. First, we test periods of low and high inflation. These are defined as times when inflation is more than 1 percentage point below target, and more than 1 percentage point above target, respectively.[8]

Second, to test for different effects if inflation is high or low in a persistent manner, we define various dummy variables that are

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[6]These control for possible country-specific differences that can affect inflation expectations, such as the quality of the forecaster pool and the difficulty to make forecasts for a given economy (e.g., because smaller economies are more prone to shocks and, as such, might ceteris paribus be relatively more volatile). Results are robust to the inclusion of month fixed effects.

[7]Results are robust to using panel-corrected standard errors.

[8]All results are robust when we define low and high inflation to be below 1 percent and above 3 percent, respectively.

Table 3. Dependence of Inflation Expectations on Past Inflation

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
A. Benchmark: Full Sample, with Country Fixed Effects					
Lagged Inflation (β_1)	0.241***	0.186***	0.180***	0.154***	0.130***
	(0.031)	(0.040)	(0.036)	(0.034)	(0.031)
Low Inflation (β_2)	—	−0.115	−0.110*	−0.207***	−0.285***
		(0.077)	(0.066)	(0.057)	(0.056)
Interaction Lagged Inflation/ Low Inflation (β_3)	—	0.107	0.102	0.213***	0.184***
		(0.066)	(0.069)	(0.058)	(0.040)
High Inflation (β_4)	—	−0.624**	−0.511	−0.446	−0.395
		(0.290)	(0.330)	(0.360)	(0.361)
Interaction Lagged Inflation/ High Inflation (β_5)	—	0.176**	0.162*	0.170*	0.178*
		(0.083)	(0.086)	(0.091)	(0.093)
p-value ($\beta_1 + \beta_3$)	—	0.000	0.000	0.000	0.000
p-value ($\beta_1 + \beta_5$)	—	0.000	0.000	0.001	0.001
Observations	1,955	1,955	1,955	1,955	1,955
R-squared	0.627	0.633	0.632	0.637	0.641
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	No	No	No	No	No

(continued)

Table 3. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
B. Robustness: Full Sample, with Time Fixed Effects					
Lagged Inflation (β_1)	0.171***	0.183***	0.169***	0.137***	0.122***
	(0.028)	(0.046)	(0.039)	(0.036)	(0.035)
Low Inflation (β_2)	–	−0.025	−0.056	−0.177***	−0.225***
		(0.081)	(0.074)	(0.060)	(0.055)
Interaction Lagged Inflation/	–	0.060	0.054	0.131**	0.145**
Low Inflation (β_3)		(0.067)	(0.065)	(0.057)	(0.062)
High Inflation (β_4)	–	−0.087	−0.052	−0.014	0.042
		(0.341)	(0.388)	(0.432)	(0.442)
Interaction Lagged Inflation/	–	0.000	−0.001	0.009	0.010
High Inflation (β_5)		(0.092)	(0.095)	(0.099)	(0.100)
p-value ($\beta_1 + \beta_3$)	–	0.000	0.000	0.000	0.000
p-value ($\beta_1 + \beta_5$)	–	0.017	0.049	0.113	0.157
Observations	1,955	1,955	1,955	1,955	1,955
R-squared	0.782	0.783	0.783	0.785	0.786
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 3. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
C. Robustness: Sample Prior to 2009					
Lagged Inflation (β_1)	0.251***	0.222***	0.197***	0.161***	0.133***
	(0.041)	(0.061)	(0.052)	(0.046)	(0.042)
Low Inflation (β_2)	—	0.009	−0.023	−0.158*	−0.256***
		(0.134)	(0.105)	(0.094)	(0.091)
Interaction Lagged Inflation/ Low Inflation (β_3)	—	0.026	0.048	0.195*	0.151
		(0.118)	(0.125)	(0.114)	(0.100)
High Inflation (β_4)	—	−0.472	−0.349	−0.255	−0.261
		(0.323)	(0.368)	(0.401)	(0.411)
Interaction Lagged Inflation/ High Inflation (β_5)	—	0.131	0.130	0.140	0.162
		(0.098)	(0.098)	(0.100)	(0.104)
p-value ($\beta_1 + \beta_3$)	—	0.015	0.044	0.001	0.003
p-value ($\beta_1 + \beta_5$)	—	0.000	0.001	0.004	0.005
Observations	1,343	1,343	1,343	1,343	1,343
R-squared	0.558	0.563	0.564	0.571	0.576
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	No	No	No	No	No

Table 3. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
D. Robustness: Sample Restricted to July Forecasts					
Lagged Inflation (β_1)	0.236***	0.260***	0.203***	0.172***	0.149***
	(0.040)	(0.024)	(0.037)	(0.038)	(0.027)
Low Inflation (β_2)	–	0.018	–0.092	–0.186***	–0.277***
		(0.092)	(0.063)	(0.041)	(0.051)
Interaction Lagged Inflation/ Low Inflation (β_3)	–	0.085	0.170***	0.305***	0.256***
		(0.071)	(0.041)	(0.040)	(0.036)
High Inflation (β_4)	–	–0.083	0.067	0.316	0.296
		(0.161)	(0.178)	(0.259)	(0.269)
Interaction Lagged Inflation/ High Inflation (β_5)	–	0.002	0.014	–0.007	0.009
		(0.060)	(0.057)	(0.073)	(0.080)
p-value ($\beta_1 + \beta_3$)	–	0.000	0.000	0.000	0.000
p-value ($\beta_1 + \beta_5$)	–	0.000	0.001	0.070	0.072
Observations	163	163	163	163	163
R-squared	0.617	0.620	0.621	0.629	0.630
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	No	No	No	No	No

Table 3. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
		E. Robustness: Sample without Zero Lower Bound			
Lagged Inflation (β_1)	0.238***	0.185***	0.178***	0.150***	0.122***
	(0.035)	(0.047)	(0.038)	(0.036)	(0.033)
Low Inflation (β_2)	—	−0.059	−0.057	−0.169**	−0.262***
		(0.116)	(0.095)	(0.082)	(0.080)
Interaction Lagged Inflation/ Low Inflation (β_3)	—	0.062	0.062	0.201**	0.169**
		(0.098)	(0.103)	(0.089)	(0.072)
High Inflation (β_4)	—	−0.607**	−0.459	−0.361	−0.314
		(0.300)	(0.346)	(0.381)	(0.383)
Interaction Lagged Inflation/ High Inflation (β_5)	—	0.178**	0.160*	0.163*	0.175*
		(0.088)	(0.089)	(0.093)	(0.096)
p-value ($\beta_1 + \beta_3$)	—	0.005	0.019	0.000	0.000
p-value ($\beta_1 + \beta_5$)	—	0.000	0.000	0.001	0.003
Observations	1,699	1,699	1,699	1,699	1,699
R-squared	0.540	0.547	0.547	0.553	0.559
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	No	No	No	No	No

Notes: The table shows results from the regression $E_{c,t}(\pi_{c,t+h}) = \alpha_c + \beta_1 \pi_{c,t-1} + \beta_2 D_{c,t}^l + \beta_3 D_{c,t}^l \pi_{c,t-1} + \beta_4 D_{c,t}^h + \beta_5 D_{c,t}^h \pi_{c,t-1} + \varepsilon_{c,t}$, where $D_{c,t}^l$ is a dummy variable for times of (persistently) low inflation, and $D_{c,t}^h$ is a dummy variable for periods when inflation is (persistently) high. Panel A reports the benchmark results. Panel B shows results for a model with time fixed effects, panel C for a model that excludes data after 2008. Panel D is restricted to forecasts in July of each year, and panel E drops observations when policy rates are close to the ZLB, defined here as policy rates smaller than or equal to 50 basis points. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. Numbers in parentheses are standard errors.

equal to one if inflation has been low (or high) according to the above definition for at least six, nine, or twelve consecutive months.

The underlying hypothesis is that the determination of inflation expectations might be affected if inflation is low (high) for long. This notion is consistent with recent work by Bianchi and Melosi (2014), who develop a theoretical framework in which the anti-inflationary determination of monetary policy varies over time. In this context, inflation expectations remain anchored when the central bank deviates from an active monetary policy for a short period of time, but disanchoring occurs and uncertainty rises when the deviation persists over time. Table 2 provides summary statistics for these dummy variables—overall, there are 485/389/338/308 observations where inflation is low for at least one/six/nine/twelve months.

The first row in table 3 shows the dependence on lagged inflation that results in times when inflation is neither (persistently) low nor (persistently) high. The estimated coefficients are similar to those obtained for the full sample (shown in column 1).

Looking at the interaction terms (β_1 and β_5), there is little evidence that the behavior of inflation expectation changes if inflation is *high*, or persistently so. In contrast, the results suggest that if inflation is *low*, and in particular if it is low for long, inflation expectations become more dependent on realized inflation. The magnitudes are substantial—if inflation has been low for at least nine consecutive months, the overall coefficient (given as the sum of $\beta_1 + \beta_5$) is 0.367, compared with a coefficient of 0.154 otherwise. This implies that inflation expectations return to target more slowly than otherwise.[9]

How do these results compare to the behavior of inflation expectations in Japan? For Japan, we estimate a coefficient of 0.575 (significant at the 1 percent level), suggesting that inflation expectations were still relatively more backward looking in Japan than in the IT countries under persistently low inflation.

Panels B–E of table 3 contain the results of several robustness tests. The first two tackle the question to what extent the results

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[9]These results do not depend on Switzerland or the euro area (which have an asymmetric definition of price stability), nor on the United States (which enters our data set only very late); dropping these countries from the sample does not affect results—in this case, the estimate of β_1 is 0.143*** and the estimate of β_5 is 0.255***.

depend on the recent period of weak inflation. As many countries simultaneously experienced weak inflation recently, one might wonder to what extent these observations are independent. Even though we allow for cross-sectional correlation of the residuals, two additional tests are performed. First, we include time fixed effects, which control for common developments in inflation expectations across all countries (like the recent weak inflation episode). Second, we only include observations prior to 2009, given that inflation started to weaken across many countries in 2009. For the first of these tests (reported in panel B), all results are robust. In contrast, for the second test (reported in panel C, for which we lose around a third of all observations), results largely lose their statistical significance. This suggests that the observations since 2009 are important for the results, but that these do not depend on inflationary developments that are common across countries.

The third robustness (panel D) deals with the changing forecast horizon of the data over the course of a year. It only includes data from July, i.e., the middle of the year (in order not to change the average forecast horizon), and finds that results are remarkably robust (even though, of course, we are now only using around a twelfth of all observations). Finally, panel E reports results for a robustness test that excludes all observations where policy rates are close to the ZLB. The goal of this test is to see whether the previous result is driven by the ZLB observations—if policy rates get close to zero, the central bank might be perceived as having less-powerful tools to bring inflation back to target, resulting in inflation expectations being relatively more backward looking. While the results are obtained only at somewhat lower levels of statistical significance, they are overall robust.[10]

While these results point to some degree of disanchoring of inflation expectations, a potential alternative explanation for the findings could be that inflation is effectively more persistent if it is low,[11] and

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[10]Even when dropping observations at the ZLB, there is a sufficient number of observations to warrant econometric testing—we are left with 384/299/256/226 observations with inflation being low for at least one/six/nine/twelve months.

[11]This, however, does not seem to be the case in our data. When testing for different persistence conditional on the level of inflation, the differences are not statistically significant.

that inflation expectations simply reflect this pattern. This argument is particularly important because the horizon of inflation expectations that we are studying is relatively short. It could well be that, while inflation expectations at shorter horizons become more backward looking, those at longer horizons remain well anchored. Accordingly, it is important to confirm the findings with alternative tests that are less affected by this complication.

5.2   Forecaster Disagreement

Another way to study the anchoring of inflation expectations is through forecaster disagreement. If expectations were perfectly anchored at target, there should be no disagreement. Hence, less disagreement can be taken as a signal indicating better anchoring of inflation expectations. As pointed out in the literature review, this approach has been used in several previous studies.[12]

To study disagreement, we need to define a corresponding metric. Much of the literature (e.g., Mankiw, Reis, and Wolfers 2004 or Dovern, Fritsche, and Slacalek 2012) uses the interquartile range of forecasts in a given country and month. The advantage of this measure over the simple standard deviation is that it is insensitive to outliers, which might be important in the analysis of survey data. In this paper, we use the interdecile range instead, which potentially incorporates a broader range of views while still being robust to outliers (unless one believes that more than 10 percent of the observations on each side of the distribution are outliers). Importantly, results are qualitatively equivalent for the interquartile range and the standard deviation.

The regressions are specified as follows:

$$\Omega_{c,t}(\pi_{c,t+h}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h}) + \gamma_2 D^l_{c,t}$$
$$+ \gamma_3 D^h_{c,t} + \varepsilon_{c,t}, \tag{2}$$

where $\Omega_{c,t}(\pi_{c,t+h})$ denotes the interdecile range of the inflation expectations for country c over the forecast horizon h (again, the

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[12]Capistran and Ramos-Francia (2010); Cecchetti and Hakkio (2010); Crowe (2010); Ehrmann, Eijffinger, and Fratzscher (2012).

next-calendar-year forecasts), collected in the Consensus Economics survey conducted in month t. The model, as before, controls for country fixed effects but now also includes month fixed effects α_m (given that over the course of the year, the forecast horizon shrinks, forecast uncertainty is reduced, and therefore disagreement should also be lower). It also includes the level of inflation expectations, to allow for the fact that higher inflation tends to be more volatile and therefore might be subject to more disagreement. As before, we estimate these regressions using simple ordinary least squares, allowing for Driscoll and Kraay (1998) standard errors.

Table 4 shows the corresponding results. Consistent with the findings of Capistran and Timmermann (2009), the estimate of γ_1 shows that disagreement is larger when inflation expectations are higher. This suggests that higher inflation rates are more difficult to forecast, a point that has been raised in arguments in favor of low inflation targets.

Moving on to the estimates of γ_2 and γ_3, we see how the cross-sectional dispersion increases both when inflation is persistently low and when it is persistently high. Comparing these results with the level of forecaster disagreement in Japan is not straightforward. One way to do this is to add the Japanese data to the regression and to simply test for a Japan-specific intercept shift. If we do this, we get a coefficient of 0.204 (statistically significant at the 1 percent level), which is substantially larger than the coefficients we obtain for γ_2, suggesting that forecaster disagreement in Japan has been larger than what is observed under persistently low inflation in the other economies.

Panels B–D contain the results of several robustness tests. The first one includes time fixed effects, as for table 3. In this case, results are no longer statistically significant (as when restricting the sample to pre-2009 data). The second, in panel C, shows that results are robust to using the standard deviation as a measure of forecaster disagreement. Finally, panel D retains the interdecile range as a measure of cross-sectional dispersion but tests whether similar results can be obtained for forecasts real GDP growth. The results confirm that disagreement increases when inflation is (persistently) low and (persistently) high.

Table 4. Cross-Forecaster Dispersion

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Mths	Low/High Inflation, at Least 9 Mths	Low/High Inflation, at Least 12 Mths
	(1)	(2)	(3)	(4)	(5)
A. Benchmark: Interdecile Range, Next-Calendar-Year Inflation Expectations					
Inflation Expectations (γ_1)	0.244***	0.226**	0.221**	0.223**	0.229**
	(0.085)	(0.093)	(0.093)	(0.093)	(0.092)
Low Inflation (γ_2)	–	0.039	0.050	0.104**	0.107*
		(0.043)	(0.048)	(0.052)	(0.058)
High Inflation (γ_3)	–	0.146	0.197	0.239*	0.208
		(0.094)	(0.120)	(0.131)	(0.140)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.225	0.237	0.244	0.254	0.248
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
B. Robustness: Time Fixed Effects					
Inflation Expectations (γ_1)	0.124**	0.103*	0.103*	0.111*	0.112*
	(0.056)	(0.056)	(0.058)	(0.060)	(0.059)
Low Inflation (γ_2)	–	–0.046	–0.048	0.008	0.022
		(0.044)	(0.052)	(0.050)	(0.056)
High Inflation (γ_3)	–	0.215***	0.251***	0.278***	0.238**
		(0.069)	(0.080)	(0.087)	(0.100)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.570	0.588	0.591	0.592	0.586
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes

(continued)

Table 4. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Mths	Low/High Inflation, at Least 9 Mths	Low/High Inflation, at Least 12 Mths
	(1)	(2)	(3)	(4)	(5)
C. Robustness: Standard Deviation					
Inflation Expectations (γ_1)	0.089*	0.081**	0.081**	0.081**	0.085**
	(0.035)	(0.040)	(0.039)	(0.040)	(0.039)
Low Inflation (γ_2)	–	0.016	0.025	0.044**	0.046**
		(0.017)	(0.020)	(0.021)	(0.023)
High Inflation (γ_3)	–	0.062	0.079	0.095*	0.079
		(0.038)	(0.048)	(0.053)	(0.056)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.227	0.241	0.246	0.257	0.250
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
D. Robustness: Interdecile Range, Next-Calendar-Year Real GDP Growth Expectations					
GDP Growth Expectations (γ_1)	−0.210***	−0.205***	−0.204***	−0.204***	−0.206***
	(0.066)	(0.067)	(0.065)	(0.066)	(0.068)
Low Inflation (γ_2)	–	0.053	0.103**	0.139**	0.115**
		(0.040)	(0.048)	(0.059)	(0.056)
High Inflation (γ_3)	–	0.071	0.128***	0.152***	0.123**
		(0.046)	(0.049)	(0.055)	(0.058)
Observations	1,872	1,872	1,872	1,872	1,872
R-squared	0.238	0.243	0.253	0.261	0.252
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes
Level of Inflation Expectations	Yes	Yes	Yes	Yes	Yes

Notes: Results from the regression $\Omega_{c,t}(\pi_{c,t+h}) = \alpha_c + \alpha_m + \gamma_1 E_{c,t}(\pi_{c,t+h}) + \gamma_2 D_{c,t}^l + \gamma_3 D_{c,t}^h + \varepsilon_{c,t}$, where $\Omega_{c,t}(\pi_{c,t+h})$ denotes the interdecile range of the inflation expectations for country c over the forecast horizon h, collected in the Consensus Economics survey conducted in month t. All other variables are as defined in the previous tables. Panel A reports the benchmark results. Panel B shows results for a model with time fixed effects, panel C for the standard deviation. Panel D provides results for the interdecile range for forecasts of real GDP growth. ***, **, * denote statistical significance at the 1, 5, and 10 percent level, respectively. Numbers in parentheses are standard errors.

5.3 Responsiveness to the Surprise Component in CPI Releases

A third way to study the anchoring of inflation expectations is to see how responsive they are to the surprise component contained in news releases. Related tests have, for instance, been conducted by Gürkaynak, Levin, and Swanson (2010) and Davis (2014).[13] The idea is that, in the presence of well-anchored inflation expectations, incoming news about the current level of inflation should not be important.

Analogous to the previous tests, we estimate the following relationship:

$$R_{c,t}(\pi_{c,t+h*}) = \alpha_c + \alpha_m + \delta_1 S_{c,t-1} + \delta_2 D_{c,t}^l + \delta_3 D_{c,t}^l S_{c,t-1}$$
$$+ \delta_4 D_{c,t}^h + \delta_5 D_{c,t}^h S_{c,t-1} + \varepsilon_{c,t}, \tag{3}$$

where $S_{c,t-1}$ is the surprise component contained in the CPI release in country c just prior to the survey conducted in month t. The dependent variable is $R_{c,t}(\pi_{c,t+h*})$, which denotes the *revision* in the inflation forecasts compared with the previous month. This test is therefore different from the first set, where we tested whether the *level* of the expectations depends on the level of lagged inflation. In contrast, we are now interested in understanding whether news about actual inflation leads to a revision in forecasts. To construct the revision, we follow the approach proposed by Kilian and Hicks (2013). Revisions for the months of January to September are based on the current-year forecasts ($R_{c,t}(\pi_{c,t+h*}) = E_{c,t}(\pi_{c,t+h0}) - E_{c,t-1}(\pi_{c,t+h0})$), whereas starting in October, the revisions are based on the expectations for the next calendar year ($R_{c,t}(\pi_{c,t+h*}) = E_{c,t}(\pi_{c,t+h1}) - E_{c,t-1}(\pi_{c,t+h1})$).

Note that equation (3) includes month fixed effects α_m, like equation (2), this time because it is likely that there is less need to revise forecasts if the forecast horizon becomes shorter. Since the

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[13] Using a related technique, Galati, Poelhekke, and Zhou (2011) find that there was a larger responsiveness in U.S., UK, and euro-area inflation expectations to news during the global financial crisis. Autrup and Grothe (2014) and Nautz and Strohsal (2015) confirm this for the United States. An interesting recent extension to the static modeling approach has been provided by Strohsal and Winkelmann (2015), who allow for exponential smooth transition autoregressive dynamics.

Bloomberg expectations data for the CPI releases are not available for all countries right from the beginning of our sample period, these tests are based on substantially fewer observations than the earlier tests. Table 5 shows the results.

Following the previous results, it is not surprising that δ_1 is positive, i.e., that inflation expectations are responsive to news. What is surprising, however, is that under persistently low inflation, the responsiveness seems to be muted (as can be seen by the negative coefficients for δ_3). This suggests a *better* anchoring of inflation expectations under these circumstances (whereas, so far, we have argued that they are not anchored as well). How can this be reconciled?

Panels B and C split the analysis into cases where the inflation numbers have been surprising to the upside and those where the surprises were negative, i.e., expectations were for a higher number than was actually released. A striking result emerges—under low inflation, inflation expectations stop responding to positive inflation surprises but continue to respond to negative inflation surprises ($\delta_1 + \delta_3$ is statistically significantly positive in panel B, as can be seen by the respective *p*-values shown in the table, but it is statistically effectively zero in panel C). In other words, if inflation is low and inflation numbers come in *lower* than expected, inflation expectations decrease further. In contrast, if inflation is low and inflation numbers come in *higher* than expected, inflation expectations do not increase. No such asymmetry is observed if inflation is (persistently) high.

Robustness tests (not shown here for brevity) show that these results go through for the pre-2009 sample. In contrast, for the model with time fixed effects, coefficients are statistically insignificant for the negative surprises. It is important to note, though, that the time fixed effects severely limit the degrees of freedom, given the small number of observations for this test.

How do these results compare to what we find for Japan? For Japan, there is no statistically significant response to surprises—not for positive surprises, not for negative surprises, and not for all surprises taken together. However, it is not clear whether this is an economically meaningful result or whether this is simply due to a lack of power—as most Japanese CPI announcements in our data sample were well predicted, there are only fifty-two instances of positive surprises, and there are thirty-five instances of negative surprises.

Table 5. Responsiveness of Inflation Expectations to News Surprises about Inflation

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
		A. Benchmark: All News Surprises			
News Surprise (δ_1)	0.280***	0.260***	0.266***	0.271***	0.279***
	(0.028)	(0.038)	(0.033)	(0.031)	(0.031)
Low Inflation (δ_2)	—	−0.072***	−0.067***	−0.068***	−0.066***
		(0.012)	(0.012)	(0.012)	(0.015)
Interaction News Surprise/ Low Inflation (δ_3)	—	−0.081*	−0.090*	−0.101*	−0.126**
		(0.045)	(0.053)	(0.052)	(0.057)
High Inflation (δ_4)	—	0.021	0.024	0.019	0.072***
		(0.036)	(0.050)	(0.057)	(0.022)
Interaction News Surprise/ High Inflation (δ_5)	—	0.095	0.188	0.214	0.145
		(0.096)	(0.130)	(0.144)	(0.127)
p-value ($\delta_1 + \delta_3$)	—	0.000	0.000	0.000	0.000
p-value ($\delta_1 + \delta_5$)	—	0.000	0.000	0.001	0.001
Observations	1,119	1,119	1,119	1,119	1,119
R-squared	0.208	0.252	0.245	0.242	0.249
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 5. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
B. Robustness: Negative News Surprises					
News Surprise (δ_1)	0.368***	0.377***	0.368***	0.368***	0.388***
	(0.080)	(0.103)	(0.083)	(0.085)	(0.095)
Low Inflation (δ_2)	–	−0.080***	−0.069***	−0.073***	−0.065***
		(0.024)	(0.018)	(0.018)	(0.017)
Interaction News Surprise/	–	−0.065	−0.026	−0.046	−0.052
Low Inflation (δ_3)		(0.113)	(0.101)	(0.100)	(0.112)
High Inflation (δ_4)	–	−0.008	0.012	−0.020	0.021
		(0.052)	(0.062)	(0.061)	(0.060)
Interaction News Surprise/	–	0.115	0.160	0.113	−0.164
High Inflation (δ_5)		(0.280)	(0.262)	(0.258)	(0.329)
p-value ($\delta_1 + \delta_3$)	–	0.000	0.000	0.000	0.001
p-value ($\delta_1 + \delta_5$)	–	0.129	0.067	0.095	0.412
Observations	454	454	454	454	454
R-squared	0.187	0.222	0.216	0.213	0.210
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 5. (Continued)

	Overall	Low/High Inflation	Low/High Inflation, at Least 6 Months	Low/High Inflation, at Least 9 Months	Low/High Inflation, at Least 12 Months
	(1)	(2)	(3)	(4)	(5)
C. Robustness: Positive News Surprises					
News Surprise (δ_1)	0.294***	0.271***	0.296***	0.309***	0.305***
	(0.079)	(0.125)	(0.077)	(0.071)	(0.076)
Low Inflation (δ_2)	–	−0.062*	−0.026	−0.010	−0.021
		(0.036)	(0.035)	(0.038)	(0.040)
Interaction News Surprise/ Low Inflation (δ_3)	–	−0.174	−0.321*	−0.395**	−0.346*
		(0.185)	(0.169)	(0.193)	(0.192)
High Inflation (δ_4)	–	0.055	0.051	0.079	0.096
		(0.061)	(0.056)	(0.062)	(0.059)
Interaction News Surprise/ High Inflation (δ_5)	–	−0.047	−0.028	−0.153	0.005
		(0.210)	(0.173)	(0.228)	(0.288)
p-value ($\delta_1 + \delta_3$)	–	0.507	0.879	0.664	0.843
p-value ($\delta_1 + \delta_5$)	–	0.055	0.090	0.495	0.255
Observations	361	361	361	361	361
R-squared	0.211	0.273	0.255	0.252	0.270
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes
Month Fixed Effects	Yes	Yes	Yes	Yes	Yes

Notes: The table shows results from the regression $R_{c,t}(\pi_{c,t+h*}) = \alpha_c + \alpha_m + \delta_1 S_{c,t-1} + \delta_2 D_{c,t}^l + \delta_3 D_{c,t}^l S_{c,t-1} + \delta_4 D_{c,t}^h + \delta_5 D_{c,t}^h S_{c,t-1} + \varepsilon_{c,t}$, where $R_{c,t}(\pi_{c,t+h*})$ denotes the revision in the inflation forecasts compared with the previous month. $S_{c,t-1}$ is the surprise component contained in the CPI release in country c just prior to the survey conducted in month t. All other variables are as defined in the previous tables. Panel A reports the benchmark results. Panel B shows results for positive news surprises (i.e., CPI inflation data coming in higher than expected), panel C for negative news surprises (i.e., CPI inflation data coming in lower than expected. ***, **, and * denote statistical significance at the 1 percent, 5 percent, and 10 percent level, respectively. Numbers in parentheses are standard errors.

6. Conclusions

Inflation targeting had originally been introduced to lower and stabilize inflation, and to anchor inflation expectations. Only recently, some central banks have started to target inflation (or provide a quantitative definition of their inflation objective) while in a situation of weak inflation. At the same time, a number of IT central banks have been confronted with an environment where inflation has been below target for considerable amounts of time. Therefore, IT is now charged with targeting inflation from below, as opposed to its traditional focus of targeting inflation from above.

Until recently, there have simply not been sufficient data to provide empirical evidence about the environment that central banks can expect when they are targeting inflation from below. This paper has attempted to provide some initial evidence in this direction, focusing on the behavior of inflation expectations. Using Consensus Economics inflation forecasts for ten IT countries, the paper has demonstrated that under persistently weak inflation, expectations are not as well anchored as otherwise. They tend to become more backward looking; disagreement across forecasters increases; and they get revised down in response to lower-than-expected inflation, but do not respond to higher-than-expected inflation. This evidence suggests that central banks should expect inflation expectations to behave differently than was the case previously, when inflation was often remarkably close to target in many advanced economies. Still, even under persistently low inflation, expectations in the IT countries studied here are generally better anchored than they were in Japan over its period of prolonged weak inflation.

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