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Disagreeing during deflations*

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Abstract

We examine inflation forecast disagreement during periods of deflation. Using a large cross-country data set of professional forecasters' expectations, we show that the relationship between inflation outcomes and forecast disagreement is U-shaped: disagreement rises with both positive and negative inflation outcomes. We show that information frictions do not explain rising disagreement in deflations and other macroeconomic factors that generally tend to correlate with forecast disagreement cannot fully explain its increase. Instead, our results are consistent with forecasters having heterogeneous views about the inflation process, with those in the left-tail of the forecast distribution shifting downwards during deflations. Econometric evidence indicates that such shifts have adverse consequences for real activity.

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1. Introduction

Various studies have documented a positive relationship between the level of inflation and forecasters' disagreement about future inflation (eg Cukierman and Wachtel (1979); Mankiw et al (2004); Capistran and Timmermann (2009)). In this paper, we show that when deflation periods are included in the analysis, the relationship between actual inflation and forecast disagreement becomes U-shaped: inflation forecast disagreement rises with both positive and negative inflation outcomes. Our findings are based on a large panel data set of professional forecasters' expectations in 42 advanced and emerging market economies (EMEs). The global nature of the data is highly relevant, as deflations have not been limited to advanced economies – 30 of the 47 deflationary episodes identified in our data set occur in emerging market economies.

A number of models have been proposed to explain forecast disagreement. In the sticky information model of Mankiw and Reis (2002), disagreement is driven by agents only updating their information sets infrequently. Disagreement can also arise through rational inattention as in Sims (2003), Woodford (2003) and Mackowiak and Wiederholt (2009) in which agents are continuously updating their information sets but only observe noisy signals about the true state of the economy. Other studies have proposed that diverging views about the underlying inflation process may drive forecast disagreement about inflation (eg Andrade et al (2019)).

Our results suggest that information frictions do not account for the increased forecast disagreement during deflations. First, higher disagreement during deflations remains after controlling for sticky information-related variables, of the type considered by Mankiw et al (2004). Moreover, tests proposed by Coibion and Gorodnichenko (2015) to examine the presence of information rigidities suggest that inflation expectations during deflations (and high inflations) are more consistent with rational expectations.[3] By contrast, we find evidence of information rigidities when inflation is at moderately positive levels.[4]

Rather, our results are consistent with forecasters having heterogeneous views about the inflation process during deflations. This disagreement is on top of that driven by other macroeconomic factors that tend to correlate with greater forecast disagreement, eg recessions (Patton and Timmermann (2010); Döpke and Fritsche (2006)), contractionary monetary policy (Glas and Hartmann (2016)), negative output gaps (eg Dovern et al (2012)) and below target inflation (Ehrmann (2015)).

To show this, we delve deeper into the tails of the forecast distribution and, find divergence in the inflation expectations process in the cross-section of forecasters, even after controlling for the macroeconomic factors mentioned above. In particular, during deflations, inflation expectations of forecasters in the left-hand tail of the forecast distribution shift downward. By contrast, there is less evidence of a statistically significant change in the process driving inflation expectations in the right-hand tail of the forecast distribution.

Non-fundamental factors may drive heterogeneous expectations about inflation during deflations. Non-fundamental disagreement can arise from multiple equilibria (see Benhabib et al (2002)). Deflation could cause some forecasters to believe the economy is in the liquidity

3 This result differs from the assumption in Wiederholt (2015) where forecast disagreement stems from information rigidities. The author shows that heterogeneous inflation expectations render deflation spirals less severe at the ZLB.

4 Coibion and Gorodnichenko (2015) also document state dependence in expectations formation, as they find that information rigidities in inflation expectations are lower during periods of greater macroeconomic volatility.

trap equilibrium and lead them to change their views about the inflation process, while other forecasters continue to believe in an equilibrium with positive inflation rates. The shift in the left tail that we observe during deflations has some non-fundamental features, as also longer-term forecasts shift down.

A credible inflation targeting regime may help to avoid a situation where agents hesitate between multiple equilibria. Indeed, we find that greater disagreement during deflations, and the downward shift in the left tail, obtain only in economies and during periods when the central bank is not an inflation targeter. By contrast, in inflation targeting regimes, which arguably provide a stronger nominal anchor, we do not find evidence of greater inflation forecast disagreement and shifts in the left tail during deflations.[5]

Fundamental factors may also drive heterogeneous expectations across forecasters. Andrade et al (2019) provides one such mechanism, where disagreement about the information content of central bank communication at the zero lower bound (ZLB) of interest rates creates disagreement about the path of future output and hence inflation. Somewhat in contrast to this fundamental source of forecaster disagreement, we find that deflations are associated with greater inflation forecast disagreement also when interest rates are away from the ZLB.

We investigate the macroeconomic impact of heterogeneous expectations in a panel vector autoregressive (VAR) model. In our model, disagreement about inflation is contemporaneously

[5] While Siklos (2013) documents that the adoption of inflation targeting makes little difference in terms of inflation forecast disagreement, we show that pursuing inflation targeting does make a difference during deflations.

exogenous to the real economy variables and, in that sense, non-fundamental in nature.[6] We identify a shock to the left-hand tail of the inflation forecast distribution, shown earlier to contribute to the rise in forecast disagreement during deflations. The estimated impulse responses show that such shocks lead to greater disagreement over forecasts for GDP growth and lower output gap and inflation outcomes, suggesting that downward shifts in the lower tail of inflation expectations have adverse consequences for economic activity.

These results complement those of Ehling et al (2018) who examine the impact of inflation disagreement on real and nominal bond yields and find that disagreement has effects on the real economy. However, and in contrast to Ehling et al (2018) where inflation disagreement is associated with investors' expectations of higher future consumption, we find that the net effect of a rise in inflation disagreement during deflations is contractionary. The output contraction could arise due to resource inefficiency costs related to greater inflation disagreement.

In addition to the studies mentioned above, our paper is also related to other strands of literature. The paper adds to recent research on the behaviour of inflation expectations during periods of low inflation (eg IMF (2016); Bank of Japan (2017); Natoli and Sigalotti (2018); Nishizaki et al (2014); Kenny and Dovern (2017)). The study also contributes to research on inflation risks and how they relate to real economic outcomes (eg Andrade et al (2015) and Fleckenstein et al (2017)).

[6] Therefore, in addition to differing from the fundamentals-based expectations in Andrade et al (2019), the scenario we consider also differs from that of Busetti et al (2014). In the latter, expectations become unanchored as a result of a sequence of deflationary shocks and of agents gradually learning about the state of the economy.

This paper is structured as follows. The next section describes the data and presents stylised facts on inflation outcomes and forecast disagreement. Section 3 discusses the empirical methodology. This is followed in Section 4 by a formal investigation of how deflation affects inflation forecast disagreement and discusses the underlying mechanisms. In the same section, we also analyse the macroeconomic effects of shifts in the left tail of the forecast distribution. Concluding comments are provided in Section 5.

2. Data and stylised facts on deflationary episodes

We use surveys of professional forecasters from Consensus Economics. The data at the forecaster-level allow us to construct measures of forecast disagreement. Moreover, data published by Consensus Economics are available for a relatively long history and are collected in a comparable fashion across a large number of advanced and emerging market economies (EMEs). Faust and Wright (2013) document the favourable forecasting performance of subjective expectations, noting that surveys of inflation expectations tend to improve the forecasts that come from a large number of different forecasting models.

Each month, Consensus Economics polls a panel of experts from public and private economic institutions, mostly investment banks and research institutions, about their predictions for the main macroeconomic variables for the current and next calendar year.[7] Given that the fixed event nature of the forecasts – expectations of inflation during a calendar year – implies a changing forecast horizon between different months, we transform the fixed event forecasts to one-year ahead forecasts by computing a weighted average of current and

[7] Longer-term forecasts, such as inflation over the next five years, are also available from Consensus, but only the mean forecasts are published.

next-year forecasts. This approach has been widely used in the literature (see eg Dovern et al (2012); Gerlach (2007); Siklos (2013)). With h as the forecast horizon, the 12-month ahead forecast is computed as

$$\hat{\pi}_{t+12|t} = \frac{h}{12}\hat{\pi}_{t+h|t} + \frac{12-h}{12}\hat{\pi}_{t+12+h|t}, \qquad (1)$$

where $\frac{h}{12}$ and $\frac{12-h}{12}$ denote the weights, ie the shares of current and next-year forecasts in the forecast period.[8]

Our data cover 42 economies, 12 advanced and 30 emerging. The length of the data set depends on the availability of inflation forecast data. For advanced economies, the data start earliest in 1990, yielding a maximum of 319 monthly observations per country. For emerging markets, the starting dates vary by region (see Online Appendix Table A1 for details).

Our inflation data are for headline consumer price inflation (CPI, year on year).[9] In our baseline results, we define deflationary episodes as those characterised by at least six consecutive months of negative headline inflation rates (year on year). Furthermore, a country is regarded as exiting the deflation episode only in the third consecutive month of positive inflation rates that potentially follow deflation. This classification ensures that very short bouts of negative inflation rates do not count as individual deflation episodes. Moreover, it avoids longer deflation periods being classified as several shorter ones, if they are interrupted only by one or two months of positive inflation rates. In the empirical analysis, we also consider

[8] We apply the same formula to both the level forecasts and forecast disagreement in the paper.

[9] A partial exception is the United Kingdom, where inflation refers to retail price (RPIX) inflation until 2004 and CPI inflation thereafter.

"persistent" deflation episodes that comprise a minimum of twelve consecutive months of negative headline inflation rates.

[Graph 1 around here]

The 47 deflation episodes identified in our sample are shown in Graph 1. Three periods with a greater occurrence of deflations stand out. First, various Asian economies experienced deflation around the time of the Asian financial crisis: Hong Kong SAR, mainland China, Chinese Taipei, Singapore and Thailand. Japan also experienced a long spell of deflation during its domestic banking crisis in the late 1990s. The second, more global, bout of deflations took place during the Great Financial Crisis (GFC). The third relatively widespread period of falling prices occurred in 2014–15, affecting many European countries but also some emerging economies in Asia. Over time, deflations were increasingly associated with near-zero interest rates (blue lines in Graph 1).

Overall, the deflation episodes are quite widely dispersed across countries. 17 deflation episodes took place in advanced economies and 30 in emerging markets, while 11 occurred in countries that were part (or later became part) of the euro area. Hong Kong SAR experienced the lowest inflation outcome within a single deflation episode in the sample (–6.1%). Online Appendix Table A2 shows details of the identified deflations, including their length and the minimum inflation outcomes and levels of expectations during these time periods.

Similarly to deflations, we also classify periods of high inflation. We define an economy to have high inflation if the headline inflation rate is above four per cent for at least six consecutive months. We omit as outliers all observations with inflation rates exceeding 10%.

Graph 2 plots inflation outcomes together with a measure of forecast disagreement, ie the interquartile range of next year forecasts, for our sample.[10] We use a generalised additive model to illustrate the relationship between the variables, shown as the blue line. The generalised additive model fits locally linear regressions, where smoothing is achieved by cubic basis splines (see Hastie and Tibshirani (1990) for more details).

[Graph 2 around here]

Graph 2 suggests that the relationship between inflation outcomes and forecast disagreement is U-shaped. The interquartile range obtains its lowest value at positive inflation rates of around 2%, with an interquartile range of around 0.5 percentage points. The upward-sloping part of the curve during positive inflation rates has been documented in previous research, see eg Mankiw et al (2004). Our results suggest a similar relationship during deflation. In particular, once inflation passes the zero mark and enters negative territory, the interquartile range rises rather steeply. At an inflation rate of –1.7%, corresponding to the average minimum inflation outcome across the deflation episodes, forecast disagreement is at a similar level as with a positive inflation rate of 6%.

3. Empirical strategy

The estimated equation for forecast disagreement is of the type:

$$disp_{c,t}\left(\pi_{c,t+12}\right) = \alpha_c + \gamma_t + \lambda_1 E_{c,t}(\pi_{c,t+12}^{pos}) + \lambda_2 E_{c,t}(\pi_{c,t+12}^{neg}) + \lambda_3 D_{c,\,t}^{defl} + \lambda_4 D_{c,\,t}^{high\,infl} + \lambda_5 X_{c,t} + \varepsilon_{c,t}. \qquad (2)$$

[10] The graph incorporates all twelve forecast horizons related to the next calendar year ($12 < h \leq 24$).

In (2), $disp_{c,t}(\pi_{c,t+12})$ denotes the dispersion (disagreement) of one-year ahead forecasts, for forecasts formed in month t for country c. Our benchmark measure of disagreement is the interquartile range. $D_{c,\,t}^{defl}$ ($D_{c,\,t}^{High\,infl}$) is a dummy variable that obtains a value of one if an economy is in deflation (high inflation) in period t and zero otherwise (see Section 2). α_c and γ_t denote country and time fixed effects, respectively.

In an equation similar to (2), Ehrmann (2015) includes the level of inflation expectations, to allow for the fact that higher inflation tends to be more volatile and could thus be subject to more disagreement (see Capistran and Timmermann (2009) for a theoretical framework). Due to the U-shape of the smooth regression line in Graph 2, we replace this variable by separate variables for both positive and negative expected inflation rates, $E_{c,t}(\pi_{c,t+12}^{pos})$ and $E_{c,t}(\pi_{c,t+12}^{neg})$, respectively.

The vector of control variables $X_{c,t}$ in (2) includes both positive and negative deviations of inflation from the inflation target ($infl\ gap_{c,\,t}^{pos}$ and $infl\ gap_{c,\,t}^{neg}$, respectively), the squared inflation gap, the policy interest rate $i_{c,t}$, the absolute change in the nominal effective exchange rate $abs(\Delta neer_{c,t})$, the squared change in the policy interest rate $(\Delta i_{c,t})^2$, the absolute change in the inflation rate $abs(\Delta\pi_{c,t})$ and the squared change in the inflation rate $(\Delta\pi_{c,t})^2$. The absolute values of changes in variables and their squared terms are motivated by sticky information models where forecast disagreement rises in response to large changes in macroeconomic variables (Mankiw and Reis (2002); Mankiw et al (2004)). As only a fraction of forecasters update their information sets in each period, forecast dispersion increases endogenously when the economy faces large shocks affecting prices. Dovern et al (2012) similarly include the squared change in the policy rate when modelling inflation forecast disagreement, to proxy for variation in monetary policy.

In addition, the vector of controls includes other macroeconomic variables that previous research has found to be correlated with inflation forecast disagreement: the output gap $y_{c,t}^{gap}$ (Dovern et al (2012)); a dummy variable for recession periods, $recession_{c,\,t}$ (Patton and Timmermann (2010)); and a dummy variable for quarters when monetary policy is contractionary, $mp\_contraction_{c,\,t}$ (Glas and Hartmann (2016))). The latter variable is set to one during quarters when the policy rate is above a Taylor-rule specified benchmark, using the Taylor-rule specification in Hofmann and Bogdanova (2012). Online Annex Table A3 lists all data sources and gives more information on the construction of the variables.

Equation (2) is estimated by ordinary least squares. We use heteroscedasticity-consistent standard errors clustered both by time and by country. Thus, we allow the residuals to be correlated both within the same country over time and across countries during the same time period. Periods of inflation rates above 10% and policy rates above 100% are excluded from all estimations in the paper.

4. Empirical evidence

4.1. Deflation and forecast disagreement

Our baseline estimates of Equation (2) show that deflations are associated with greater forecast disagreement. Using the interquartile range as the measure for disagreement, the coefficient on the deflation dummy in Column (1) in Table 1 is economically and statistically significant – forecast dispersion rises by around 0.4 percentage points during deflation, compared to other periods. In contrast, high inflation episodes do not lead to a further rise in forecast disagreement, beyond that already captured by a higher level of expected inflation. Indeed, Column (1) shows that when the level of one-year-ahead positive expected inflation is higher, forecast disagreement is greater.

[Table 1 around here]

To what extent does the rise in disagreement reflect something specific to deflations, instead of other macroeconomic factors that tend to correlate with forecast disagreement? Column (1) includes a battery of control variables that have been shown to matter in previous studies for the degree of forecast disagreement, such as recessions and contractionary monetary policy. Another possible factor is the deviation of inflation from the central bank's target. We include in Column (2) the positive and negative deviations of inflation from the inflation target (the inflation gap) and its squared term. The coefficient on the deflation dummy remains robust to the inclusion of these variables. Column (3) displays results for deflations that last a minimum of twelve months. Disagreement rises also during the more persistent deflations, with a similarly sized coefficient estimate as for the shorter deflations. The results are robust to considering an alternative measure of forecast disagreement, the interdecile range (Columns (4) and (5)).[11] Taken together, these results suggest that the increase in disagreement during deflations goes beyond that associated with larger inflation gaps or other macroeconomic factors that tend to correlate with the degree of forecast disagreement.

To what extent could information frictions account for the rise in forecast disagreement during deflations? The coefficients on controls suggested by a sticky information model in

[11] We show in an Online Appendix table that the results are also robust to excluding the period of the Great Financial Crisis (GFC; September 2008–December 2009). In the Online Appendix, we also present results using a one-sided output gap, as well as shadow policy rates from Krippner (2016) for those economies that carried out unconventional monetary policies during part of the sample period and where such data are available.

Table 1 obtain the expected signs and are in some cases highly statistically significant. Forecast disagreement rises in response to large changes in policy rates, and is also greater when changes in exchange rates are larger. These dynamics are consistent with a framework where expectations are adjusted infrequently and there are costs to acquire and process information. Yet, the observation that the deflation dummy remains statistically significant suggests that sticky information may not fully account for the rise in forecast disagreement.

To further analyse the relevance of information frictions, we use the framework proposed by Coibion and Gorodnichenko (2015). The estimated model links ex-post mean forecast errors to ex-ante mean forecast revisions. In the presence of information frictions, average forecast errors across agents will be predictable using the average forecast revisions. This is not the case for full-information rational expectations, which imply conditionally and unconditionally unpredictable forecast errors. We consider the following equation, estimated for the full panel of countries:

$$\pi_{c,t+h} - E_t\pi_{c,t+h} = \alpha_c + \gamma_t + \beta(E_t\pi_{t+h} - E_{t-1}\pi_{t+h}) + \varepsilon_{c,t}. \qquad (3)$$

The left-hand term of Equation (3) is the ex-post forecast error (mean across forecasters in country c), while the right-hand term is the mean ex-ante forecast revision. In estimating (3), we include forecasts at all available horizons $12 < h < 24$ for the next calendar year. Coibion and Gorodnichenko (2015) show that the coefficient β on the forecast revision term can be written as $\frac{\lambda}{1-\lambda}$, where λ is the degree of information rigidity. When there are no information frictions, $\lambda = 0$. In such a case, the forecast error cannot be predicted using information dated t or earlier.

[Table 2 around here]

We find that the degree of information rigidity depends on the inflation environment. Perhaps surprisingly given previous findings on the presence of information rigidities (eg

Coibion and Gorodnichenko (2015)), panel estimates of (3) yield a coefficient estimate of β that is not significantly different from zero (Column (1) of Table 2). However, this result of insignificant information rigidity obtains because the sample contains various different inflation environments. Indeed, when we estimate (3) and include interaction terms of β with the deflation and high inflation dummy variables introduced earlier, as well as an interaction of β with a dummy for "other" (moderately positive) inflation environments, we obtain evidence of state-dependent information rigidities. In particular, Column (2) in Table 2 shows statistically and economically significant information rigidity during the "other" inflation environments, with a β estimate of 0.97. However, information frictions do not appear to be present during deflation and high inflation environments. Intuitively, forecasters are updating their information sets more frequently during more turbulent times. As information frictions do not account for the observed disagreement, the large rise in forecast disagreement during deflations appears to be driven by other factors.

4.2. Heterogenous expectations formation

To what extent could forecasters' heterogeneous views about the inflation process during deflations explain our results? To investigate this, we focus on the tails of the inflation forecast distribution. Table 3 evaluates the relationship of deflation with forecasts that are in the left and right tails, ie the dependent variables in these regressions are level forecasts at the 25th and 75th percentiles, respectively. Other control variables are identical to those used in the estimates of Equation (2).

[Table 3 around here]

The results show that forecast disagreement rises during deflations in part because of downward shifts in forecasts in the left-hand tail of the forecast distribution that are not present in the right-hand tail. For inflation forecasts at the 25th percentile of the distribution (left tail), inflation expectations shift downward by an average of 0.15 percentage points during deflations (Column (1) of Table 3). The coefficient estimate is statistically significant at the 1% level. During persistent deflations, expectations in the left tail fall by a similar magnitude (Column (2)).

By contrast, during deflations there is no evidence of downward shifts for forecasts at the 75th percentile (right tail). In particular, the coefficients on the deflation and persistent deflation dummy variables in Columns (3) and (4) are positive but only weakly statistically significant.

What is behind heterogeneous expectations formation during deflations? Both non-fundamental and fundamental factors may be at play. Non-fundamental disagreement could arise from multiple equilibria (see Benhabib et al (2002)). If the downward movement in the left-hand tail is driven by a non-fundamental shock, longer-term forecasts, in addition to short-term ones, should shift downward for forecasters in the left-hand tail of the distribution.[12] This differs from e.g. a demand driven disturbance, which could be expected to dissipate relatively quickly and thus have little effect on longer-term forecasts. Unfortunately, Consensus does not publish data on forecast distributions for horizons beyond the next calendar year. However, using the longest available horizons (expectations formed in the first quarter of the current calendar year for the next calendar year, ie horizons of 22–24 months), we find that deflations are associated with a downward shift in inflation expectations in the left-hand tail (25th percentile) also for these somewhat longer-term forecasts. In particular, the coefficient on the deflation dummy variable is –0.062 (with a standard error of 0.027). In the case of persistent

[12] We are grateful to the anonymous referee for making this point.

deflations, the coefficient is –0.128 (standard error of 0.034). This suggests that the forces driving down left-tail forecasts are at least partly non-fundamental in nature.

A credible inflation targeting regime may help avoid situations where agents hesitate between non-fundamental driven multiple equilibria because monetary policy may be expected to counteract deflation concerns more aggressively in order to maintain credibility of the announced targets. Indeed, we show in Columns (2) and (4) of Table 4 that greater disagreement during deflations obtains only in economies and during periods when the central bank is not an inflation targeter.[13] In inflation targeting regimes, we do not find evidence of greater inflation forecast disagreement during deflations (Columns (1) and (3)), as the coefficients on the deflation dummy variables are not statistically significant, even during persistent deflations. An identical finding obtains when we consider the effects of deflations on the left-hand tail of the forecast distribution in inflation targeting economies and other countries: deflations lead to statistically significant shifts in the left-tail only in non-inflation targeting economies (Columns (1) to (4) in Online Annex Table A6).

[Table 4 around here]

Considering fundamental factors instead, one source is forecast disagreement about the path of real variables such as output and employment. For example, Andrade et al (2019) show that disagreement about the information content of central bank communication at the zero lower bound (ZLB) of interest rates can create disagreement about the path of future output and hence inflation. This mechanism, however, does not operate outside of the ZLB. By

[13] When we limit the estimation to cover only those periods when interest rates are away from the ZLB, we obtain an identical result: deflations are associated with greater forecast disagreement only in non-inflation targeting economies. These results are available upon request.

contrast, we find that deflations are associated with greater inflation forecast disagreement also when interest rates are away from the ZLB. In particular, we show in Columns (5) and (6) of Table 4 that deflations are associated with greater inflation forecast disagreement also when periods of ZLB are excluded from the estimation, as the coefficients on the deflation dummy variables remain statistically significant and positive. Similarly, left-tail forecasts also shift down during those deflations where the economy is outside the ZLB (Columns (5) and (6) in Online Annex Table A6).

4.3. Macroeconomic implications

We investigate the macroeconomic impact of heterogenous expectations in a panel vector autoregressive (VAR) model. We apply our previous result that deflations are associated with shifts in the left tail of forecast distribution. Then, we identify exogenous shocks to the left tail of the forecast distribution, and examine the effects of such shocks on macroeconomic variables. Similar to Ehling et al (2018), we use a model where disagreement shocks are contemporaneously exogenous to the real economy variables and, in that sense, non-fundamental in nature.

Formally, we write the panel VAR as:

$$y_{c,t} = A_1 y_{c,t-1} + A_2 y_{c,t-2} + \cdots + A_p y_{c,t-p} + B z_{c,t} + u_c + e_{c,t}, \qquad (3)$$

where $y_{c,t}$ is a vector of k endogenous variables, $z_{c,t}$ contains the exogenous variables, the A_1, …, A_p and B are coefficient matrices to be estimated; u_c contains the panel fixed effects; and $e_{c,t}$ is assumed to be a white noise error term.

Our model incorporates monthly data for country c for the left tail of the inflation forecast distribution (25th percentile), median inflation expectations, GDP growth forecast disagreement (the interquartile range), the output gap, inflation and the policy interest rate, in the same order. All expectations refer to one-year-ahead expectations. To identify shocks to the left-hand tail, we use a recursive identification scheme with contemporaneous zero restrictions and a Cholesky decomposition of the variance-covariance matrix. Given our ordering assumption, the shock to the lower tail is pre-determined, and contemporaneously exogenous to median expected inflation, GDP growth forecast disagreement, and realisations of output, inflation and the policy rate. The ordering is thus similar to Leduc et al (2007), which also includes a pre-determined expectations variable and the authors examine the effects of shocks to expectations on real variables. Moreover, at the time of the survey, forecasters do not yet know the current-month outcomes for the macro variables. The ordering of output, inflation and policy rate follows conventional monetary VARs, and the vector of exogenous variables is comprised of month dummy variables.

We estimate the panel VAR by generalised method of moments for an identical sample as the disagreement regressions. The VAR includes three lags. The panel-specific fixed effects are removed by forward orthogonal deviation, with lags of the transformed variables instrumented by lags of the untransformed variables (see Abrigo and Love (2015)). We examine the responses of all endogenous variables to a negative one standard deviation shock in the left tail of the forecast distribution, until 40 months have passed from the shock. 90% confidence intervals, obtained with 1,000 Monte Carlo draws, illustrate parameter uncertainty.

Graph 3 shows that the negative shock to the left-hand tail is temporary and peters out slowly (upper left-hand panel). As a response to the tail shock, the median inflation forecast falls. Notably, the negative shock to the lower tail leads to a temporary increase in GDP forecast disagreement, with a large contemporaneous impact. Macroeconomic outcomes are also affected, in a contractionary manner, as both the output gap and inflation decline.

[Graph 3 around here]

Even though the VAR ordering implies that the shock to the left-tail is pre-determined, given that it is an expectations variable, we cannot rule out the possibility that it incorporates some information about the future course of the real variables. Moreover, as Mehra and Herrington (2008) note, forecasters may have access to within-period information about the real economy variables. Thus, in an alternative specification, we allow the expectations shocks to reflect the realisations of output, inflation and the interest rate.[14] In this case, we cannot argue that the shock is orthogonal to the real economy and non-fundamental in nature. Yet, this specification results in similar impulse responses as the baseline case: as a response to the negative left-tail inflation forecast shock, inflation, the output gap and median inflation expectations fall, and GDP growth forecast disagreement rises (see Online Annex Graph A1).

The rise in GDP forecast dispersion, as well as declines in the output gap and inflation, suggest that left-tail inflation forecast shocks, even if non-fundamental in nature, have real effects. These results complement those of Ehling et al (2018) who examine the impact of inflation disagreement on real and nominal bond yields and find that disagreement has effects on the real economy. However, and in contrast to Ehling et al (2018) where inflation disagreement is associated with investors' expectations of higher future consumption, we find that the net effect of a rise in inflation disagreement during deflations is contractionary. This could be driven by inefficiency costs: in a New Keynesian framework, greater price dispersion is costly for economic output due to its negative effect on resource allocation. Moreover, if a rise in forecast disagreement reflects higher inflation uncertainty, price signals in the economy could become blurred and hurt economic activity. For example, Huizinga (2016) shows that

[14] In this case, the variables are ordered as: output gap, inflation, policy interest rate, left-hand tail of the inflation forecast distribution, median inflation expectations, GDP growth forecast disagreement.

inflation uncertainty dampens investment due to greater uncertainty about the real net present value of capital expenditures. These results are also consistent with other findings in previous literature, including the adverse implications of forecast disagreement on economic activity (Bachmann et al (2013)), as well as the information content of survey-based inflation risks (Andrade et al (2015)) and that of deflation probabilities computed from financial market prices (Fleckenstein et al (2017)).

5. Conclusion

In this paper, we analysed inflation forecast disagreement during periods of deflation, using a large cross-country data set of Consensus forecasts. Whereas previous research has documented that forecast disagreement is increasing in the level of positive inflation outcomes, we uncover a U-shaped relationship when deflations are included, such that forecast disagreement rises with the absolute levels of both inflation and deflation. We show that neither information frictions, nor macroeconomic factors that correlate with forecast disagreement, explain its increase during deflations. Instead, our results are consistent with forecasters having heterogeneous views about the inflation process during deflations, as expectations in the left-tail of the forecast distribution shift down. Econometric evidence indicates that such shifts have adverse consequences for real activity.

Our results suggest that the monetary policy framework, in particular the ability of an inflation targeting regime to provide a strong nominal anchor, can help reduce heterogeneous expectations and thus forecast disagreement during deflations. Central bank communication is a related factor that could potentially affect the degree of disagreement during deflations. Given the mushrooming of techniques available to process communication, we consider this a potentially fruitful area for future research.

References

Abrigo, M and I Love (2015): "Estimation of panel vector autoregression in Stata: a package of programs", *University of Hawaii Working Paper*.

Andrade, P, E Ghysels and J Idier (2015): "Tails of inflation forecasts and tales of monetary policy", mimeo.

Andrade, P, G Gaballo, E Mengus and B Mojon (2019): "Forward guidance and heterogeneous beliefs", *American Economic Journal: Macroeconomics* 11(3), pp. 1–29.

Bachmann, R, S Elstner and E Sims (2013): "Uncertainty and economic activity: evidence from business survey data", *American Economic Journal: Macroeconomics* 5(2), pp. 217–49.

Bank of Japan (2017): "Development in inflation expectations over the three years since the introduction of quantitative and qualitative monetary easing (QQE)", October.

Benhabib, J, S Schmitt-Grohe and M Uribe (2002): "Avoiding liquidity traps", *Journal of Political Economy* 110(3), pp. 535–63.

Busetti, F, G Ferrero, A Gerali and A Locarno (2014): "Deflationary shocks and de-anchoring of inflation expectations", *Occasional Paper* no. 252, Banca d'Italia.

Capistrán, C and A Timmermann (2009): "Disagreement and biases in inflation expectations", *Journal of Money, Credit and Banking* 41(2–3), pp. 365–96.

Coibion, O and Y Gorodnichenko (2015): "Information rigidity and the expectations formation process: A simple framework and new facts", *American Economic Review* 105(8), pp. 2644–78.

Cukierman, A and P Wachtel (1979): "Differential inflationary expectations and the variability of the rate of inflation: Theory and evidence", *American Economic Review* 69(4), pp. 595–609.

Dovern, J, U Fritsche and J Slacalek (2012): "Disagreement among forecasters in G7 countries", *The Review of Economics and Statistics* 94(4), pp. 1081–1096.

Döpke, J and U Fritsche (2006): "When do forecasters disagree? An assessment of German growth and inflation forecast dispersion", *International Journal of Forecasting* 22(1), pp. 125–35.

Ehling, P, M Gallmayer, C Heyerdahl-Larsen and P Illeditsch (2018): "Disagreement about inflation and the yield curve", *Journal of Financial Economics* 127(3), pp. 459–84.

Ehrmann, M (2015): "Targeting inflation from below: how do inflation expectations behave?", *International Journal of Central Banking* 11(S1), pp. 213–249.

Faust, J and J Wright (2013): "Forecasting inflation", *Handbook of Economic Forecasting 2A*, 2-56, G Elliott and A Timmermann (eds), Elsevier, Amsterdam

Fleckenstein, M, F Longstaff and H Lustig (2017): "Deflation risk", *Review of Financial Studies* 30(8), pp. 2719–60.

Gerlach, S (2007): "Interest rate setting by the ECB, 1999-2006: Words and deeds", *International Journal of Central Banking* 3(3), pp. 1–45.

Glas, A and M Hartmann (2016): "Inflation uncertainty, disagreement and monetary policy: Evidence from the ECB Survey of Professional Forecasters", *Journal of Empirical Finance* 39(B), pp. 215–228.

Hastie, T and R Tibshirani (1990): "Generalized Additive Models", *Monographs on Statistics and Applied Probability* 43, Chapman & Hall.

Hofmann, B and B Bogdanova (2012): "Taylor rules and monetary policy: A global "Great Deviation"?", *BIS Quarterly Review*, September, pp. 37–49.

Huizinga, J (1993): "Inflation uncertainty, relative price uncertainty, and investment in U.S. manufacturing", *Journal of Money, Credit and Banking* 25(3), pp. 521–549.

International Monetary Fund (2016): "Global disinflation in an era of constrained monetary policy", *World Economic Outlook*, Chapter 3, October, pp. 121–70.

Kenny, G and J Dovern (2017): "The long-term distribution of expected inflation in the euro area: what has changed since the great recession?", *ECB Working Paper* no. 1999.

Krippner, L (2016): "Documentation for measures of monetary policy", available at https://www.rbnz.govt.nz/-/media/ReserveBank/Files/Publications/Research/additional-research/leo-krippner/5892888.pdf

Leduc, S, K Sill and T Stark (2007): "Self-fulfilling expectations and the inflation of the 1970s: evidence from the Livingston Survey", *Journal of Monetary Economics* 54, pp. 433–59.

Mackowiak, B and M Wiederholt (2009): "Optimal sticky prices under rational inattention", *American Economic Review* 99 (3), pp. 769–803.

Mankiw, N G and R Reis (2002): "Sticky information versus sticky prices: A proposal to replace the New Keynesian Phillips curve", *The Quarterly Journal of Economics* 117(4), pp. 1295–1328.

Mankiw, N G, R Reis and J Wolfers (2004): "Disagreement about inflation expectations", in: M Gertler and K Rogoff (eds), *NBER Macroeconomics Annual 2003*, pp. 209–48.

Mehra, Y and C Herrington (2008): "On the sources of movements in inflation expectations: A few insights from a VAR model", *Federal Reserve Bank of Richmond Economic Quarterly* 94(2), pp. 121–46.

Mehrotra, A and J Yetman (2018): "Decaying expectations: what inflation forecasts tell us about the anchoring of inflation expectations", *International Journal of Central Banking* 14(5), pp. 55–101.

Natoli, F and L Sigalotti (2018): "Tail co-movement in inflation expectations as an indicator of anchoring", *International Journal of Central Banking* 14(1), pp. 35–71.

Nishizaki, K, T Sekine and Y Ueno (2014): "Chronic deflation in Japan", *Asian Economic Policy Review* 9(1), pp. 20–39.

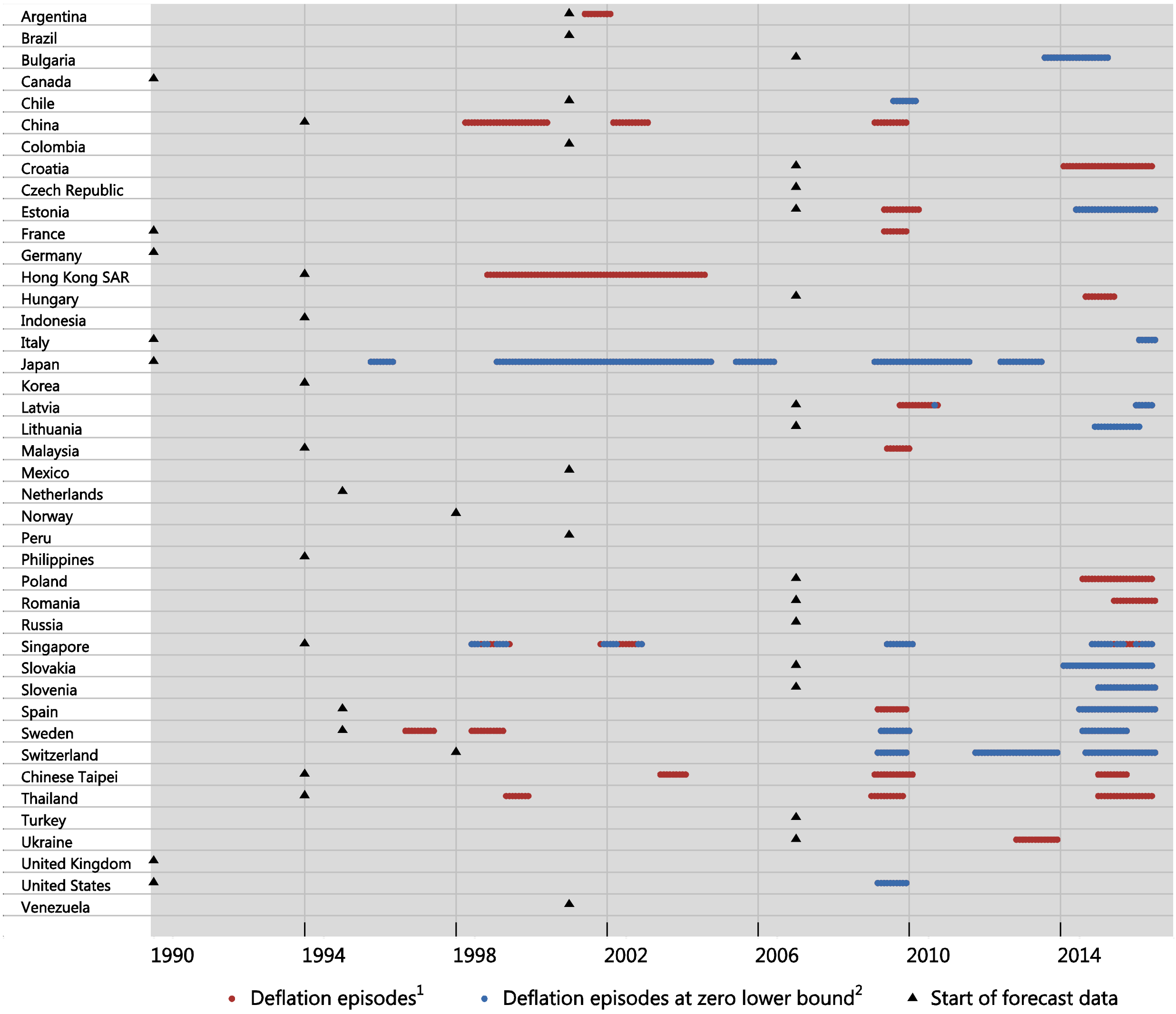
Patton, A and A Timmermann (2010): "Why do forecasters disagree? Lessons from the term structure of cross-sectional dispersion", *Journal of Monetary Economics* 57, pp. 803–20.

Siklos, P (2013): "Sources of disagreement in inflation forecasts: An international empirical investigation", *Journal of International Economics* 90(1), pp. 218–31.

Sims, C (2003): "Implications of rational inattention", *Journal of Monetary Economics* 50(3), pp. 665–90.

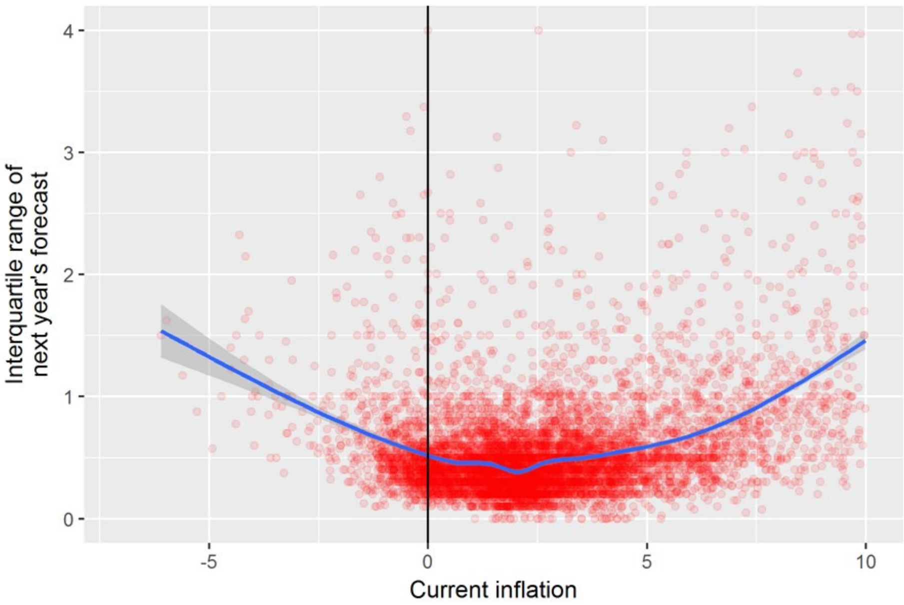
Wiederholt, M (2015): "Empirical properties of inflation expectations and the zero lower bound", mimeo.

Woodford, M (2003): "Imperfect common knowledge and the effects of monetary policy", in P Aghion et al (eds.), *Knowledge, Information and Expectations in Modern Macroeconomics: In Honor of Edmund S. Phelps*, Princeton University Press.



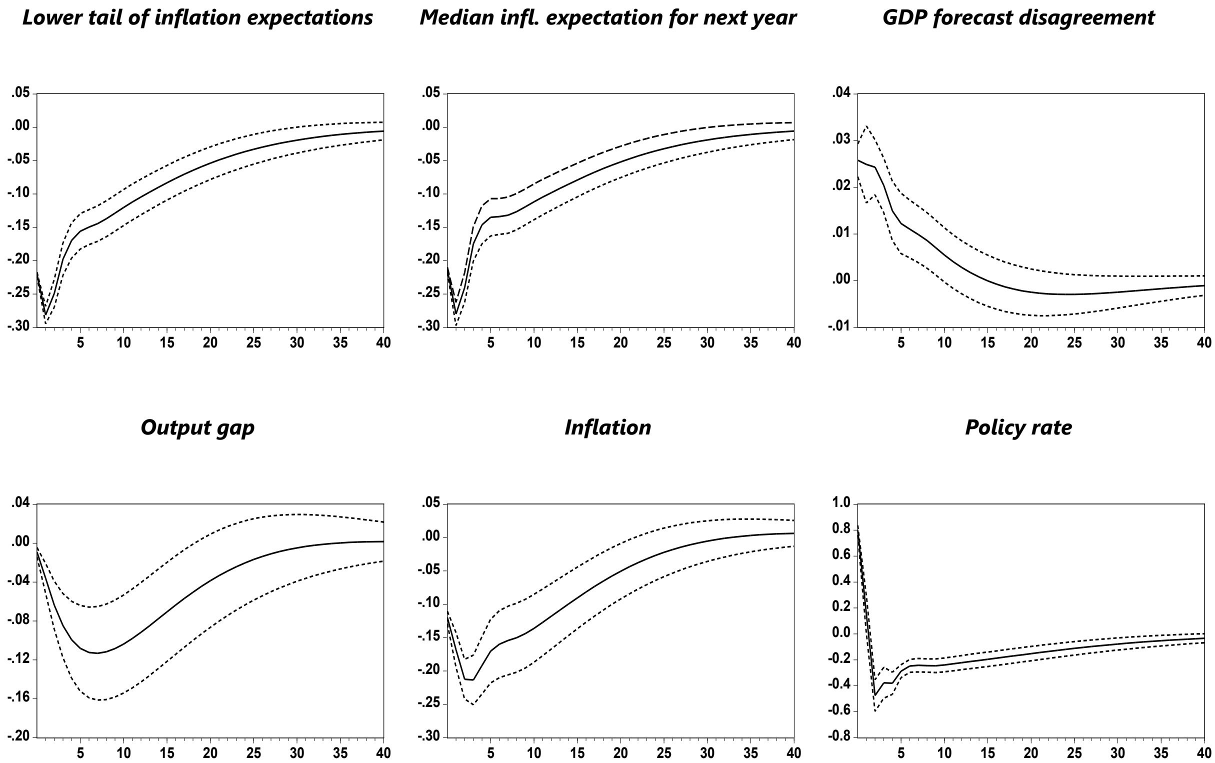
Graph 1: Deflation episodes

Notes: [1] Negative headline consumer price inflation (CPI, year on year) for at least six consecutive months. A deflation episode ends if subsequently at least three consecutive months of positive inflation rates occur. [2] Deflation episodes occurring when policy rates are at or below 0.5 per cent. If policy rate data are not available, money market interest rate data are used.



Graph 2: Inflation forecast disagreement and current inflation outcomes

Notes: The graph shows month-forecaster observations for current inflation and the interquartile range of next year's forecast. The blue line results from a generalised additive model between the two variables. The shaded area is the 95% confidence interval.



Graph 3: Response of variables to negative shock in left-hand tail of forecast distribution

Notes: The titles of the panels show the name of the response variable. The underlying shock is a negative one standard deviation shock to the 25th percentile of inflation expectations. The numbers on the x-axis denote the number of months that have passed from the shock.

Variable	(1)	(2)	(3)	(4)	(5)
$E_{c,t}(\pi_{c,t+12}^{pos})$	0.273**	0.287**	0.276**	0.537**	0.518**
	(0.124)	(0.127)	(0.124)	(0.223)	(0.219)
$E_{c,t}(\pi_{c,t+12}^{neg})$	0.0634	0.0633	0.0419	0.0546	0.0279
	(0.126)	(0.156)	(0.136)	(0.202)	(0.173)
$D_{c,\,t}^{defl}$	0.430**	0.373**		0.689**	
	(0.195)	(0.166)		(0.280)	
$D_{c,\,t}^{High\,infl}$	-0.470*	-0.425*	-0.427*	-0.730*	-0.734*
	(0.266)	(0.236)	(0.243)	(0.408)	(0.419)
$infl\ gap_{c,t}^{pos}$		0.0248	0.0330	0.0118	0.0293
		(0.0234)	(0.0245)	(0.0376)	(0.0389)
$infl\ gap_{c,t}^{neg}$		-0.165**	-0.189**	-0.261**	-0.311**
		(0.0660)	(0.0751)	(0.109)	(0.126)
$(infl\ gap_{c,\,t})^2$		-0.00665**	-0.00773**	-0.00991*	-0.0123*
		(0.00326)	(0.00365)	(0.00563)	(0.00649)
$y_{c,\,t}^{gap}$	-0.0560**	-0.0590***	-0.0610***	-0.119***	-0.123***
	(0.0211)	(0.0202)	(0.0208)	(0.0367)	(0.0377)
$abs(\Delta\pi_{c,t})$	0.113*	0.0791*	0.0784*	0.0674	0.0648
	(0.0640)	(0.0446)	(0.0457)	(0.0740)	(0.0763)
$(\Delta\pi_{c,t})^2$	-0.00929	-0.00771	-0.00733	0.0237	0.0252
	(0.0134)	(0.0103)	(0.0100)	(0.0283)	(0.0278)
$abs(\Delta neer_{c,t})$	4.247***	3.603**	3.806**	10.66***	11.05***
	(1.557)	(1.739)	(1.610)	(2.376)	(2.523)
$i_{c,t}$	0.0422*	0.0444*	0.0458*	0.0913*	0.0940*
	(0.0216)	(0.0222)	(0.0233)	(0.0465)	(0.0485)
$(\Delta i_{c,t})^2$	7.23e-06***	5.80e-06**	6.28e-06**	1.16e-05**	1.26e-05**
	(2.61e-06)	(2.34e-06)	(2.51e-06)	(4.48e-06)	(4.83e-06)
$recession_{c,\,t}$	5.13e-05	-0.00759	-0.00740	-0.0152	-0.0139
	(0.0293)	(0.0281)	(0.0288)	(0.0573)	(0.0586)
$mp\_contraction_{c,\,t}$	0.0432	-0.0531	-0.0525	-0.105	-0.107
	(0.0304)	(0.0487)	(0.0457)	(0.0953)	(0.0929)
$D_{c,\,t}^{defl\,long}$			0.334**		0.641**
			(0.146)		(0.277)
Obs	7,860	7,860	7,860	7,856	7,856
R-squared	0.538	0.562	0.554	0.649	0.641

Table 1: Forecast disagreement

Notes: Dependent variable is the interquartile range of expected inflation over the next 12 months (Columns (1) to (3)) or the interdecile range (Columns (4) and (5)). Robust standard errors clustered by country and time in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Columns (1), (2) and (4) show results with deflation dummies that comprise all deflations; Columns (3) and (5) include only persistent deflations. All models include country and time fixed effects.

Variable	(1)	(2)
$(E_t\pi_{t+h} - E_{t-1}\pi_{t+h})$	0.649	
	(0.397)	
$D_{c,t}^{defl} \times (E_t\pi_{t+h} - E_{t-1}\pi_{t+h})$		0.141
		(0.467)
$D_{c,t}^{high\ infl} \times (E_t\pi_{t+h} - E_{t-1}\pi_{t+h})$		-0.202
		(0.327)
$D_{c,t}^{other} \times (E_t\pi_{t+h} - E_{t-1}\pi_{t+h})$		0.970***
		(0.381)
Obs	6,953	6,953
R-squared	0.142	0.351

Table 2: Estimates for information frictions

Notes: Dependent variable is the ex-post forecast error: $\pi_{c,t+h} - E_t\pi_{c,t+h}$. Robust standard errors clustered by country in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. All models include country fixed effects. In addition to the coefficients shown, the model in Column (2) includes separate constant terms for deflations, high inflations and "other" periods.

	(1)	(2)	(3)	(4)
Variable	25th pctile	25th pctile	75th pctile	75th pctile
$E_{c,t}(\pi^{pos}_{c,t+12})$	0.883***	0.886***	1.168***	1.162***
	(0.0387)	(0.0379)	(0.0890)	(0.0870)
$E_{c,t}(\pi^{neg}_{c,t+12})$	0.934***	0.934***	1.001***	0.981***
	(0.0546)	(0.0460)	(0.103)	(0.0904)
$D^{defl}_{c,\,t}$	-0.151***		0.221*	
	(0.0523)		(0.116)	
$D^{High\,infl}_{c,\,t}$	0.149**	0.150**	-0.274	-0.275
	(0.0681)	(0.0703)	(0.169)	(0.173)
$infl\ gap^{pos}_{c,t}$	-0.00621	-0.00963	0.0176	0.0224
	(0.00939)	(0.00942)	(0.0156)	(0.0167)
$infl\ gap^{neg}_{c,t}$	0.0605***	0.0708***	-0.104**	-0.118**
	(0.0201)	(0.0227)	(0.0464)	(0.0528)
$(infl\ gap_{c,\,t})^2$	0.00218*	0.00263**	-0.00445**	-0.00508**
	(0.00119)	(0.00130)	(0.00212)	(0.00240)
$y^{gap}_{c,\,t}$	0.0251***	0.0260***	-0.0357**	-0.0368**
	(0.00708)	(0.00733)	(0.0134)	(0.0138)
$abs(\Delta\pi_{c,t})$	-0.0239	-0.0238	0.0582*	0.0576*
	(0.0160)	(0.0167)	(0.0301)	(0.0305)
$(\Delta\pi_{c,t})^2$	-0.00152	-0.00160	-0.00957	-0.00929
	(0.00361)	(0.00350)	(0.00779)	(0.00765)
$abs(\Delta neer_{c,t})$	-2.084***	-2.159***	1.578	1.704
	(0.525)	(0.566)	(1.649)	(1.530)
$i_{c,t}$	-0.0143	-0.0148	0.0298**	0.0308**
	(0.00943)	(0.00977)	(0.0131)	(0.0139)
$(\Delta i_{c,t})^2$	-3.71e-06***	-3.93e-06***	2.06e-06	2.31e-06
	(8.68e-07)	(9.16e-07)	(1.50e-06)	(1.62e-06)
$recession_{c,\,t}$	0.00124	0.000760	-0.00743	-0.00768
	(0.0123)	(0.0124)	(0.0165)	(0.0170)
$mp\_contraction_{c,\,t}$	0.0120	0.0134	-0.0409	-0.0390
	(0.0198)	(0.0191)	(0.0299)	(0.0275)
$D^{defl\,long}_{c,\,t}$		-0.152***		0.183*
		(0.0547)		(0.0941)
Obs	7,860	7,860	7,860	7,860
R-squared	0.992	0.992	0.981	0.980

Table 3: Tails of forecast distribution and deflation

Notes: Dependent variable is the 25th percentile (Columns (1) and (2)) or the 75th percentile of the forecast distribution of inflation over the next 12 months (Columns (3) to (4)). Robust standard errors clustered by country and time in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Columns (1) and (3) show results from estimations where the deflation dummy includes all deflations; Columns (2) and (4) include only persistent deflations. All models include country and time fixed effects.

	(1)	(2)	(3)	(4)	(5)	(6)
Variable	IT	Non-IT	IT	Non-IT	Excl ZLB	Excl ZLB
$E_{c,t}(\pi^{pos}_{c,t+12})$	0.0901***	0.332**	0.0908***	0.321**	0.269**	0.262**
	(0.0241)	(0.141)	(0.0248)	(0.138)	(0.104)	(0.100)
$E_{c,t}(\pi^{neg}_{c,t+12})$	-0.451*	0.197	-0.421	0.179	0.00555	-0.0211
	(0.254)	(0.181)	(0.276)	(0.162)	(0.150)	(0.113)
$D^{defl}_{c,t}$	-0.0119	0.416**			0.463**	
	(0.0517)	(0.175)			(0.202)	
$D^{High\,infl}_{c,t}$	-0.00188	-0.628*	-0.00319	-0.630*	-0.296*	-0.302*
	(0.0280)	(0.322)	(0.0264)	(0.332)	(0.150)	(0.155)
$infl\ gap^{pos}_{c,t}$	-0.0343*	0.0907*	-0.0333*	0.0961*	0.0297*	0.0395**
	(0.0181)	(0.0519)	(0.0164)	(0.0519)	(0.0164)	(0.0183)
$infl\ gap^{neg}_{c,t}$	-0.0353	-0.226**	-0.0341	-0.261***	-0.109***	-0.137***
	(0.0238)	(0.0828)	(0.0229)	(0.0898)	(0.0374)	(0.0454)
$(infl\ gap_{c,t})^2$	0.00839**	-0.00941**	0.00811***	-0.0110**	-0.00408**	-0.00531***
	(0.00304)	(0.00373)	(0.00286)	(0.00406)	(0.00165)	(0.00195)
$y^{gap}_{c,t}$	-0.0126	-0.0586***	-0.0129	-0.0607***	-0.0410***	-0.0432***
	(0.0144)	(0.0180)	(0.0145)	(0.0179)	(0.0139)	(0.0148)
$abs(\Delta\pi_{c,t})$	0.0692***	0.0840	0.0690***	0.0757	0.0431	0.0403
	(0.0210)	(0.0681)	(0.0206)	(0.0665)	(0.0338)	(0.0355)
$(\Delta\pi_{c,t})^2$	-0.0111***	-0.00997	-0.0111***	-0.00907	-0.00341	-0.00286
	(0.00370)	(0.0142)	(0.00366)	(0.0138)	(0.00978)	(0.00944)
$abs(\Delta neer_{c,t})$	1.033	2.849	1.034	3.120	4.023***	4.187***
	(0.755)	(4.173)	(0.755)	(3.986)	(1.373)	(1.314)
$i_{c,t}$	0.00311	0.0626***	0.00314	0.0641**	-0.0286*	-0.0268
	(0.00880)	(0.0222)	(0.00885)	(0.0237)	(0.0166)	(0.0161)
$(\Delta i_{c,t})^2$	0.0147	6.01e-06***	0.0147	6.44e-06***	0.00477***	0.00482***
	(0.0139)	(2.18e-06)	(0.0139)	(2.33e-06)	(0.000893)	(0.000898)
$recession_{c,t}$	-0.00323	0.0362	-0.00342	0.0372	0.0262	0.0296
	(0.0177)	(0.0273)	(0.0173)	(0.0274)	(0.0221)	(0.0220)
$mp\_contraction_{c,t}$	-0.0213	0.00570	-0.0236	0.00496	0.0785**	0.0760**
	(0.0299)	(0.0433)	(0.0325)	(0.0417)	(0.0324)	(0.0339)
$D^{defl\,long}_{c,t}$			0.0180	0.352**		0.503***
			(0.0750)	(0.150)		(0.183)
Obs	3,195	4,653	3,195	4,653	6,532	6,532
R-squared	0.449	0.635	0.449	0.626	0.656	0.651

Table 4: Forecast disagreement and monetary policy

Notes: Dependent variable is the interquartile range of expected inflation over the next 12 months. Robust standard errors clustered by country and time in parentheses. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Columns (1), (2) and (5) show results from estimations where the deflation dummy includes all deflations; Columns (3), (4) and (6) include only persistent deflations. All models include country and time fixed effects.