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Forecast Disagreement and the Inflation Outlook: New International Evidence

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Abstract

Short-term inflation forecast disagreement in nine advanced economies is examined. Domestic versus global determinants are considered. Disagreement is evaluated vis-à-vis several benchmarks. An indicator of central bank communication is added. A quasi-confidence interval for disagreement is also estimated. Disagreement is sensitive to the chosen group of forecasters examined. The GFC led to a spike in inflation forecast disagreement that was short- lived. Forecast disagreement can be reasonably seen as a variable that can change abruptly from high to low disagreement regimes. Furthermore, low and high levels of forecast disagreement can coexist with high levels of uncertainty. There is a global component in forecast disagreement but domestic determinants appear to be of first order importance. There appear to be relatively few indications that forecasts are coordinated with those of central banks with the possible exception of professional forecasters. Finally, central bank communication appears to play an only small role in explaining forecast disagreement.

Keywords: forecast disagreement; inflation; central bank communication
JEL classification: E52, E58, C53

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1. Introduction

The behavior of inflation worldwide over the past decade or so, especially since the onset of the 'Global Financial Crisis' (GFC), has arguably been the focus of intense debate, especially in monetary policy circles. The profession, as well as central bankers, remain divided over whether the dynamics of inflation are reasonably well explained by a link with past and expected inflation together with the degree of economic slack (e.g., see Mavroeidis, Plagborg-Møller and Stock 2014). More broadly, the factors believed to influence inflation have also waxed and waned over the years with exchange rates, changes in liquidity, the choice of policy regimes and, more recently, economic slack or weak wage growth among the principal candidates used to explain low inflation and, by implication, expectations that inflation will continue to remain low.

A common feature in much of the extant empirical work that attempts to capture the role of expectations is the reliance on point forecasts such as ones published by professional forecasters, collected from household or firm surveys, public institutions or agencies and, more recently, by central banks. Typically, however, studies continue to rely on forecasts from a single source. This can be useful when attempting to understand the forecasting process as in Capistrán and Timmermann (2008). Examining Consensus forecasts the authors posit an asymmetric cost function so that forecast errors are penalized differently depending upon whether they are positive or negative.

However, unless the policy makers, for example, consider forecasts from a wide variety of sources a more representative interpretation of dispersion about the outlook for inflation may well be ignored. Indeed, it is precisely the variety of explanations concerning the formation of expectations that partly motivates this study. This ranges from Mankiw and Reis' (2002) sticky information hypothesis, wherein information about macroeconomic fundamentals spreads slowly (also, see Carroll 2003) to Sims' rational inattention where agents do not always react to new information that is observed.

Inasmuch as the events of the past several years amounted to a wake-up call to seek a better understanding of the myriad of sources that are able to explain differences in expectations it is

essential that policy makers examine the determinants of inflation forecast disagreement. This paper investigates the evolution and sources of diversity of views about the short-term inflation outlook and highlights the fact that various forecasters views can and do diverge over time for different reasons.

Beyond the focus on point forecasts naturally there is also interest in the accuracy and efficiency of forecasts. In particular, considerable attention has recently turned to the relative performance of central bank forecasts. While monetary authorities generally perform well in such contests[1] (e.g., see IEO 2014 and Ng and Wright 2013, and references therein), the results are sensitive to samples, testing procedures, definitions, among other considerations that influence such exercises. Recent post-mortems of the forecasting record of central banks (e.g., Stockton 2012, Alessi et. al. 2014) have acquitted them of performing much worse than their professional counterparts in the private sector. Nevertheless, the extant research does point to a need for central banks to demonstrate more introspection about their forecasting performance.

Forecast accuracy is often established as a condition that holds on average over a particular sample period as opposed to each and every period of time.[2] Yet, many forecasts, especially ones that are published by public agencies, professional forecasters, and central banks, face a trade-off between accuracy and the underpinnings of such forecasts, that is, their logical consistency and plausibility. Otherwise, forecasts risk being poorly communicated with deleterious consequences for the reputation of the forecaster (e.g., see Drehmann and Juselius 2013, Zellner 2002). It comes as no surprise then that 'judgment' almost always plays a role.

[1] Bloomberg Business is the latest in the growing number of external assessments and analyses of central bank forecasting performance. See http://www.bloomberg.com/news/articles/2015-07-07/here-are-central-banks-who-have-been-getting-it-right-and-wrong.

[2] While some forecasters can be persistently better than others it is never the case that one forecaster routinely dominates others through time. Indeed, forecasts based on household or business surveys can do quite well even if the individuals surveyed seemingly have comparatively little expertise (e.g., see Tetlock 2005).

This is particularly the case for forecasts published by central banks. Therefore, while useful, the exclusive emphasis on forecast accuracy can be misplaced.[3]

Disagreement over the inflation outlook is critical since the larger the dispersion of inflation expectations around some central value the greater the likelihood of a loss of credibility in the authorities accountable for delivering an inflation target, or some promised inflation performance (e.g., Bauer 2015, Bordo and Siklos 2015). There continues to be considerable debate about our understanding of the dynamics of realized inflation and questions have also been raised about the desirability of anchoring of expectations to some inflation goal (e.g., inter alia, Coibion and Gorodnichenko 2015, Bernanke 2007, Constâncio 2015, Kamada et. al. 2015, Strohsal and Winkelmann 2015).[4] Therefore, investigating forecast disagreement ought to provide some insights into forecasters' sensitivity to short-term shocks. For example, whereas central banks might 'look through' the effects of one-off supply or uncertainty shocks (e.g., oil prices or economic policy uncertainty) households and even professional forecasters might not (e.g., Lahiri et.al. 2015, Reifschneider and Tulip 2007, Boero et.al. 2014, Glas and Hartmann 2015). Once again one is led to examining forecast disagreement for the necessary clues.

Admittedly, a difficulty here is that the horizon over which these expectations apply plays an important role. Monetary policy still acts with long and variable lags. Although central bankers tend to think that current policy decisions can take up to two years to take full effect some view

[3] It is well-known, for example, that the mean squared prediction error (MSPE) between the best and the worst forecast need not be statistically significantly different from each other. Hence, forecasting accuracy is not the only characteristic of a forecast that matters.

[4] One should not underestimate the importance central bankers place on anchoring inflation expectations. For example, Yellen (2015) argues "…the presence of well-anchored inflation expectations greatly enhances a central bank's ability to pursue *both* of its objectives--namely, price stability and full employment." Kuroda (2015) goes so far as to suggest that: "If Japan can successfully overcome deflation and re-anchor inflation expectations, as it is now in the process of doing, this will represent a major step in monetary policy history not only in Japan but also around the globe." Draghi (2014) also refers to the importance of anchoring in the context of a decline in eurozone inflation: "The firm anchoring of inflation expectations is critical under any circumstances, as it ensures that temporary movements in inflation do not feed into wages and prices and hence become permanent. But it is even more critical in the circumstances we face today." Carney (2015a) explains why an anchor matters in the following terms: "Those expectations matter as they feed into the wage and price setting processes that ultimately determine inflation. That is why central banks are keenly alert to the possibility that low inflation could de-anchor medium-term inflation expectations, increasing the persistence of inflation."

the appropriate horizon to be much longer.[5] I return to this issue below as data limitations hamper our ability to estimate measures of forecast disagreement beyond the short-term.

Events of the past few years have also led to the introduction of concepts such as economic policy uncertainty (Baker et. al. 2015) wherein conflicting signals from a wide variety of sources can contribute to raising general uncertainty about the current, and expected, state of the economy. The dispersion of forecasts, albeit relying only on the Survey of Professional Forecasters, is one of the components of their index.[6] Sources of disagreement over the outlook stems from different weights forecasters might apply to global versus domestic shocks. This has led some research to place relatively greater emphasis on global over other determinants (inter alia, see Borio and Filardo 2007, Ciccarelli and Mojon 2010).

While realized inflation across many parts of the world may look similar, leading in some cases to deceptively similar point inflation forecasts (see, however, below), in reality, differences in the stance of monetary policy, owing in no small part to the spread of unconventional monetary policy, are arguably much larger (e.g., Carney 2015). Divergences in monetary policy could become more apparent from an analysis of forecast disagreement over time.

Just when arguments in favor of central bank transparency seemed to gain universal acceptance along came the theoretical possibility that credible central banks could create conditions wherein private sector agents would coordinate their beliefs with those of the monetary authorities (Morris and Shin 2002).[7] Even if this outcome is unlikely to emerge in practice (Svensson 2006) an analysis of disagreement may help identify some of the differences in dispersion of private sector between household forecasts and those of the central bank.

Since 2008 in the United States, and later in several other advanced economies, the fall in central bank policy rates to the zero lower bound has also meant that the outlook is

[5] There is no precise definition of the 'long-run' but Yellen, in the 16 January 2009 FOMC transcripts, is quoted as saying that the time horizon is longer than six years.

[6] Indeed, forecast dispersion has occasionally also been mentioned as a possible leading indicator of an impending economic slowdown or possible looming crisis (Mackintosh 2015).

[7] The notion that the forecasts of others, not just those published by central banks, may have macroeconomic effects is not new (e.g., see Townsend 1983).

incompletely communicated via only forecasts. Instead, there has been increased emphasis and importance placed on what central bankers say (or write). Unlike point forecasts or the 'fan charts' that have become the staple of many central bank monetary policy reports there is greater room for interpretation about the meaning and intent of central banks statements that accompany their decisions and deliberations. As a result, there may be scope for disagreement in the inflation outlook to be influenced by the content of announcements from the monetary authority when there is little prospect for change in the policy rate.

This paper examines short-term sources of inflation forecast disagreement in nine advanced economies, and takes account of the role of domestic versus global factors among other determinants. Four other contributions are made. Previously, the series and scope of forecasts generated by most central banks were too brief to be reliably used as benchmarks for evaluating forecast disagreement. This paper remedies the situation as well as investigates disagreement vis-à-vis other potential benchmarks (e.g., survey-based forecasts or professional forecasts). After all, there is no reason why the ideal measure of forecast disagreement should be evaluated relative only to the mean of all available forecasts as is traditionally the case.[8] Second, a set of indicators of the content of central bank announcements is considered that is inspired from widely used metrics in the psychology and political science literatures. Because of the dramatic turn of events since 2008 we may also evaluate how the introduction of unconventional monetary policies influence inflation forecasts and, consequently, forecast disagreement. Of course, these events are part and parcel of the global factors that have been identified as having impact inflation that may also be captured by other proxies.[9] Third, we interpret all forecasts as being generated from possibly mis-specified 'models'. This enables us to adapt an idea from the model confidence set approach (Hansen et.al. 2011) to obtain a quasi-confidence interval for inflation forecast disagreement. Finally, we posit that (some) forecasters may revise their outlook as data, especially for the output gap, are revised over time. Accordingly, I include the accumulated revisions in quarterly vintages of the output gap.

[8] The median is another option, of course. However, examination of the individual forecasts suggests that the mean and median are not statistically different from each in the overwhelming number of cases.

[9] Haldane (2015) argues that the succession of crises since 2007 continue to generate macroeconomic surprises prompting central banks, in particular, to revise their forecasts.

The rest of the paper is organized as follows. The next section summarizes the relevant literature. Section 3 provides a working definition of forecast disagreement and describes the sources of data. Section 4 outlines the methodology used to investigate the determinants of inflation forecast disagreement. Section 5 describes the empirical results. The final section concludes.

2. Related Literature[10]

Glas and Hartmann (2015) consider the tension between forecast disagreement and uncertainty and rely on data from the Survey of Professional Forecasters (SPF) conducted by the European Central Bank (ECB) to show that rising inflation uncertainty typically precedes a deterioration of forecasting performance while disagreement is primarily determined by the state of the macroeconomy. Bachmann et. al. (2013) also report, based on the German Ifo[11] Survey of Business Climate, that forecast errors are correlated with forecast dispersion and, unlike some studies to be cited below, conclude that uncertainty and disagreement may be treated as proxies for each other.

At a theoretical level the link between uncertainty and disagreement has also attracted considerable interest.[12] Lahiri et. al. (2015) make the case that uncertainty represents one element of disagreement but it is not the only one. They then develop what they refer to as theoretically sound measures of disagreement and uncertainty but assume that forecast errors are stationary. The empirical evidence is far from reaching a consensus on the time series properties of forecast errors.[13] Nevertheless, the authors are correct in pointing out that there exists a common component across forecasts or forecast errors. Data availability and data structure also play a role in the ability to separately measure forecast uncertainty and

[10] Siklos (2013) provides a brief survey of the literature that deals with forecast disagreement, its measurement (also see section 3 below) that is up to date until 2010. Below I focus on the evidence and issues that have received attention since then.

[11] The Institute for Economic Research housed at the University of Münich.

[12] This development has partly been encouraged, as noted earlier, by the creation of an index of economic policy uncertainty. See Baker et. al. (2015) and http://www.policyuncertainty.com/.

[13] Although such a conclusion is more likely to be reached for professional and central bank forecasts than for households' forecasts of inflation. See, for example, Ng and Wright (2013), IEO (2014) and Mavroeidis et. al. (2014) who review the issues.

disagreement as argued in Boero et. al. (2014).[14] They conclude, using data from the Bank of England's Survey of External Forecasters, that forecast disagreement can be useful to proxy uncertainty but only when these measures disagreement exhibits large changes. Clements and Galvão (2014) propose a distinction between ex ante and ex post measures of uncertainty, the latter being determined by realized data while former is determined by models or probabilistic considerations, and conclude, for example, that ex ante tracks well ex post uncertainty when the forecast horizon is short.

Jurado et. al. (2015) also consider the dispersion versus uncertainty concepts with the objective of empirically identifying, for the U.S., salient uncertainty 'events'. As far as the sample covered by the present study is concerned the only such event take place in the years 2007 to 2009 which marks the period of the Global Financial Crisis (GFC). Nevertheless, they also find that uncertainty rises in recession as well as when the forecast horizon lengthens. The authors interpret uncertainty as the common latent factor among individual measures of uncertainty.

Surveying empirical studies that examine varieties of forecasts it is still the case that research tends to rely on U.S. data. This is not surprising given the number of published forecasts and the span of available data that can be brought to bear on the problem being investigated (also see below). Typically, investigators will resort to SPF, or forecasts published by the Federal Reserve (i.e., Greenbook or Federal Open Market Committee (FOMC)), and occasionally Blue Chip or a survey (e.g., University of Michigan Survey).

While accuracy and efficiency of forecasts continue to be the focus of some studies (e.g., Chang and Hanson 2015, IEO 2014) attention has turned in recent years to asking whether the data are also informative about the forecaster's knowledge about how monetary policy functions and whether their forecasts are consistent with core economic relations (e.g., a Taylor rule, a New Keynesian Phillips curve). Studies in this vein include Carvalho and Nechio (2014) who report that households' expectations are consistent with a simple Taylor rule type specification but not some of the other macroeconomic relations they examine. Dräger (2015) considers the

[14] For example, details about the probabilistic structure that underlies forecasters' outlook play a role (i.e., the definition of the bins, or categories, expectations fall into).

case of Swedish households while Dräger et. al. (2015) explore a range of U.S.-based forecasts and find that households' forecasts are less consistent with theoretical propositions from macroeconomics than ones produced by professional forecasters. Kamada et. al. (2015), relying on Japanese data, report that expectations differ according to whether the household is or is not well-informed, based on an Opinion Survey conducted by the Bank of Japan.

Other themes that have attracted attention recently include the role that news plays in influencing expectations. Bauer (2015), for example, uses the Blue Chip and SPF forecasts to estimate their sensitivity to macroeconomic news and concludes that a policy of targeting inflation contributes to reducing the volatility of inflation expectations and, therefore, represents an effective anchoring device.[15] Anchoring of inflation expectations among households in Japan is the focus of the studies by Kamada et. al. (2015), and Nishiguchi et. al. (2014). These studies report that central bank announcements (e.g., the introduction of quantitative and qualitative easing or QQE) can shift the distribution of expectations towards the announced objective.[16] Central bank communication also figures prominently in Dräger et. al. (2015). They rely on this signal as a device to ascertain how households versus professionals respond to such signals. The authors conclude that while households' expectations formation processes are generally less consistent with macroeconomic theory than those employed by professional forecasters efforts by central banks to become more transparent have narrowed the gap between forecasters. Strohsal et. al. (2015), and Strohsal and Winkelmann (2015), also consider the anchoring issue and the role of news effects and reach the strong conclusion, in the U.S. case, that inflation was almost "perfectly" anchored since 2004. Other than in 2008 the central banks investigated[17] were able to control inflation expectations.

Coibion and Gorodnichenko (2015) argue that the anchoring of expectations is a double-edged sword since a sharp change in, say, commodity prices (e.g., oil) ought to lead to a revision of

[15] To the extent that more individual's expectations become anchored this ought to reduce forecast disagreement. See Badarinza and Buchmann (2009) for evidence from the Eurozone.

[16] Shortly after the appointment of Governor Kuroda at the Bank of Japan the central bank announced its determination to meet a 2% inflation target. The original intention was to achieve the target within 2 years. However, the sharp drop in oil prices in 2014 has forced the Bank to delay meeting this objective.

[17] Economies examined were the U.S., the Eurozone, U.K., and Sweden.

expectations, even if only for a short time, otherwise the risk of deflation in an already low inflation environment would be much greater. Hence, the U.S. economy, where the 2008-2009 financial crisis originated, may well have benefited from the absence of perfect expectations anchoring among households.[18] Nevertheless, it is also possible that this conclusion holds only for U.S. data only as the evidence for Japan in Nishiguchi et. al. (2014) and Eurozone data reported in Bachmann et. al. (2013) would seem to contradict the claim made by Coibion and Gorodnichenko (2015).

The anchoring of inflation expectations is also relevant for monetary policy more generally especially since an increasing number of central banks drove their policy rates near to, or reached, the zero lower bound (ZLB), as well as introducing additional monetary policy loosening measures generally referred to as quantitative easing (QE). In particular, the current constellation of global economic slack and persistently low inflation[19] would seem to offer the opportunity for monetary policy to become "irresponsible" by permitting observed and expectations of inflation to rise so that they are safely away from deflation (e.g., see Woodford 2012). Others counter that a central bank's reputation is at stake and, consequently, an un-anchoring of expectations might result (e.g., Koo 2009). As noted above the goal of anchoring inflation expectations is possibly the most cherished one among central bankers next to the maintenance of financial stability especially following the events since 2007. It is important to stress, as noted in the introduction, there is no consensus on the horizon over which expectations ought to be anchored.

What about the influence central bank forecasts on the forecasts of others? As noted above, the theoretical predictions of Morris and Shin (2002) are difficult to test directly and, in any case, have been criticized by others as unrealistic (e.g., Svensson 2006). The literature that investigates the performance of central bank forecasts is generally restricted to the U.S. experience for reasons already stated though studies referred to earlier for the U.K., Sweden,

[18] Their evidence is primarily based on the University of Michigan Survey data. A general problem with some survey data is that inflation is often not clearly defined and participants must often respond with a forecast to the nearest integer.

[19] This is the so-called "Dog That Didn't Bark" (IMF 2013) that continues to pre-occupy policy makers.

and the Eurozone, notably, are now also available. Other than Siklos (2013) only Hubert (2015) provides recent evidence for Sweden, U.K., Canada, Japan and Switzerland.[20]

Central bank communication is, of course, a two-way street. While the global increase in central bank transparency is well-known (Dincer and Eichengreen 2014), and has been found to reduce the dispersion of some central bank forecasts (Siklos 2013), this might be partly due to the fact that central banks also take into account the public's views about the current and future inflation outlook (Nunes 2013). Whether the public agrees with the central bank's forecast is another matter but evaluating forecast disagreement is better suited to address these questions.

3. Measuring Forecast Disagreement, Uncertainty, and Data

There is no universally agreed upon measure of inflation forecast disagreement. Inflation is defined here are the annual rate of change in a consumer price index (CPI) as this is the purchasing power indicator for which forecasts are most frequently published.[21] The results reported below consider the squared deviations measure.[22] Let d_{th}^{j} represent forecast disagreement at time *t*, over a forecast of horizon *h*, for economy *j*. Then,

$$d_{th}^{j} = \frac{1}{N_j - 1} \sum_{i=1}^{N_j} (F_{ith}^{j} - \overline{F}_{gth}^{j})^2 \qquad (1)$$

[20] That study only examines how central bank forecasts influence Consensus forecasts. Siklos (2013) considers their influence on a broader set of forecasts. Aruoba and Schorfheide (2015) also indicate that the issue whether private agents and central bank forecasts can have the appearance of being coordinated is an important one for our understanding of the dynamics of inflation.

[21] This potentially adds some 'noise' to the interpretation of the results for at least two reasons. First, some central banks (e.g., the Fed) may target a different price index (e.g., the Personal Consumption Expenditures or PCE index) while all central banks tend to be more concerned with a measure of core inflation (i.e., one that typically strips food, energy and indirect taxes). Since, as noted earlier, judgment also influences forecasts the various benchmarks considered may not be perfectly comparable.

[22] The measure used here comes closest to the one used in Lahiri and Sheng (2008) while the transformation applied yields a version that is the normalized absolute deviation of forecasts implemented by Banternghansa and McCracken (2009). Forecast disagreement is sometimes also evaluated, for example, by calculating the inter-quartile range of forecasts (e.g., Mankiw, Reis, and Wolfers (2003), Capistrán and Timmermann (2008)). The indicator used here has the virtue of retaining all the available information.

where *F* is the inflation forecast, N_j is the number of forecasts, *i* identifies the forecast, while $\overline{F}^j$ represents the mean forecast value across forecasting groups *g* (to be defined in greater detail below) in economy *j*. Equation(1) is a measure of forecast dispersion. The absolute standard deviation of d_{th}^j is then normalized to produce values that range between 0 and 1. Accordingly, the following expression is reported below

$$\tilde{d}_{th}^{j} = \left| \sqrt{\frac{1}{N_j - 1} \sum_{i=1}^{N_j} (F_{ith}^{j} - \overline{F}_{gth}^{j})^2} \right| \qquad (2)$$

suitably normalized.[23] Cross-economy comparisons are then more easily made.

Forecasts can be grouped in a variety of ways to generate forecast combinations. These include ones prepared by central banks (CB), survey-based forecasts conducted among households and businesses (S), a set of forecasts (P) by public agencies (i.e., OECD, IMF, Consensus), as well as a group consisting of professional (PR) forecasts (e.g., Consensus, Survey of Professional Forecasters). Mean values of *d* are then calculated for each economy *j* in the dataset. Grouping of forecasts is likely to be useful for a variety of reasons. For example, some of the data used in this study are projections, others are actual forecasts. Moreover, the assumptions and models (whether of the implicit or explicit variety) used to generate inflation forecasts are also likely to differ across the available sources. Not to be forgotten is the considerable evidence that favors simple forecast combinations over other forms of aggregation of forecast or even forecasts by specific forecasters (e.g., see Timmermann 2006). Of particular interest in this study is the case where the benchmark are forecasts published by the central bank, that is, $\overline{F}_{CBth}^{j}$.

The potential connection between disagreement and uncertainty was raised earlier. Lahiri et. al. (2015; also see references therein) outline the requirements under which measures of disagreement can underestimate forecast uncertainty or, rather, the conditions under which the two move in parallel with each other. Boero et. al. (2014) cover much the same ground and report that forecast disagreement and uncertainty are reasonable proxies for each other

[23] There is, of course, no unique normalization but the estimates of d_{th}^j discussed below are bounded between [0,1] (i.e., using the transform $(d - d_{min}) / (d_{max} - d_{min})$.

especially when the former exhibits large and frequent changes. Among the difficulties researcher encounter when attempting to disentangle the two concepts is that most forecasts are aggregated and even forecasts that have a probabilistic element can be classified into arbitrary bins. Hence, the precise information needed to measure a 'pure' form of uncertainty is unobserved. For these reasons the present study focuses on disagreement as proxied by a measure of dispersion around different candidates for some central tendency.[24]

The sampling frequency of the raw data ranges from the monthly to semi-annual forecasts. The focus is on the short-term inflation outlook, namely the one year ahead horizon although the precise horizon can be a little longer depending on the data source (see below). Hence, *h* in equation (2) is set to 1. Moreover, forecasts are either of the fixed event (i.e., a forecast for inflation for a particular calendar year) or fixed horizon (e.g., one quarter or one year ahead) variety. Fixed event data are converted into a fixed horizon using a simple procedure.[25] All raw data, however, were converted to the quarterly frequency to facilitate estimation of the macroeconomic determinants of (2). Data at the monthly or semi-annual frequencies are converted to quarterly data via quadratic-match averaging.[26] Finally, survey data need to be converted from index form into an inflation rate. Two approaches are often employed, namely the regression and probability methods. The former is associated with the work of Pesaran (1985, 1987) while the latter is best known from the work of Carlson and Parkin (1975). Both techniques are used and the mean of the two resulting series serve as the proxy for inflation expectations or forecasts from the relevant survey-based data (see also Siklos 2013).

[24] In an earlier version some proxies for forecast uncertainty were generated for U.S. data and these support the contention of Boero et. al. who examine U.K. data. Both Lahri et. al. (2015), and Boero et. al. (2014), show that the variance of (density) forecasts is the sum of average individual uncertainty and a measure of the dispersion, or disagreement, between individual density forecasts. The first element is generally unobserved.

[25] Consider a monthly forecast of inflation (π) for calendar year *t*, released in month *m* (with quarterly date we replace 12 months with 4 quarters per year). Denote such a forecast as $\pi_{m,t}^{FE}$ where FE refers to the fixed event nature of the forecast. Hence, a forecast for the fixed event one year ahead would be written $\pi_{m,t+1}^{FE}$. The transformation from FE to FH, where FH represents a fixed horizon forecast, is $\pi_{m,t}^{FH} = [(13-m)/12]\pi_{m,t}^{FE} + [(m-1)/12]\pi_{m,t+1}^{FE}$.

[26] Essentially, this fits a local quadratic polynomial for each observation of the low frequency series. This polynomial is then used to fill in the missing observations at the higher frequency.

Ideally, I would also have liked to collect data on medium-term to long-term inflation forecasts for all of the nine economies considered here. However, other than Consensus forecasts and some forecasts from the Survey of Professional Forecasts it proved to be impossible to obtain a complete, let alone a comparable, set of forecasts 5 to 10 years out for all of the forecasting groups analyzed here.

Nine economies are included, five of which explicitly target inflation. The inflation targeting (IT) group of countries are Australia (RBA), Canada (BoC), New Zealand (RBNZ), Sweden (SR or Riksbank), and the U.K. (BoE). The remaining economies are not considered to have adopted inflation targeting though all of them aim for price stability and have even indicated a numerical objective they aim to meet as a means of guiding inflationary expectations: the euro area (ECB), Japan (BoJ), Switzerland (SNB), and the U.S.A. (Fed).[27] The full sample, before any data transformations are applied, is 1999Q1 to 2014Q4 although some series are available for slightly shorter samples (see the Appendix).

Macroeconomic and financial time series were obtained from *International Financial Statistics* CD-ROM (June through August 2015 editions), the BIS, OECD release data and revisions database (http://stats.oecd.org/mei/default.asp?rev=1) and the databases of the individual central banks. They include: an output gap, both domestic and global, obtained by applying an H-P filter to the log of real GDP,[28] the price gap, namely the difference between observed and

[27] The ECB aims for inflation in the Harmonized Index of Consumer Prices (HICP) of "…a year-on-year increase in the Harmonized Index of Consumer Prices (HICP) for the euro area of below 2%", https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html. The BoJ's objective has changed over time although its mandate has been to achieve some form of price stability. The 2% objective has been made more explicit, however, since the appointment of Governor Haruhiko Kuroda in 2013. See https://www.boj.or.jp/en/announcements/release_2013/k130122b.pdf. The SNB defines price stability as "…a rise in consumer prices of less than 2% per year." See http://www.snb.ch/en/iabout/snb/id/snb_tasks. Finally, the Fed, under Chairman Bernanke declared in 2012 that "… inflation at the rate of 2 percent (as measured by the annual change in the price index for personal consumption expenditures, or PCE) is most consistent over the longer run with the Federal Reserve's statutory mandate." (http://www.federalreserve.gov/faqs/money_12848.htm). Nevertheless, many have argued that a 2% medium-term objective was effectively adopted under Alan Greenspan's chairmanship of the FOMC.

[28] Both the standard two-sided gap and a one-sided gap were estimated. The empirical results rely on the one-sided gap measure. The global output gap measure is constructed as in Borio and Filardo (2007).

core inflation rates,[29] and an indicator of commodity price inflation (i.e., inflation in oil prices; Brent crude price per barrel). Finally, to capture the possible effects of uncertainty the VIX is added.[30]

Table 1 updates details about the number and types of forecasts that were also the basis of the results in Siklos (2013). A total of 83 forecasts from a variety of sources are used. The majority of them (43) are from professionals or various international institutions such as the IMF (i.e., the World Economic Outlook (WEO)), and the OECD. Professional forecasts include the mean forecast from Consensus Economics, forecasts collected from *The Economist*, as well as the US and euro area Surveys of Professional Forecasters. All 9 central banks in the data set publish inflation forecasts.[31] Over a third of the forecasts (27) are obtained from household and firm surveys.

Short-term forecasts are important since they can signal the emergence of some underlying shift in the credibility of monetary policy. Blinder et.al. (2008) point out that "short-run" communication, such as the release of an inflation forecast, is likely to have a wide variety of effects and this could be revealed in the behavior of forecast disagreement. Moreover, short-term forecasts are precisely those that are likely to be the focus of transparent central banks. Finally, since the paper aims to determine the sensitivity of expectations to central banks announcements a focus on the one year horizon is warranted.

When central banks loosened monetary policy in response to the Great Recession verbal forms of communication became increasingly important as a means of signaling the stance of monetary policy. At the same time, language was carefully crafted to signal policy easing in the foreseeable future or at least until there are clear signs that the state of the economy improves

[29] It is common for central banks to make the distinction between the two inflation indicators especially as they are not likely to respond to supply side shocks unless these feed into expectations while demand side shocks typically elicits a response.

[30] The data were obtained from http://www.cboe.com/micro/vix/historical.aspx. I also considered, where available, the economic policy uncertainty index (i.e., for the U.S.A., Europe, Canada, and Japan) due to Baker et.al. (2015) and the results are largely the same as the ones described below.

[31] The Reserve Bank of Australia forecasts were excluded from Siklos (2013). A total of 74 forecasts were used in Siklos (2013). Hence, the number of forecasts has risen by approximately 12% relative to that study.

and, with it, risks for inflation exceeding its objective.[32] In such an environment the distinction between positive and negative news announcement is germane to a study of forecast disagreement.

We evaluate the content of monetary policy announcements by developing a proxy for the tone of central bank communication. I evaluate the conduct of monetary policy in a novel manner by generating a vector of variables that quantifies the content or tone of the language used in central bank press releases. Typically, researchers have attempted to interpret whether the monetary authority aims to tighten or loosen policy based on a reading and subsequent assessment of the bias in central bank announcements turning these evaluations typically into binary dummy variables. Instead, I use the DICTION algorithm (see Hart, Childers, and Lind 2013) to quantify the tone of communication emanating from central banks.[33] Alternatively, DICTION can be viewed as an algorithm that collects ideas that are expressed in a document. Next, I compute an idea density indicator of the number of ideas per, say, 10 words.[34] To remain consistent with the relevant literature on central bank communication I refer to the idea density measure as an indicator of the tone of central bank communication.

The DICTION algorithm transforms a collection of words into a numerical indicator the *tone* of the document. Tone is interpreted on the basis of a dictionary of words that convey meaning along various dimensions. There is no unique way of doing so. Rather, expressions and terms are grouped into two categories: positive and negative tone.[35] A positive tone signals current and anticipated improvements in economic conditions and this is also interpreted as signaling higher future inflation. In contrast, a negative tone implies a weakening of economic conditions and this is viewed as being conducive to the central bank expecting lower future inflation. The

[32] For example, see Filardo and Hoffman (2015) for a critical review of forward guidance practices.
[33] There exist several algorithms that attempt to evaluate the content of documents. Others that have been used by economists included Wordscores, Leximancer, and General Inquirer, to name three.
[34] This is based on the metric developed by Chand et. al. (2010). Of course, the choice of 10 words is arbitrary and the selection of ideas that are grouped together is also dictated by the chosen language quantification algorithm.
[35] By default, DICTION classifies words in a document according to the following characteristics. They are: *certainty*, that is, a collection of words indicating resoluteness; *optimism*, namely language that endorses a position or a concept; *activity*, such that the words suggest ideas or stances being implemented and that inertia is avoided; *realism*, meant to inform the reader of tangible results or recognizable facts; and, finally, *commonality*, that is, language that draws attention to common values or positions in a text.

numerical value associated with the tone of central bank announcements (i.e., press releases and minutes if these are published) is based on the press release that accompanies central bank announcements of the policy rate setting. DICTION calculates the relative frequency with which words used in central bank communication are consistent with the chosen categories that are associated with either positive or negative sentiment about overall economic conditions. The words are drawn from a dictionary of over 10,000 words (an Appendix contains more details).

There is always a subjective element in the measurement of the content of any document and central bank press releases and committee minutes, where available, are no exception. However, evaluating the tone of central bank announcements is likely made easier since central bankers are well-known to carefully weigh the usage or removal of specific terms.[36]

4. Econometric Specification

It is hypothesized that forecast disagreement can be explained by common factors. Some are domestic while others are considered global. In addition, it is conceivable that the level of forecast disagreement is influenced by the level of inflation or its forecasted value. The simplest way to proxy this is by relying on a mean forecast, either across forecast sources or across economies. Alternatively, I assume that disagreement rises and falls with the common component of domestic forecasts of inflation evaluated via averaging or principal components estimation. The same argument holds for the common factor in forecasts across countries which are taken to represent the global factor in inflation forecasts. The foregoing arguments are motivated by the well-known relationship between the level and volatility of inflation.[37] Presumably, more volatile inflation increases the likelihood that forecasters disagree with the inflation outlook. Unlike a proxy for the common factor in inflation forecasts which can be viewed as exogenous[38] the volatility of inflation is likely endogenous since it is influenced not

[36] One of many examples that come to mind is the U.S. Federal Reserve dropping the word "patient" in its press releases in mid-2015.

[37] The literature is thought to originate with Friedman's Nobel Lecture (Friedman 1977). Subsequent contributions to the debate include, inter alia, Ball (1992), Stock and Watson (2007, 2010), Bernanke et. al. (2001), and Cecchetti et. al. (2006).

[38] Unless, of course, forecasters explicitly coordinate their forecasts or an individual forecast represents the forecasts of others. We assume this is unlikely given the wide variety of forecasts used to derive the common factor in inflation forecasts.

only by forecasts but the other macroeconomic and financial determinants of inflation forecast disagreement.

Accordingly, the estimated specification is written as follows:

$$\tilde{d}_t^j = \alpha^j + \beta_0 \Gamma_t^{j,D} + \beta_1 \Gamma_t^{j,G} + \eta_t^j \qquad (3)$$

where $\tilde{d}$ is defined above (see equation (1)) as inflation forecast disagreement and, Γ^D, Γ^G are, respectively, the domestic and global factors affecting inflation forecast disagreement.[39] Note also that since a global component is included for each *j* forecast disagreement in each economy is a function of both domestic and international determinants.

The domestic or global common factors are estimated via the mean or principal components with factor loadings that are constant.[40] The common factor is derived from the following estimated relationship

$$\Gamma_t^{j,k} = p_t^{j,k} \mathbf{v}_t^{j,k} + e_t^{j,k} \qquad (4)$$

where Γ has been defined, k=D,G, and $p_t^{j,k}$ represent the factor loadings based on the time series vector $\mathbf{v}$ and $e_t^{j,k}$ is a residual term.

5. Empirical Results

Figure 1 and Figure 2 show CPI headline inflation rates as well as two estimates of one year-ahead forecasts of inflation. In Figure 1 inflation forecasts are proxied by the overall mean of all available forecasts for each one of the 9 economies in the study (see Table 1). In Figure 2 the proxy for one year ahead inflation rates is the first principal component of inflation forecasts. Generally, estimates reveal that a single factor explains over 70% of the variation in inflation forecasts (results not shown). However, for Australia, the U.K., Sweden and the U.S. either two

[39] It is possible, at the quarterly frequency, that some forecasters (e.g., central banks) have information for some variables at time *t*. However, even in this case, since forecasts involve judgment it is not necessarily the case that the most current information will affect inflation forecasts. In any case as a sensitivity test, I also estimate equation (3) with the right hand side variables entering with a lag and the conclusions are unaffected (not shown).

[40] Given the length of the sample I also experimented with time-varying common factor in a rolling fashion with windows that range from 2 to 5 years in length and the results were little changed.

or three factors were estimated although the additional factors explain less than 20% of the variation in available forecasts. Moreover, in all 9 economies, the factor loadings for the first principal component are all positive. Due to the unbalanced nature of the dataset for inflation forecasts (see the Appendix) the sample shown in both figures is from 2002 on for the sake of comparison although data for mean inflation forecasts begins in 1999.

Both sets of forecasts respond to observed inflation although the factor model generated estimates follow observed inflation somewhat more closely. More often than not, inflation forecasts also move contemporaneously with headline inflation rates. However, there are a few instances, most notably around the GFC of 2008-2009, when forecasts lag behind inflation for a short period of time. Finally, there is little visual evidence that forecasts deviate persistently from observed inflation. Of course, by combining a wide range of forecasts I am exploiting the well-known benefits from combining forecasts. Since there is a longer sample when mean inflation forecasts are used, and because the conclusions reached below are unaffected when either inflation forecast proxy is employed, the econometric evidence presented below reports rely only on the case where mean inflation forecasts are used.

The behavior of various inflation proxies for the inflation rate naturally raises questions about the evolution of forecast errors and, perhaps more importantly, about whether forecasts that rely on the central bank's outlook for inflation one year ahead as the benchmark, as opposed to observed inflation, would produce equally good forecasts. Relying on the small sample correction for the widely used Diebold-Mariano (1995) test I am unable to reject the null that central bank forecasts are the same as the other forecast combinations considered for Australia, Japan, New Zealand, and Sweden. For Canada and the Eurozone the only rejections are obtained vis-à-vis survey-based forecasts with central bank forecasts proving to be the superior forecast. In the case of Switzerland, the U.K. and the U.S., there are frequent rejections with the exception of public forecasts for the U.K., and survey-based forecasts for the U.S. In the case where the null is rejected central bank forecasts are deemed superior to the rest (results not shown).

Figure 3 plots the cumulative revisions in the growth rate of the output gap. Each quarterly vintage is revised every quarter. I constructed an output gap, using the H-P filter with a smoothing parameter of 100,000, and then calculated the growth rate on an annualized basis. The change in the output gap over time is then due to revisions in the data which are summed over time. It is immediately observed from Figure 3 that in most economies, pre-GFC, revisions are positive. This means that temporal revisions to the output gap suggest that they are becoming larger over time. In contrast, revisions turn negative post-GFC and appear to influenced, at least in the relevant economies, by the announcement of unconventional monetary policies (i.e., quantitative easing). After some time revisions begin to rise once again in most cases (Australia, Japan, and the Eurozone are two exceptions) beginning around 2012. It is conceivable then that (some) forecasters may revise their forecasts based on this kind of new information leading to changes in forecast disagreement.

Figures 4 and 5 provide graphical evidence of the evolution of inflation forecast disagreement based on two different aggregations of the dataset. Figure 4 provides an estimate of the mean of $\tilde{d}^{j}_{th}$ (see equation (2)) for each one of the 9 economies in the sample. Moreover, a quasi-confidence interval is also provided by estimating the range of estimates of forecast disagreement. Recall that there is no *a priori* reason to believe that the only benchmark is the overall mean inflation forecast. Since in most cases we do not observe the model(s) used by the individuals or groups that provide inflation forecasts but all forecasters acknowledge that the forecasts or others, together with some judgement, influence how their expectations are formed, 6 separate versions of inflation forecast disagreement were estimated. The resulting quasi-confidence interval is akin to the model confidence set approach but, in the present case, without explicit knowledge of the range of model specifications.

The evidence suggests considerable variation in inflation forecast disagreement across economies and over time. Indeed, in most cases, there tend to be brief periods of sharply higher levels of disagreement followed, typically, by longer periods of low disagreement. Greater disagreement over the inflation outlook is clearly visible in almost every economy around the time of the GFC. However, there are other periods of higher forecast disagreement

not directly associated with a financial crisis. For example, in the U.S., there is rising disagreement in the period leading up to the tech bubble of 2001 and again during the phase when the Federal Reserve gradually tightens monetary policy until 2005. Similarly, the sharp fall in disagreement after the GFC is reversed during the period when quantitative easing policies are introduced by the Fed (i.e., QE2) in 2010. Similarly, in Japan, forecast disagreement actually exceeds levels reached during the GFC when the Governor Kuroda launches QQE in 2013. Notice too that there is rising inflation forecast disagreement in the early 2000s over the period when the BOJ is in the midst of QE1. Other illustrations of the impact of monetary policy decisions on forecast disagreement include the Swiss National Bank's decision to target the Swiss Franc's exchange rate in 2011 and the Reserve Bank of Australia's change of course in setting of its policy rate (the cash rate) beginning in November 2011.

It is also worthwhile remarking on the behavior of the quasi-confidence intervals. These tend to be wider the higher is the level of forecast disagreement. Nevertheless, it is interesting to observe that in the U.S. there is considerable agreement about the short-term inflation outlook at the height of the GFC. This is not the case in the other economies considered. Similar to the point estimates, the quasi-confidence intervals can grow wider or narrower very quickly. Whether the bands shown can be likened to an estimate of forecast uncertainty is unclear. Nevertheless, it should be pointed out that low levels of disagreement need not imply narrow quasi-confidence bands as the examples of New Zealand, Australia, Canada, and Sweden demonstrate. It is interesting that, for the Eurozone, the results are similar but not the same as in López-Pérez (2014) who studies uncertainty in the ECB's SPF. The quasi-confidence intervals in Figure 4 reveal that uncertainty rises as early as 2000, not 2001, but does decline in 2004. I also find a rise in 2005 and 2006 not reported in the same study. Thereafter, the results mirror ones reported in López-Pérez (2014).

Figure 5 plots of forecast disagreement on a global scale. Instead of the quasi-confidence bands the point estimates for 4 different benchmarks, namely central banks, professional forecasters, forecasts of public agencies, and survey-based forecasts are shown alongside the conventional approach of using the mean of all forecasts as the benchmark. The term global is used here

because inflation forecasts across all 9 economies are averaged (a similar result is obtained when the first principal component is used the inflation forecast proxy). The motivation, as discussed earlier, is the view that inflation has increasingly been overtaken in recent years by a global dimension.

It is clear that the selection of the benchmark has a considerable impact on forecast disagreement. Conventional calculations of forecast disagreement come closest to ones generated based on professional forecasts while the least coherent benchmark is the one based on central bank forecasts. Survey-based and public forecasts represent intermediate cases. Like their domestic counterpart (see Figure 4) all show a rise in forecast disagreement around the time of the GFC but whereas overall forecast disagreement fell sharply since then forecast disagreement relative to the central banks benchmark remains elevated. Estimates of forecast disagreement also demonstrate a common response to the events of the early 2000s, when the tech bubble burst and concerns were expressed then about the potential for deflation spreading outside Japan.

Tables 2 and 3 present estimates based on equation (3). Both ask the extent to which we can find a few common determinants that drive inflation forecast disagreement as a function of different benchmarks. To economize on space three benchmarks are chosen. They are: all forecasts excluding ones from the central bank, central bank forecasts, and survey-based forecasts. It is difficult to find common determinants of disagreement but this is not surprising if different forecasts are thought to be driven by different information sets. Nevertheless, differentials between domestic and global output gaps, the gap between headline and core inflation, and average forecasts of inflation relative to a global mean forecast of inflation, come closest to what could be termed common driving factors of inflation forecast disagreement.[41]

It is interesting to note that gaps in headline versus core inflation have relatively small effects on forecast disagreement. The only consistent exceptions are Australia and the Eurozone where

[41] As noted above the specifications reflect a preference for parsimony partly due to the sampling frequency of the data. Nevertheless, the conclusions are broadly similar if more conventional variables (e.g., term spread, asset prices, nominal effective exchange rates) are used instead and the variables expressed as differentials enter individually.

the gaps raises disagreement in the former but reduces it in the latter. Central banks, of course, are fond of stressing that even if the control of headline inflation is their mandate, operationally core inflation is more relevant, especially in the short-run. The reason that changes in core inflation allows the monetary authority to look past temporary supply side factors that need not be reflected in inflation expectations. Nevertheless, there is no reason, a priori, for forecasters to react in the same fashion across different economies. Indeed, as shown for example in Table 2, forecast disagreement is consistently affected by the inflation gap (PGAP) in only two economies. There is only a smattering of reaction to this variable in a few other economies. These results could conceivable also reflect the relative success of some central banks at communicating threats to meeting their operational inflation objective.

A rise in domestic output relative to global economic conditions raises forecast disagreement except in the U.S. where it has the opposite effect unless the benchmark is a central bank forecast. Turning to the global variables oil price inflation has effectively no impact on forecast disagreement other than a modest reduction in Canada when survey-based forecasts serve as the benchmark. The failure of oil prices to significantly impact disagreement is not surprising since forecasters, including households and firms, typically view these prices as having a fairly immediate but possibly short-run impact on inflation. Of course, forecasters may still disagree about the pass-through effects although these should emerge via the uncertainty around the point estimates of forecast disagreement.

The VIX, which can also be interpreted as a proxy for spillover effects from the U.S., has a statistically significant impact on disagreement in relatively few cases but the effect appears to be economically small. If the VIX is a proxy for uncertainty then the estimates of disagreement appear to be very nearly of the pure variety.[42] Of course, the addition of real time revisions may also represent another form of uncertainty that can influence inflation forecasts. Interestingly, cumulative real time revisions tend to consistently reduce forecast in the Eurozone, the U.K., and Japan. In contrast, these same revisions raise disagreement in the U.S. where, arguably,

[42] I also included a dummy variable for unconventional monetary policy actions in the US and this variable proved statistically insignificant in the overwhelming number of cases. The dummies, set to 1 when a policy action is announced and 0 otherwise, accounts for the launch of QE1 (November 2008-March 2009), QE2 (November 2010), and the tapering of bond purchases in 2014.

these types of observations are more readily available. Nevertheless, in several of the oldest inflation targeting economies (i.e., Australia, Canada, Sweden and, to a slightly lesser extent New Zealand), forecast disagreement is not seen as being affected by data revisions. This could reflect the anchoring of inflation expectations although the evidence here is only suggestive.

Forecast disagreement also tends to rise when the domestic inflation outlook is higher than average global inflation forecasts. To the extent that central banks are concerned about sources of the un-anchoring of inflation expectations, the gap between domestic and global inflation forecasts nay represent one such source.

Overall, central bank communication has little effect on forecast disagreement with the exception of the U.K where it does serve to reduce disagreement. In contrast, RBNZ communication is seen to increase forecast disagreement in New Zealand. If more was expected from central bank communication then the results could perhaps also be explained by the sampling frequency or the manner in which the tone of central bank announcements is proxied. It may also be the case that central bank communication can influence inflation expectations but not the extent to which different forecasters see the short-term inflation outlook.[43] To the extent that central bank communication does not increase forecast disagreement this may be seen as a success.

Table 3 repeats the exercise but the mean of various proxies of disagreement, and the maximum or minimum levels of disagreement (see Figure 4) are instead regressed against the same determinants used in the estimates provided in Table 2. In general it appears that the same variables drive the range of estimates of inflation forecast disagreement. Therefore, to the extent that the quasi-confidence intervals shown are informative about uncertainty over the inflation outlook differences of opinion do not appear to stem from a shift of focus to different determinants, at least among the ones considered here.

Finally, Figure 6 serves as another reminder that findings about short-term inflation forecast disagreement can be highly sensitive to the benchmark used to generate estimates of $\tilde{d}^{j}_{th}$ as

[43] When some of the other variants of the communication variable shown in Table 2 are used there are a few other cases where the variable is found to be statistically significant (Switzerland, U.K., and Sweden).

well as illustrating that, in spite of a global component to inflation, disagreement can differ substantially across countries. To illustrate, I begin with a reminder that, based on estimates shown in Figure 4, it may be useful to characterize inflation forecast disagreement as operating in two states, namely a high or a low disagreement state. Hence, it seems appropriate to estimate a Markov-switching model where, in most cases, disagreement is determined by a constant and a regime dependent AR(1) term. The resulting smoothed probabilities of being in a high disagreement state are plotted in Figure 6 for the same three cases reported in Table 2.

Three results are apparent from these figures. First, when the benchmark relies on the central bank's forecast, professional forecasts can to yield similar estimates of being in the high disagreement state. However, there are at least two notable exceptions. Inflation forecast disagreement remains in the high state for the U.S. while a central bank benchmark gives the impression that forecasters are in the low disagreement state. Japan's experience is essentially the reverse.

Second, it is also clear that disagreement vis-à-vis the central bank or vis-à-vis survey-based forecasts can yield sharply different interpretations about the likelihood of being in a high disagreement state. Lastly, even if there is a significant global element driving inflation forecast disagreement, largely driven by common shocks (e.g., the GFC), the domestic component remains important and all three figures suggest that divergences in views across the economies examined persist, whether economies are in crisis conditions or not.

6. Conclusions and Implications

This paper has examined the evolution of disagreement over the short-term inflation outlook in nine advanced economies during the decade and half beginning in the 2000s. Factors such as overall central bank transparency and the monetary policy regime in place took a back seat during this period as cross-economy differences in these areas were arguably much smaller than they had been in previous decades. Instead, the paper focuses on how disagreement is largely shaped by the benchmark against which this concept is evaluated and the role of potential shocks to the inflation process such as the global financial crisis. In particular, the study also asks whether there is some evidence that forecasters coordinate in some sense their

outlook with the ones published by central banks. In this sense the fallout from greater central bank transparency continues to potentially play a role is how inflation forecasts are distributed over time and across economies.

Overall, forecast disagreement is sensitive to the group of forecasters chosen as the benchmark. Several other conclusions are also drawn. In addition, the evidence reaffirms the power of forecast combinations to deliver superior forecasts. Next, and not surprisingly, the GFC led to a spike in inflation forecast disagreement that was short-lived. Nevertheless, there were other periods when forecast disagreement rose sharply in some economies but not others. Indeed, it appears that forecast disagreement can be reasonably seen as a variable that operates in two regimes, namely high and low disagreement regimes. Estimation of a quasi-confidence interval for forecast disagreement finds that variation around a mean level of disagreement is high when disagreement reaches a high state. Nevertheless, the relationship is not a straightforward one as there are instances when the range of disagreement is high even when the average level of disagreement is low. If the quasi-confidence intervals represent a measure of forecast uncertainty then low and high levels of forecast disagreement can co-exist with high levels of uncertainty. While there a global component in forecast disagreement is empirically relevant the domestic determinants appear to be of first order importance. More importantly, there appear to be relatively few indications that forecasts are coordinated with those of central banks. Finally, central bank communication appears to play a relatively minor role in explaining forecast disagreement but this could be interpreted as a success for the monetary authorities.

A number of extensions and unresolved questions remain. If central bank communication is thought, *a priori*, to be a separate and significant determinant of disagreement the present study may not have measured it precisely enough or the quarterly sampling frequency is too coarse to properly capture its significance. Alternatively, the communication variable is proxied reasonably well, certainly no worse than an output gap, but is related to levels of expected inflation and not disagreement over the inflation outlook. Second, forecasts are likely revised as data are revised. Some indicator of real time data revisions, especially in output, may prove to be an additional determinant of forecast disagreement. Lastly, it would be worthwhile to

explore asymmetries in forecast disagreement such as whether recessions versus recoveries lead forecasters to focus on different determinants.[44] Alternatively, inflations versus disinflations (and, possibly, deflations) could represent another source of asymmetry. We leave these extensions to future research. Finally, given the differences in behavior of forecast disagreement across the 9 economies examined, there is potentially scope for asking whether forecast disagreement is an indicator of the degree of perceived cross-economy divergences in monetary policy. These extensions are left for future research.

[44] Equation (3) was also estimated by replacing oil price inflation (largely insignificant in the vast majority of estimated regressions) with a recession dummy (NBER for the USA, CEPR for the Eurozone, C.D. Howe Institute for Canada, and the Economic Cycle Research Institute's dating scheme for the remaining economies considered. Some evidence that forecast disagreement is higher is found for Canada, the Eurozone, Sweden and the USA but not for the other economies examined.

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Table 1 – Numbers of Forecasts and Forecast Types

Economy	Total	Survey type	Central Bank
AUSTRALIA	8	3	1
CANADA	7	1	1*
Euro area	9	3	1
JAPAN	12	6	2**
NEW ZEALAND	7	1	1
SWEDEN	8	3	1
SWITZERLAND	6	1	1
U.K.	12	5	3$
U.S.A.	14	4	2@
TOTALS	**83**	**27**	**13**

NOTES: * Bank of Canada's baseline forecast; ** Two versions of BoJ monetary policy committee forecast; $ BoE unconditional and conditional forecasts as well as BoE Staff forecasts; @ Greenbook and FOMC forecasts. Professional and public forecasts are the remaining forecasts. The latter are forecasts published by government or international agencies.

Table 2a Determinants of Forecast Disagreement: All Forecasts Excluding Central Bank Forecasts

Dep. Var:	AUS	CAN	CHE	EUR	GBR	JPN	NZL	SWE	USA
Constant	-0.061 (0.180)	0.095 (0.173)	0.160 (0.170)	0.334 (0.098)*	0.253 (0.266)	0.775 (0.093)*	-0.084 (0.095)	0.351 (0.143)**	-0.282 (0.155)†
GAPQ-GLOBALGAP	0.063 (0.023)*	-0.026 (0.049)	0.053 (0.018)*	0.161 (0.041)*	0.098 (0.036)*	-0.008 (0.037)	0.001 (0.018)	0.022 (0.032)	-0.094 (0.037)*
PGAP	0.181 (0.056)*	-0.042 (0.032)	-0.113 (0.091)	-0.124 (0.035)*	0.009 (0.052)	-0.119 (0.060)†	-0.012 (0.035)	0.014 (0.032)	0.080 (0.051)
MEAN-F_MEAN	0.271 (0.218)	-0.132 (0.083)	-0.025 (0.117)	-0.067 (0.076)	0.181 (0.096)†	0.241 (0.060)*	0.235 (0.058)*	0.271 (0.091)*	0.306 (0.138)**
POS1D-NEG1D	0.075 (0.215)	-0.055 (0.339)	0.304 (0.828)	-0.292 (0.227)	-0.489 (0.270)†	-0.094 (0.092)	0.435 (0.204)**	-0.268 (0.273)	0.205 (0.219)
OILPRICEPCH	-0.000 (0.001)	-0.001 (0.001)	0.001 (0.002)	-0.000 (0.001)	0.001 (0.001)	0.002 (0.001)†	0.001 (0.001)	0.001 (0.001)	-0.003 (0.002)
VIX	-0.001 (0.003)	0.009 (0.002)*	0.002 (0.004)	0.003 (0.002)	0.146 (0.004)*	0.001 (0.003)	0.005 (0.003)†	0.010 (0.004)*	0.004 (0.004)
Real Time revisions	-0.015 (0.028)	-0.007 (0.017)	-0.18 (0.024)	-0.032 (0.013)**	-0.040 (0.016)**	-0.028 (0.016)†	-0.017 (0.011)	0.001 (0.012)	0.016 (0.348)
R-squared:	0.409	0.504	0.390	0.641	0.707	0.415	0.427	0.353	0.420
F-statistic:	4.749	6.969	4.108	12.266	16.563	4.860	5.119	3.734	4.970
Prob(F-stat):	0.004	0.000	0.001	0.000	0.000	0.000	0.000	0.003	0.000

Notes: The title refers to the benchmark used to calculate disagreement (equation (2)). Least squares estimation with heteroscedasticity and autocorrelation-consistent standard errors (HAC). The full sample is 2001Q1-2014Q4 when central bank communication variables are included, otherwise 1999Q1-2014Q4. * means statistically significant at the 1% level; ** at the 5% level; † at the 10% level. GAPQ is the domestic output gap, GLOBALGAP is the global output gap; PGAP is the headline versus core inflation differential; MEAN is the arithmetic mean of all domestic inflation forecasts and F_MEAN is the global inflation forecast; POS1D-NEG1D is the differential between positive and negative sentiment in central press releases issued following a policy rate decision (times 10); OILPRICEPCH is the rate of change (annualized) in the U.K. Brent price of crude per barrel; VIX is the Chicago Board Options Exchange (CBOE) implied volatility of S&P 500 index. Real Time revisions is the accumulated revisions in the growth rate of the output gap. AUS=Australia, CAN=Canada, CHE=Switzerland, EUR=Eurozone, GBR=U.K., JPN=Japan, NZL=New Zealand, SWE= Sweden, USA=U.S..

Table 2b Determinants of Forecast Disagreement: Central Bank Forecasts

Dep. Var:	AUS	CAN	CHE	EUR	GBR	JPN	NZL	SWE	USA
C	-0.013 (0.313)	0.211 (0.270)	0.256 (0.177)	0.375 (0.097)*	0.005 (0.146)	0.709 (0.113)*	0.062 (0.099)	0.234 (0.139)†	-0.251 (0.144)†
GAPQ-GLOBALGAP	0.065 (0.059)	-0.132 (0.084)	0.029 (0.018)	0.181 (0.041)*	0.048 (0.020)**	-0.017 (0.044)	-0.022 (0.019)	0.033 (0.031)	-0.075 (0.034)**
PGAP	0.302 (0.110)*	0.035 (0.050)	-0.019 (0.091)	-0.115 (0.034)*	0.033 (0.029)	-0.080 (0.071)	-0.032 (0.037)	0.005 (0.031)	0.067 (0.047)
MEAN-F_MEAN	0.163 (0.415)	-0.253 (0.141)†	0.205 (0.117)†	-0.076 (0.076)	0.090 (0.053)†	0.377 (0.073)*	0.204 (0.060)*	0.137 (0.088)	0.254 (0.128)**
POS1D-NEG1D	-0.091 (0.461)	0.401 (0.480)	0.793 (0.848)	-0.312 (0.225)	-0.228 (0.148)	0.016 (0.109)	0.292 (0.212)	-0.216 (0.264)	0.247 (0.203)
OILPRICEPCH	-0.001 (0.002)	-0.004 (0.001)*	-0.000 (0.002)	0.000 (0.008)	0.000 (0.005)	0.002 (0.001)	0.002 (0.001)	-0.001 (0.001)	0.001 (0.002)
VIX	0.005 (0.006)	0.007 (0.004)**	0.006 (0.004)	-0.002 (0.002)	0.012 (0.002)*	0.005 (0.004)	0.004 (0.003)	0.008 (0.004)**	0.003 (0.004)
Real Time revisions	-0.011 (0.066)	-0.033 (0.024)	-0.150 (0.023)	-0.035 (0.013)	-0.018 (0.089)**	-0.012 (0.018)	-0.038 (0.011)*	0.002 (0.012)	0.030 (0.017)†
R-squared:	0.475	0.623	0.334	0.610	0.788	0.560	0.410	0.202	0.480
F-statistic:	3.106	7.095	2.649	10.719	25.443	8.347	4.777	1.734	6.327
Prob(F-stat):	0.018	0.000	0.025	0.000	0.000	0.000	0.000	0.123	0.000

Note: See note to Table 2a.

TABLE 2c BENCHMARK: Determinants of Forecast Disagreement: Survey-Based Forecasts

Dep. Var:	AUS	CAN	CHE	EUR	GBR	JPN	NZL	SWE	USA
C	-0.208 (0.169)	0.070 (0.162)	-0.152 (0.307)	0.310 (0.095)*	0.162 (0.288)	0.681 (0.085)*	0.051 (0.145)	0.442 (0.162)*	-0.364 (0.126)*
GAPQ-GLOBALGAP	0.036 (0.022)†	-0.026 (0.044)	0.073 (0.039)†	0.184 (0.040)*	0.145 (0.039)*	0.005 (0.034)	0.001 (0.028)	0.017 (0.036)	-0.090 (0.030)*
PGAP	0.151 (0.053)*	0.005 (0.029)	-0.248 (0.138)†	-0.135 (0.034)*	-0.058 (0.056)	-0.092 (0.054)†	0.105 (0.054)†	0.015 (0.036)	0.069 (0.041)**
MEAN-F_MEAN	0.392 (0.205)†	-0.073 (0.075)	-0.187 (0.176)	-0.062 (0.074)	0.239 (0.104)**	0.225 (0.054)*	-0.127 (0.088)	0.379 (0.103)*	0.365 (0.112)*
POS1D-NEG1D	0.198 (0.202)	-0.028 (0.327)	-0.423 (13.04)	-0.242 (0.221)	-0.473 (0.292)	-0.066 (0.084)	0.271 (0.310)	-0.214 (0.309)	0.268 (0.177)
OILPRICEPCH	0.000 (0.001)	-0.002 (0.001)**	0.001 (0.003)	0.001 (0.001)	0.002 (0.001)	0.001 (0.001)	-0.003 (0.001)**	0.001 (0.002)	0.000 (0.002)
VIX	-0.001 (0.003)	0.007 (0.002)*	-0.002 (0.006)	-0.002 (0.002)	0.013 (0.004)*	0.001 (0.003)	0.014 (0.004)*	0.009 (0.004)**	0.004 (0.003)
Real Time revisions	-0.003 (0.026)	-0.012 (0.015)	0.075 (0.041)†	-0.033 (0.013)*	-0.034 (0.017)†	-0.021 (0.014)	0.033 (0.017)**	0.013 (0.014)	0.022 (0.015)
R-squared:	0.384	0.454	0.281	0.602	0.663	0.462	0.384	0.385	0.579
F-statistic:	4.277	5.352	1.287	10.369	13.515	5.899	4.272	4.298	9.448
Prob(F-stat):	0.001	0.000	0.300	0.000	0.000	0.000	0.001	0.001	0.000

Note: See notes to Table 2a.

Table 3a Determinants of Forecast Disagreement: Maximum Levels of Disagreement

Dep. Var:	AUS-MAX	CAN-MAX	CHE-MAX	EUR-MAX	GBR-MAX	JPN-MAX	NZL-MAX	SWE-MAX	USA-MAX
C	-0.117 (0.197)	0.171 (0.195)	0.248 (0.195)	0.363 (0.104)*	0.402 (0.329)	1.039 (0.108)*	-0.011 (0.147)	0.442 (0.160)*	-0.237 (0.166)
GAPQ-GLOBALGAP	0.074 (0.025)*	-0.033 (0.055)	0.058 (0.021)*	0.180 (0.044)*	0.119 (0.045)*	-0.011 (0.044)	0.007 (0.029)	0.027 (0.036)	-0.087 (0.039)**
PGAP	0.228 (0.061)*	-0.050 (0.035)	-0.090 (0.105)	-0.103 (0.037)*	-0.003 (0.064)	-0.105 (0.070)	0.045 (0.055)	0.014 (0.035)	0.097 (0.055)†
MEAN-F_MEAN	0.187 (0.238)	-0.177 (0.094)†	-0.015 (0.135)	-0.090 (0.081)	0.152 (0.119)	0.263 (0.070)*	0.108 (0.090)	0.276 (0.101)*	0.337 (0.148)**
POS1D-NEG1D	0.170 (0.235)	-0.119 (0.383)	0.168 (0.951)	-0.325 (0.242)	-0.535 (0.333)	-0.348 (0.108)*	0.374 (0.316)	-0.263 (0.305)	0.193 (0.232)
OILPRICEPCH	-0.000 (0.001)	-0.001 (0.001)	-0.000 (0.002)	-0.000 (0.001)	0.001 (0.001)	0.000 (0.001)	-0.002 (0.001)	0.000 (0.001)	-0.000 (0.002)
VIX	0.004 (0.004)	0.011 (0.003)*	0.004 (0.004)	0.000 (0.003)	0.015 (0.005)*	0.000 (0.004)	0.012 (0.004)*	0.010 (0.004)**	0.004 (0.004)
Real Time revisions	0.010 (0.030)	-0.018 (0.019)	-0.037 (0.027)	-0.034 (0.014)**	-0.057 (0.020)*	-0.004 (0.018)**	0.020 (0.017)	0.006 (0.014)	0.014 (0.020)
R-squared:	0.481	0.550	0.392	0.610	0657	0.478	0.311	0.294	0.419
F-statistic:	6.352	8.397	4.138	10.724	13.141	6.275	3.094	2.849	4.951
Prob(F-stat):	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.014	0.000

Notes: See Notes to Table 2a. The benchmark is ALL forecasts. MAX is the highest level of disagreement at time *t* in each economy. See Figure 3.

Table 3b Determinants of Forecast Disagreement: Mean Levels of Disagreement

Dep. Var:	AUS-MEAN	CAN-MEAN	CHE-MEAN	EUR-MEAN	GBR-MEAN	JPN-MEAN	NZL-MEAN	SWE-MEAN	USA-MEAN
C	-0.100 (0.151)	0.116 (0.166)	0.180 (0.155)	0.335 (0.097)*	0.262 (0.242)	0.737 (0.087)*	-0.018 (0.093)	0.315 (0.125)**	-0.281 (0.148)†
GAPQ-GLOBALGAP	0.051 (0.019)*	-0.025 (0.047)	0.047 (0.016)*	0.172 (0.041)*	0.101 (0.033)*	0.002 (0.035)	-0.006 (0.018)	0.018 (0.028)	-0.093 (0.035)*
PGAP	0.158 (0.047)*	-0.037 (0.030)	-0.106 (0.083)	-0.122 (0.034)*	-0.012 (0.047)	-0.095 (0.056)†	0.008 (0.035)	0.009 (0.028)	0.080 (0.049)
MEAN-F_MEAN	0.246 (0.183)	-0.148 (0.080)†	-0.019 (0.107)	-0.0733 (0.0754)	0.164 (0.087)†	0.221 (0.055)*	0.165 (0.057)*	0.225 (0.079)*	0.308 (0.132)**
POS1D-NEG1D	0.109 (0.180)	-0.090 (0.327)	0.239 (0.755)	-0.293 (0.225)	-0.461 (0.245)†	-0.152 (0.086)†	0.365 (0.201)†	-0.227 (0.238)	0.220 (0.209)
OILPRICEPCH	-0.000 (0.001)	-0.001 (0.001)	0.000 (0.002)	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)	-0.000 (0.002)
VIX	0.000 (0.003)	0.009 (0.002)*	0.002 (0.003)	-0.005 (0.002)	0.012 (0.004)*	0.001 (0.003)	0.006 (0.003)**	0.009 (0.003)*	0.004 (0.004)
Real Time revisions	-0.004 (0.023)	-0.012 (0.016)	-0.019 (0.022)	-0.032 (0.013)**	-0.038 (0.014)*	-0.028 (0.015)†	-0.010 (0.011)	0.001 (0.011)	0.018 (0.018)
R-squared:	0.429	0.535	0.375	0.629	0.696	0.445	0.356	0.335	0.456
F-statistic:	5.145	7.896	3.853	11.601	15.666	5.500	3.785	3.460	5.746
Prob(F-stat):	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.004	0.000

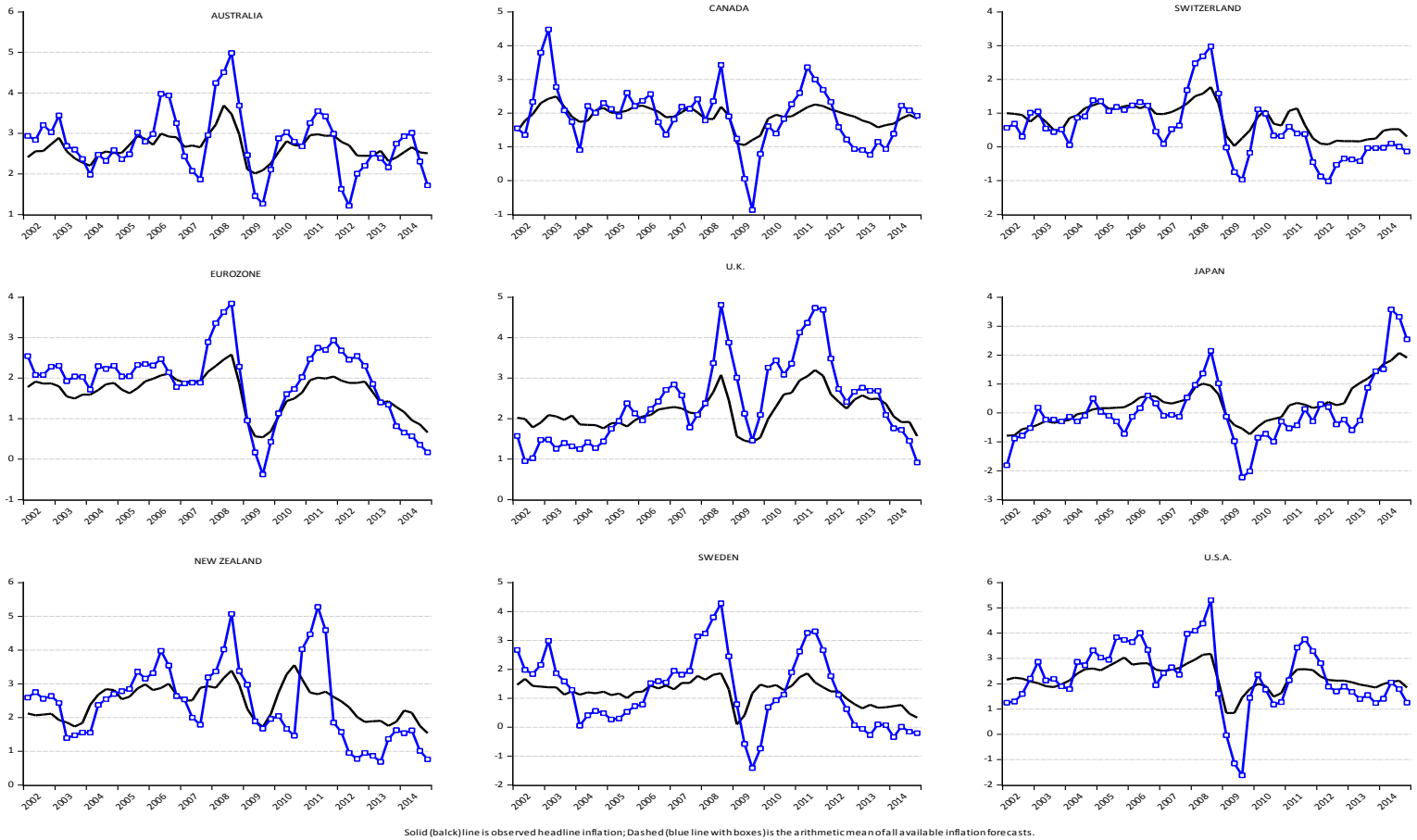
Notes: See Notes to Table 3a.

TABLE 3c Determinants of Forecast Disagreement: Minimum Levels of Disagreement

Dep. Var:	AUS-MIN	CAN-MIN	CHE-MIN	EUR-MIN	GBR-MIN	JPN-MIN	NZL-MIN	SWE-MIN	USA-MIN
C	-0.020 (0.066)	0.086 (0.153)	0.085 (0.107)	0.307 (0.095)*	0.038 (0.132)	0.500 (0.071)*	0.011 (0.059)	0.249 (0.081)*	-0.330 (0.122)*
GAPQ-GLOBALGAP	0.015 (0.008)†	-0.023 (0.043)	0.027 (0.011)**	0.179 (0.040)*	0.054 (0.018)*	-0.028 (0.028)	-0.013 (0.011)	0.001 (0.018)	-0.085 (0.029)*
PGAP	0.056 (0.020)*	-0.008 (0.028)	-0.109 (0.058)†	-0.137 (0.034)*	0.013 (0.026)	-0.095 (0.045)**	0.017 (0.022)	0.006 (0.018)	0.060 (0.040)
MEAN-F_MEAN	0.111 (0.080)	-0.082 (0.073)	-0.001 (0.074)	-0.060 (0.074)	0.100 (0.048)**	0.227 (0.045)*	0.051 (0.036)	0.177 (0.051)*	0.297 (0.109)*
POS1D-NEG1D	0.044 (0.078)	-0.103 (0.300)	0.438 (0.524)	-0.250 (0.221)	-0.194 (0.134)	-0.024 (0.070)	0.224 (0.126)†	-0.194 (0.155)	0.261 (0.173)
OILPRICEPCH	-0.000 (0.003)	-0.001 (0.0008)†	0.001 (0.001)	0.001 (0.001)	0.000 (0.004)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)	0.006 (0.002)
VIX	-0.000 (0.001)	0.006 (0.002)*	0.001 (0.002)	-0.002 (0.002)	0.009 (0.002)*	0.003 (0.003)	0.004 (0.002)**	0.003 (0.002)	0.003 (0.003)
Real Time revisions	-0.012 (0.010)	-0.012 (0.015)	-0.001 (0.015)	-0.031 (0.013)**	-0.018 (0.008)**	-0.018 (0.012)	-0.010 (0.007)	0.003 (0.007)	0.026 (0.015)†
R-squared:	0.353	0.433	0.293	0.599	0.741	0.478	0.358	0.311	0.599
F-statistic:	3.743	5.247	2.659	10.244	19.599	6.279	3.822	3.092	8.696
Prob(F-stat):	0.003	0.000	0.022	0.000	0.000	0.000	0.002	0.001	0.000

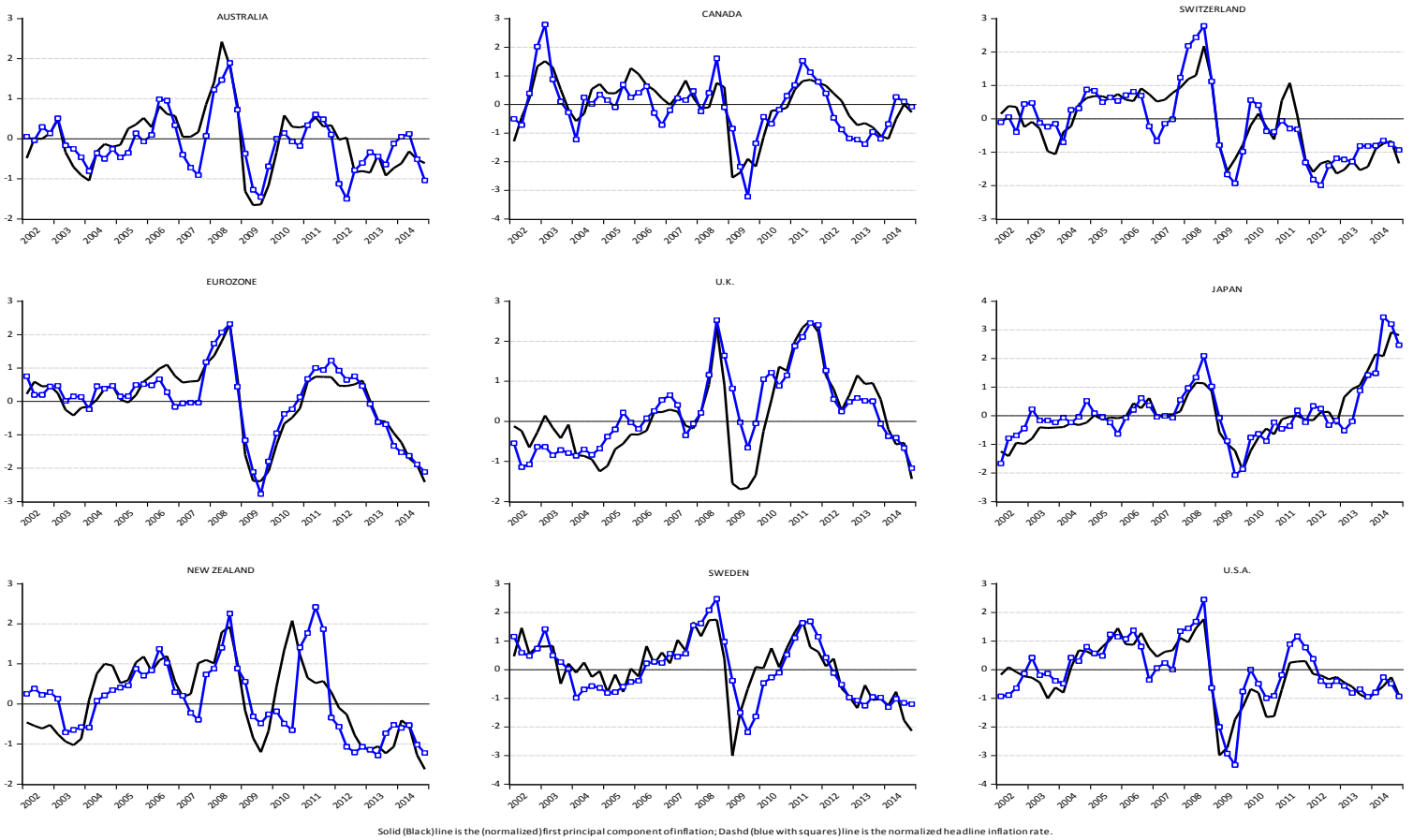
Note: See Notes to Table 3a.

Figure 1 Headline Inflation and the Mean of Inflation Forecasts



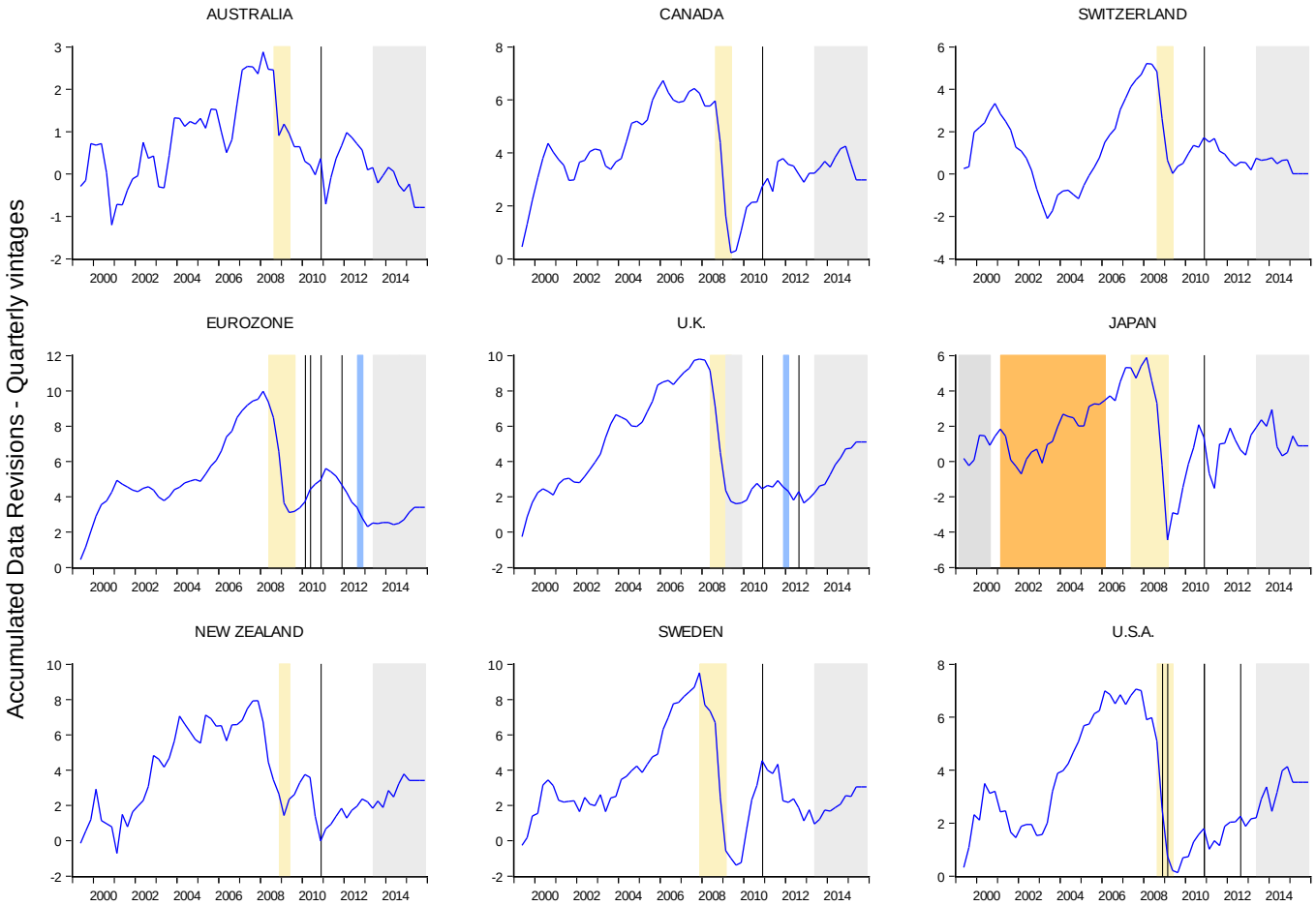
Note: Inflation is annualized log change in CPI Headline and Core (excludes energy, food, and indirect taxes). The mean of all available forecasts is used.

Figure 2 Headline Inflation and the First Principal Component of Inflation Forecasts



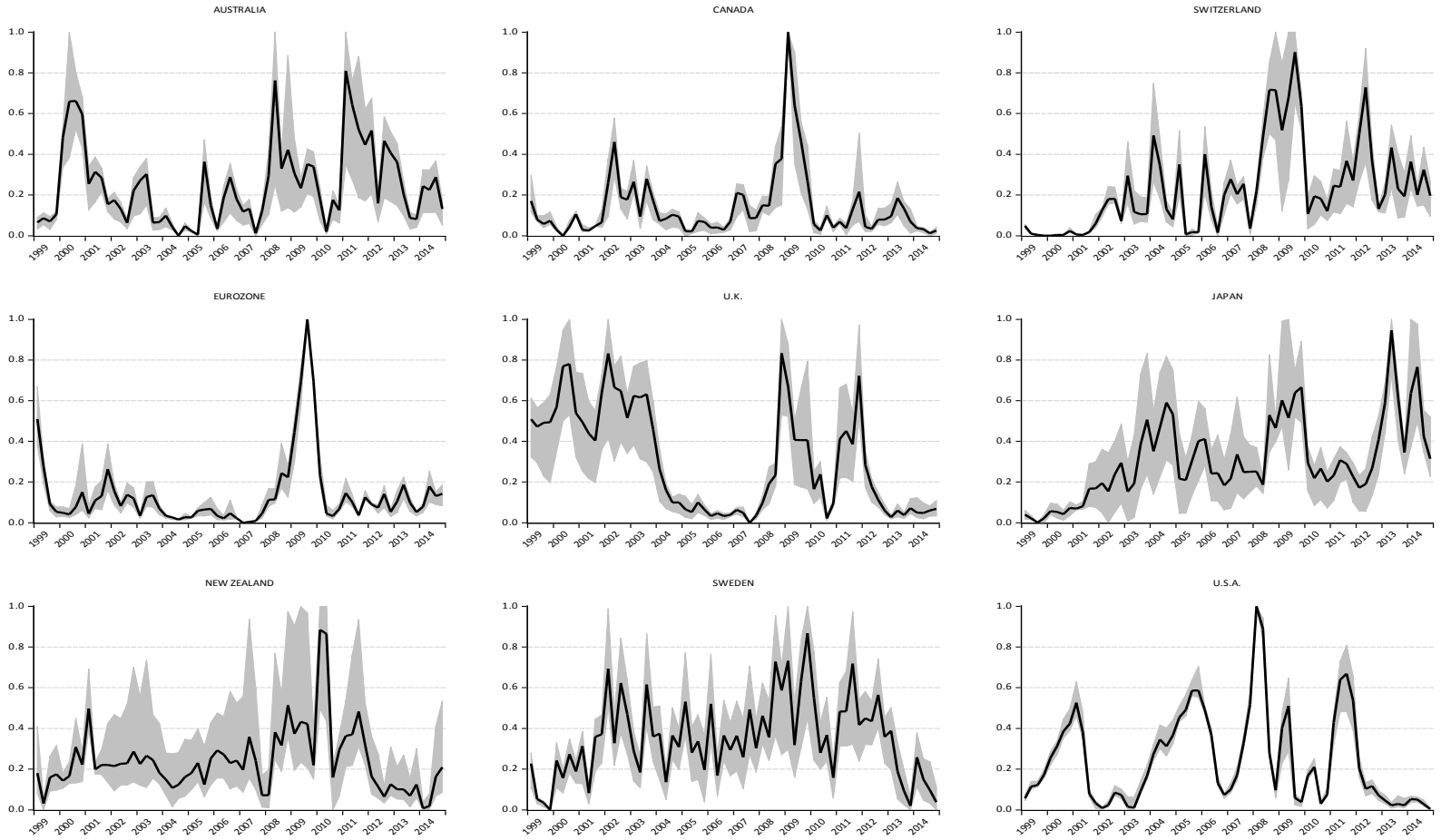
Note: The first principal component is estimated over an unbalanced panel of all available inflation forecasts. Estimation is based on principal factors with the number of factors estimated via the Kaiser-Guttman approach. Headline inflation is defined in Figure 1. For the U.S. the full sample excludes the Greenbook forecasts and forecasts from the Atlanta Federal Bank survey; for the U.K. full sample estimates exclude MPC staff estimate.

Figure 3 Real Time Revisions Over Time



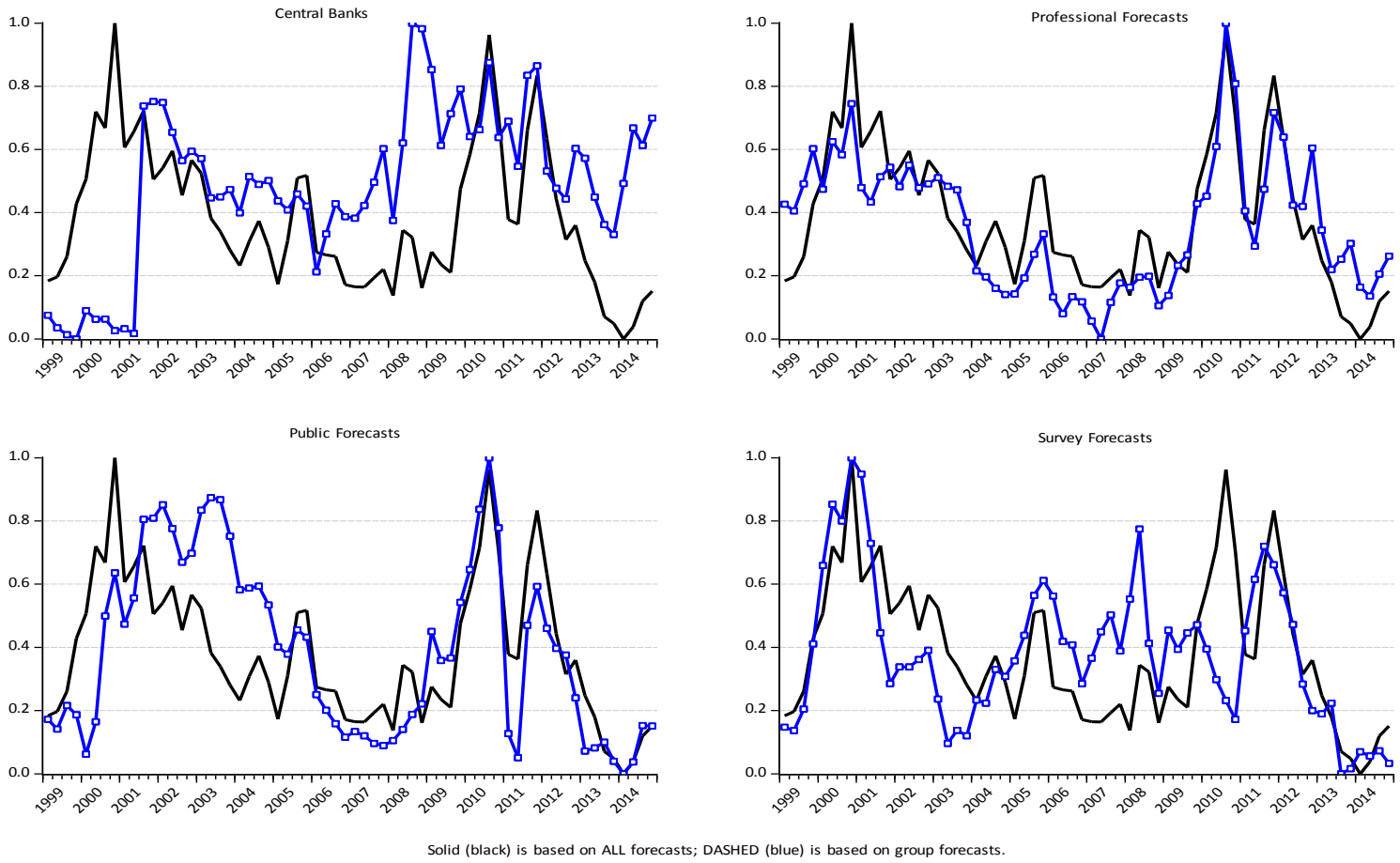
Note: The output gap is first estimated using an HP filter (smoothing parameter of 100,000). The change in growth rate of the output gap for quarterly vintages since 1999 (where available) is then evaluated and cumulated over time.

Figure 4 Quasi-Confidence Intervals for Inflation Forecast Disagreement



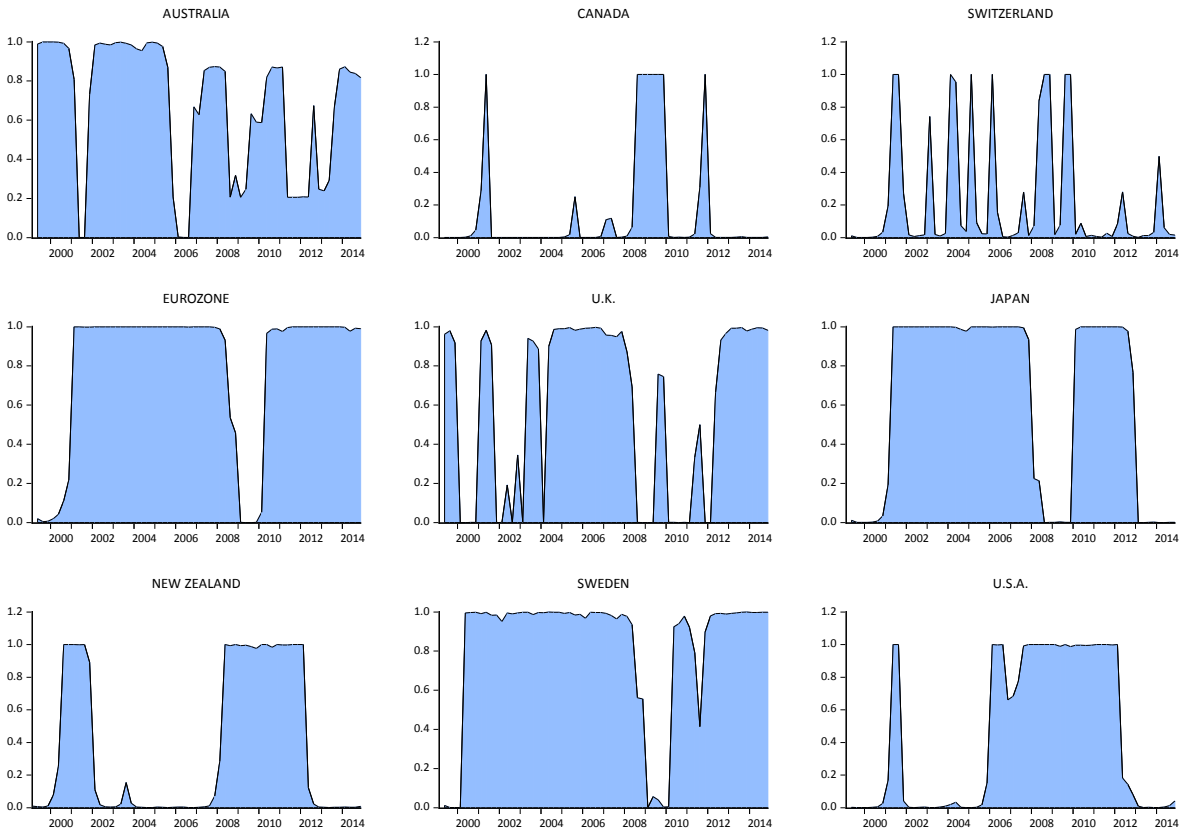
Note: Estimate based on equation (2) applied to all forecast groupings (ALL, all except central bank, central bank only, professionals, public, and survey-based forecasts). For details of each grouping see the main text and the Appendix.

Figure 5 Inflation Forecast Disagreement: Global



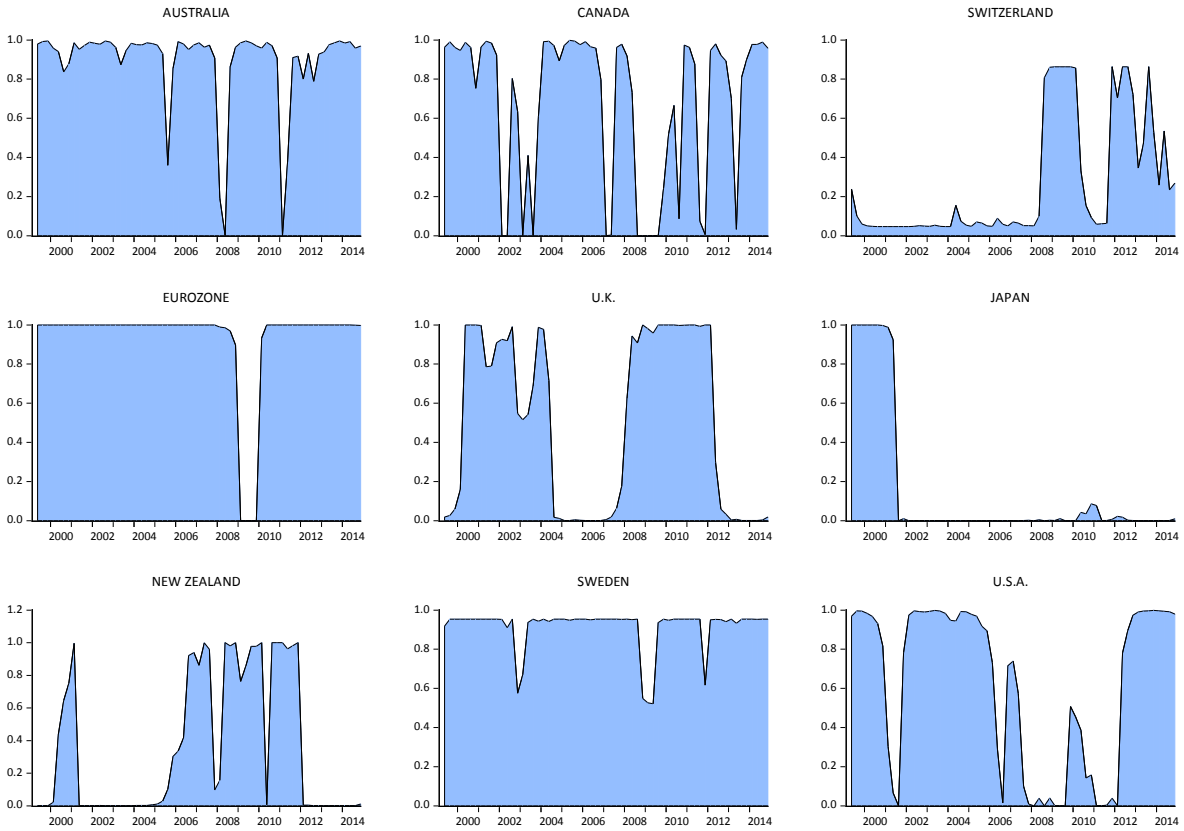
Note: See notes to Figure 3. Equation (2) is used to calculate disagreement by grouping different sources of forecasts across all of the 9 economies in the study.

Figure 6a Markov Switching Model of Forecast Disagreement: Central Bank Benchmark



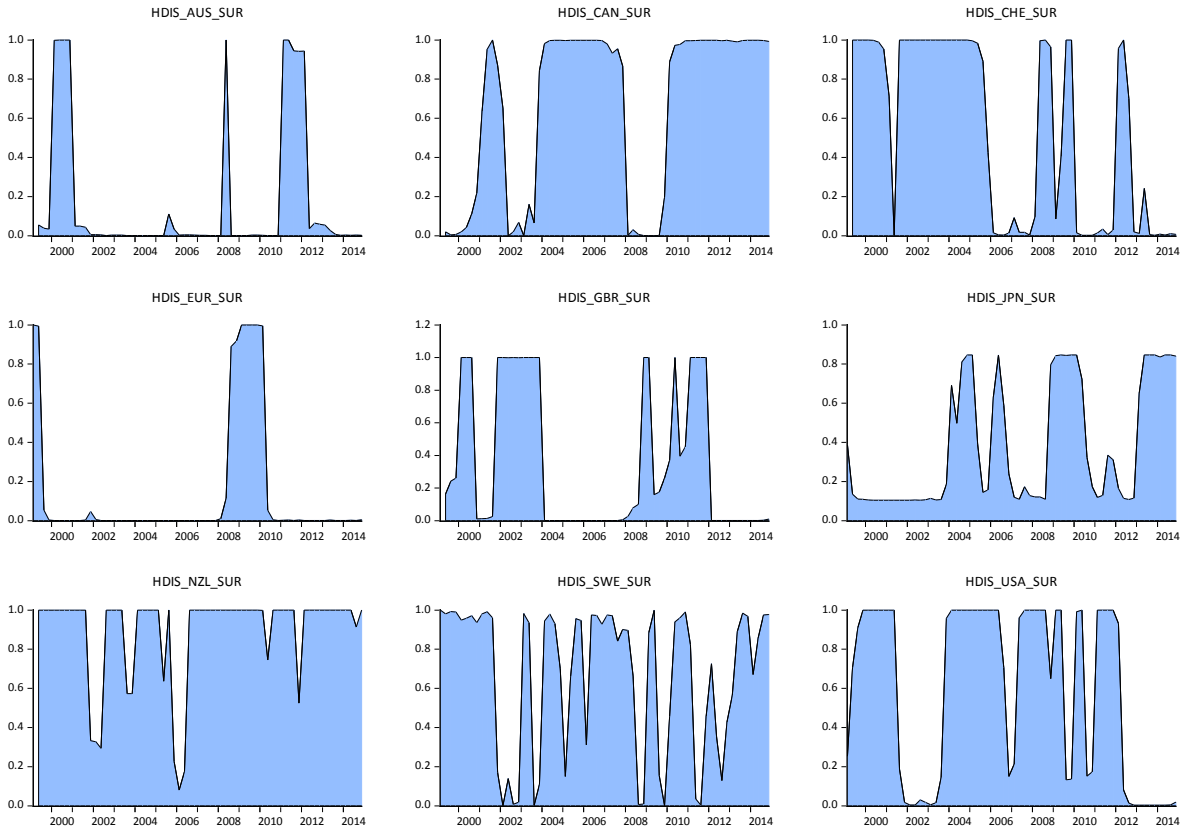
Note: Forecast disagreement is estimated via Markov switching (BHHH optimization method, Huber-White standard errors, Knuth random number generator for starting values) with a constant and regime-specific AR(1) variables, except for Australia, Canada, Switzerland, New Zealand, and Sweden where the AR(1) is not regime-specific and provided a better fit. The title of the Figure indicates the benchmark used to calculate forecast disagreement.

Figure 6b Markov Switching Model of Forecast Disagreement: Professional Forecasters Benchmark



Note: See note to Figure 5a. For Canada, Switzerland, and Sweden, the non-regime-specific AR(1) model provided a better fit.

Figure 6c Markov Switching Model of Forecast Disagreement: Survey-Based Forecasts Benchmark



Note: See note to Figure 5a. For Canada, Switzerland, the Eurozone, and the U.S.A. only a constant is included. For Sweden an AR(2) non-regime-specific model provided a better fit.

APPENDIX I – Forecast Data: Survey Forecasts are UNDERLINED, professional forecasts are in *ITALICS*, and forecasts by PUBLIC agencies are in BOLD characters

A. Private Sector , Governmental or International Institutions, including surveys

Economy	Forecast (Frequency[1])	Horizons[2] RELEASE DATE	START	Forecast (Frequency)[1]	Horizons[2]	START
AUSTRALIA (AUD)	***1.****The Economist* (M)	cy, 1y	**1990.08**[2]	**6.**Melbourne Institute (Q)	cy	1993Q2
	2.*Consensus (M)*	cy, 1y	1990.01	**7.**National Australia Bank Survey (Q)	cy	1989Q2
	3.World Economic Outlook (SA)	cy, 1y ya-APR/OCT	1993S1 1990S1			
	4.OECD (SA)	cy,ya-JUN/DEC	2002S1			
	5.Union officials forecasts	1&2yr ahead	1988Q1			

[1] Survey data are underlined.

[2] In bold series required some interpolation either because of gaps, missing observations, or a change in the frequency of published forecasts. Linear interpolation is used.

CANADA (CAD)	***1.****The Economist* (M)	cy, 1y	**1990.08**	**6.**Bank of Canada (Q) - Survey	2y-bins	2001.2
	2.*Consensus (M)*	cy, 1y	1989.10			
	3.World Economic Outlook (SA)	cy, 1y	1993S1			
		cy, 1y	1990Q1			
	4.*Conference Board of Canada (Q)*	ya	**1990S1**			
	5.OECD (SA)	cy, ya				
EURO AREA (EUR)	***1.****The Economist* (M)	cy, 1y	1998.11	**5.***SPF*[3] *(Q)*	cy, 1y, 2y, 5y	1999.1
	2.*Consensus (M)*	cy, 1y	1989.10	**6.**EC Consumer & Business Survey (M)[3] X2	ya-balance[4]	1985.01
	3.OECD (SA)	cy, ya	1990S1			
	4. World Economic Outlook (SA)	cy, ya	1993S1	**7.**ZEW (M)	ya-bins[5]	1991.12
JAPAN (JPN)	***1.****The Economist* (M)	cy, 1y	**1990.08**	**5.**ZEW (M)	ya-bins	1991.12
				6.BoJ Survey(Q)	ya, 5y-bins	2001.2
	2.*Consensus (M)*	cy, 1y	1989.10	X2		(2004.2/5y)
	3.World Economic Outlook (SA)	cy, 1y	**1993S1**	**7.**TANKAN (Q)	forecasted change in output prices – All Ind.[5]	1985.1 1971 (Q), 2004.06 (M)
		cy, ya				
	4.OECD (SA)	cy, ya	1990S1	**8.**Japan Centre for Economic		

[3] Two separate surveys are conducted. Hence, the variable consists of two time series.

				Research[4]		
				9. Cabinet Office – Price Expectations (M)	ya	2004.04
NEW ZEALAND (NZL)	**1.***Consensus (M)*	cy, 1y	**1990.01**	**5.**RBNZ (Q) Market scope	qa, 1y, 2y	1987.3
	2.World Economic Outlook (SA)	cy, 1y	1993S1	**6.Treasury budget & fiscal update (SA)**	cy, 1y 2y May/Dec	**1997S1**
	3.*New Zealand Institute of Economic Research (Q) NZIER)*	cy, ya, 2,3,4 ya ya	1988-2011Q4[6]			
	4.OECD (SA)	cy, ya	1990S1			
SWEDEN (SWE)	***1.****The Economist* (M)	cy, 1y	1990.08	**5.**EC Consumer & Business Survey (M) X2	ya-balance[4]	1995.01 (1990.01)
	2.*Consensus (M)*	cy, 1y	**1989.11**	**6.** NIER (M)[7]		
	3.World Economic Outlook (SA)	cy, 1y cy, ya	1993S1		cy, ya	1996.01
	4.OECD (SA)	cy, ya	1990S1			

[5] Beginning 2014Q1 the TANKAN survey now includes a series entitled "Inflation Outlook of Enterprises – All industries". This series was too short to be used.

[4] Previously the Economic Planning Agency expectations data. The EPA was dissolved in 2012.

[6] Therafter spliced with NZIER's own "consensus" forecasts.

[7] National Institute for Economic Research.

SWITZERLAND (CHE)	***1.****The Economist* (M)	cy, 1y	1990.08	**5.**ZEW (M)[8]	ya-bins	1991.12
	2.*Consensus (M)*	cy, 1y	1989.11			
	3.World Economic Outlook (SA)	cy, 1y cy, ya				
	4.OECD (SA)	cy, ya	1990S1			
UNITED KINGDOM (GBR)	***1.****The Economist* (M)	cy, 1y	1991.01	**5.**EC Consumer & Business Survey (M)X2	ya-balance[4]	1985.01
	2.*Consensus (M)*	cy, 1y	**1989.11**			
	3.World Economic Outlook (SA)	cy, 1y	1993S1 1993Q1	**6.**YOUGOV (M) **7.**BoE/NOP (Q) **8.** ZEW	ya - median 1y-bins Ya-bins	2005.12 2000.1 1991.12
	4.OECD (SA)	cy, ya	1990S1			
UNITED STATES (USA)	***1.****The Economist* (M)	cy, 1y	**1990.08**	***6.****SPF*[3] *(Q)*	cq, qb, cy, ya, 5yr, 10y	1981.3 (1991.4 for 10y)
	2.*Consensus (M)*	cy, 1y	1989.11 1990.31			
	3.World Economic Outlook (SA)	cy, ya	1993S1	**7.**Michigan Survey (Q)[10] **8.**Livingston Survey (SA)	ya cm, cy, 6m, 12m, 1y, 2y, 10y	1978.1 1985S1
	4.OECD (SA)		1990S1			
	5.*Wall Street Journal (SA/M)*[9]	cy, ya	**2001.08**	**9.**ZEW (M) **10.Cleveland Fed (M)**	ya-bins 1ya, 2ya	1991.12 1982.01

[8] Only the Carlson-Parkin technique applied as the other approach failed to generate a solution.

[9] Originally semi-annual and becomes monthly in 2009. Interpolation is used to fill in missing data.

11.Congressional Budget Office (SA)	ya, 2y	2005.1
12. Atlanta Fed	ya	2011.10

Additional notes to part A:

1. M, Q, SA are monthly, quarterly and semi-annual, respectively.

2. cy, 1y, ya, represent mean current year and one year ahead and year ahead, respectively. There is little substantive difference between 1y and ya other than different source use different language to refer to forecasts that pertain to the year following the publication of the forecast. In some cases, however, the forecast can refer to the calendar year ahead, or to a forecast for a calendar year ahead from the time of publication, in which case the forecast horizon may overlap the current and following calendar year. #m, #q, or #y refer to forecasts # months, quarters or years ahead.

3. Survey of Professional Forecasters.

4. Balance refers to the horizon stated applicable to the remainder (i.e., balance) of the year. Bins refers to the fact that forecasts are arranged in the form of a distribution of responses.

[10] Used to be released in bins but now converted to annual rates of change.

B. Central Bank Forecasts

Economy	Frequency/AUTHOR	Horizons	START
AUSTRALIA (AUS)	**Quarterly/RBA**	**Up to 2 years ahead**	**2007**
CANADA *(CAD)*	**Quarterly/BoC**[11]	**Up to 8 quarters ahead**	**2005**
EUROZONE (EUR)	**Quarterly/ECB**	**One year ahead**	**2000**
JAPAN (JPN)	**Semi-Annual**[12]**/MPC**	**Current and 1 year ahead**	**2000**
NEW ZEALAND (NZD)	**Quarterly/RBNZ**	**Up to 12 quarters ahead**	**1997**
SWEDEN (SWE)	**Quarterly/Riksbank**	**Up to 8 quarters ahead**	**2000**
SWITZERLAND (CHE)	**Quarterly/SNB**	**Up to 2 years ahead**	**2003**
UNITED KINGDOM (GBR)	**Quarterly/MPC**[13]	**Up to 8 quarters ahead**	**1993, 1998**
	Monthly/Staff	**"near-term" (current year)**	**2011.01**
UNITED STATES (USA)	**Semi-Annual/FOMC** **Greenbook**	**Current and up to 2 years ahead and "longer run"** **Up to 9 quarters ahead**[14]	**2000** **1965**

[11] A mix of semi-annual and quarterly forecasts provided until 2009 when fully quarterly forecasts are available. Referred to as the Bank's baseline forecast.

[12] Quarterly can be generated since 2011. Some interpolation required for missing data for the year 2000-2003.

[13] Both unconditional (i.e., based on current bank rate) and conditional (based on market rates) used.

[14] Data end on 2009Q4 at the time of writing.

C. Sources for Forecasts and Surveys

Economy	Source(s)
AUSTRALIA	**http://www.melbourneinstitute.com/ CLICK on MEDIA RELEASES** http://www.rba.gov.au/statistics/tables/index.html#prices_inflation **MI Consumer expectations and NAB data from Quarterly Business Survey** **http://www.consensuseconomics.com/** **http://www.imf.org/external/ns/cs.aspx?id=29** **http://www.economist.com/** [1] **http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html** **http://www.rba.gov.au/publications/smp/index.html**
CANADA	**http://www.consensuseconomics.com/** **http://www.imf.org/external/ns/cs.aspx?id=29** **http://www.conferenceboard.ca/** **http://www.economist.com/** **http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html** **http://www.bankofcanada.ca/en/** **(**http://www.bankofcanada.ca/en/bos/index.html)
EURO AREA	**http://www.consensuseconomics.com/**

	http://www.economist.com/[2] http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm http://www.ecb.int/stats/prices/indic/forecast/html/index.en.html http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://www.zew.de/de/publikationen/finanzmarktreportarchiv.php3?year=2010
JAPAN	http://www.consensuseconomics.com/ http://www.economist.com/ http://www.imf.org/external/ns/cs.aspx?id=29 http://www.zew.de/en/daszew/daszew.php3 http://www.boj.or.jp/en/ **TANKAN Survey (INPUT and OUTPUT prices)** http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://www.zew.de/de/publikationen/finanzmarktreportarchiv.php3?year=2010 http://www.cao.go.jp/index-e.html http://www.epa.or.jp/esp/fcste.html
NEW ZEALAND	http://www.consensuseconomics.com/ http://www.rbnz.govt.nz/statistics/econind/j6/data.html **- RBNZ Survey** http://www.rbnz.govt.nz/statistics/econind/j5/data.html **- Household Survey** http://www.nzier.org.nz/

	http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://www.treasury.govt.nz/budget/forecasts
SWEDEN	http://www.consensuseconomics.com/ http://www.economist.com/ http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm http://www.imf.org/external/ns/cs.aspx?id=29 http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://riksbank.com/
SWITZERLAND	http://www.consensuseconomics.com/ http://www.economist.com/ http://www.imf.org/external/ns/cs.aspx?id=29 http://www.zew.de/en/daszew/daszew.php3 http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://www.snb/ch
UNITED KINGDOM	http://www.consensuseconomics.com/ http://www.economist.com/ http://ec.europa.eu/economy_finance/db_indicators/surveys/time_series/index_en.htm http://www.imf.org/external/ns/cs.aspx?id=29

	http://www.bankofengland.co.uk/ http://today.yougov.co.uk/archives/financial http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html
UNITED STATES	http://www.consensuseconomics.com/ http://www.economist.com/ http://www.imf.org/external/ns/cs.aspx?id=29 http://www.philadelphiafed.org/research-and-data/real-time-center/ http://www.src.isr.umich.edu/http://www.src.isr.umich.edu/ http://www.oecd.org/document/59/0,3343,en_2649_34109_42234619_1_1_1_37443,00.html http://online.wsj.com/home-page http://www.zew.de/de/publikationen/finanzmarktreportarchiv.php3?year=2010 http://www.clevelandfed.org/research/data/inflation_expectations/index.cfm?DCS.nav=Local http://online.wsj.com/public/page/economic-forecasting.html#mod=mdc_h_econhl **OR** http://online.wsj.com/public/resources/documents/info-flash08.html?project=EFORECAST07

Additional notes to Part C:

1. For year ahead forecasts the data for January-February for each year until 2007 were added by interpolating the forecasts for the available adjacent months. This was necessary because the forecasts are for the calendar year (current or one year ahead) published each month and the table published omitted these two months.

2. For the euro area forecasts are for EUR 11 countries until 2000 December, thereafter EUR forecasts**. The same calculation applies to the Consensus forecasts.**

3. For Germany the forecasts are for greater or consolidated Germany beginning in November 1995.

E . Descriptors Used for Forecasts in Tables & Figures

Forecast Name	Code
The Economist	ECON
Consensus	CONS
European Commission Consumer Survey	ECCS
European Commission Business Survey	ECBS
European Central Bank	ECB
World Economic Outlook	WEO
Conference Board of Canada	CBD
Center for European Economic Research	ZEW
Reserve Bank of New Zealand	RBNZ
Market Scope (New Zealand)	Scope
Tankan (Japan)	TAN
Yougov Opinion Polling Survey (UK)	YOUGOV
Greenbook, US Federal Reserve	GREEN
Federal Open Market Committee (US)	FOMC
Livingston Survey (US)	LIV
Survey of Professional Forecasters (US, euro area)	SPF
Bank of England (UK)	BOE
University of Michigan Survey (US) - mean	MICH
National Opinion Poll (UK)	NOP
Melbourne Institute (Australia)	MLB
Bank of Japan	BOJ
Bank of Japan Monetary Policy Committee	PBOJMAJ (Majority of Committee)

	PBOJALL (Entire Committee)
Bank of Canada Business Survey	**BOCs**
Bank of Canada Baseline Forecasts	**BOC**
Bank of Canada Global	**BOCg**
New Zealand Institute for Economic Research	**NZIER**
Riksbank (Sweden)	**RIKS**
Organization for Economic Cooperation and Development	**OECD**
Swiss National Bank	**SNB**
National Institute of Economic Research	**NIER, BNIER, CNIER**
Infitted	**Regression method conversion**
Infitted1	**Probability approach conversion**

Miscellaneous additional notes to the Data:

Data from the Economist are from individual banks or financial institutions. The representative forecasters change over time. Forecasts for January each year are for the previous calendar year due to lags in the release of final calendar year inflation rates.

Conference Board of Canada forecasts are released as Winter, Spring, Summer and Autumn quarterly forecasts.

The Wall Street Journal forecasts (USA) are released as part of their Economic Forecasting Survey of a large number of forecasters.

The ZEW Survey is released early each month and represents the previous month's forecast/expectation.

JCER and BoJ forecast data (JAP) are based on the fiscal year (1 April – 31 March).

U Michigan Survey data have now been converted to annualized inflation rates. Previously, a weighted average was used depending on the fraction of respondents in each bin ranging from don't know to 15% or more inflation.

RBNZ forecasts are released in their MPS in March (Q1), June (Q2), September (Q3), and December (Q4).

Bank of Canada forecasts are released in their MPR in January (Q1), April (Q2), July (Q3), and October (Q4).

ECB Euro area projections were released in the Monthly Bulletin. This was replaced by the Economic Bulletin in 2015. Forecasts are released in March (Q1), June (Q2), September (Q3), and December (Q4).

RBA forecasts are released in their statement on Monetary Policy in February (Q1), May (Q2), August (Q3), and November (Q4).

Bank of Japan inflation forecasts are for CPI less fresh food and, beginning in 2015, less fresh food and the effect of consumption tax hikes.

FOMC forecasts are from the MPR to Congress Summary of Economic Projections and are for the PCE index. These are released ordinarily in February and July of each year.

The SNB inflation forecasts are conditional on the prevailing LIBOR and are for Q4 of the current, one year and two year ahead horizons.

OECD forecast are semi-annual and ordinarily released in January and June though dates have changed slightly over time.

WEO forecasts are semi-annual and are ordinarily released in April and October although there have occasionally been small variations in the month of the release.

Number of Quarterly Observations Available from Fixed Horizon Forecasts Used in the Study

Source	AUS	CAN	CHE	EUR	GBR	JPN	NZL	SWE	USA
Consensus	64	64	64	64	64	64	64	64	64
Economist	64	64	64	64	64	64	64	64	64
OECD	52	52	52	52	52	52	64	52	52
WEO	64	64	64	64	64	64	64	64	64
Melb. Inst.	64								
Natl Aus B	64								
RBA	32								
Union	64								
BoC		38							
BoC surv		53							
Conf Bd		62							
ZEW			34	63	64	64			64
SNB			48						
ECB				57					
EC bus				64	64			64	
EC Cons				64	64			64	
SPF				64					
BoE const					64				
BoE i					64				
BoE staff					16				
NOP					59				
YouGoov					37				

BoJ surv1						53			
BoJ surv2						54			
Cab Off						43			
JCER						42			
MPC all						54			
MPC maj						54			
Tankan						62			
NZIER							64		
RBNZ							64		
Scopus							64		
Treas.							64		
Riksbank								60	
NIER								64	
Atl. Fed									17
CBO									40
Clev. Fed									64
Greenbook									48
Livingstone									64
FOMC									58
U Mich									64
WSJ									46

Note: Highlighted cells are forecasts used in the principal components analysis (full sample). In the pre-2007 sub-sample (1999Q1-2007Q1) the Greenbook forecasts (end 2010Q4) are added back; in the post 2007 sample (2007Q3-2014Q4) the BoE's MPC staff forecasts are added back.

Appendix: Content Analysis Details

Source: DICTION

Positive sentiment consists of expressions that convey **OPTIMISM** (=[praise, satisfaction, inspiration] *less [*blame, hardship, demial]).

Alternative proxies include:

The SUM of **Accomplishment** (words expressing task completion), **cooperation** (terms designating behavioral interactions), **centrality** (terms denoting institutional regularities and/or substantive agreement on core values), and **satisfaction** (terms associated with positive affective states): **POS1**

Words (as well as synomyms) that would be included under the above heading include ones such as growth, generate, alignment, contribute, conformity, mandate, auspicious, secure.

The SUM of **satisfaction** (defined above) and **praise** (affirmation of some person, group, or abstract entity): **POS2**

Words of praise include ones such as successful, good, and their synomyms.

The SUM of **present concern** (e.g., signs, turning point), **recovery**, and **expansion**: **POS3**

Negative sentiment consists of words that convey a tone of **passivity** (words ranging from neutrality and inactivity).

Alternative indictors of negative tone include:

The SUM of **exclusion** (describes sources and effects that are isolating), **hardship** (negative outcomes or reduction in capacity, unemployment, weakness), and **passivity** (defined above): **NEG1**

The SUM of **present concern** (defined above) and **hardship** (defined above): **NEG2**

The SUM of **ambivalence** (ambiguity), and **blame** (detrimental, vulnerable): **NEG3**