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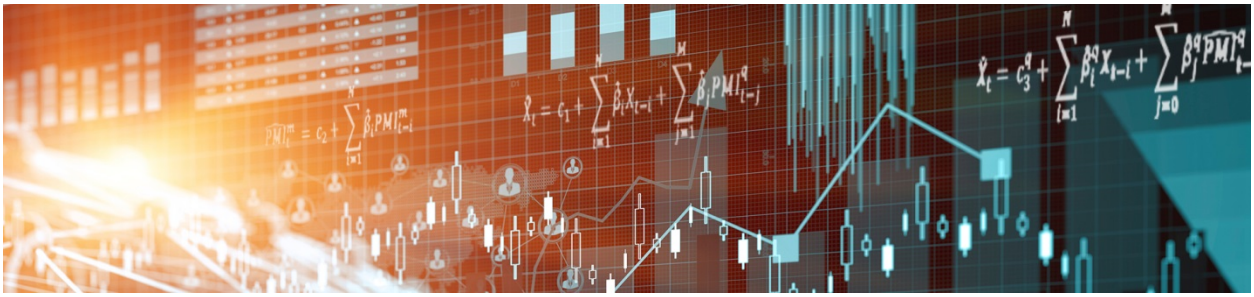
Staff Working Paper/Document de travail du personnel 2018-2

How Do Central Bank Projections and Forward Guidance Influence Private-Sector Forecasts?



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Bank of Canada Staff Working Paper 2018-2

January 2018

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ISSN 1701-9397

Acknowledgements

The authors would like to thank Raisa Leiderman for her excellent research assistance. We benefited greatly from comments and suggestions from Philippe Andrade, Antonio Diez de los Rios, Bruno Feunou, Michael Ehrmann, Andrew Filardo, Jean-Sébastien Fontaine, Toni Gravelle, Paul Hubert, Franke Heinemann, Paul Hubert, Andrew Levin, Luba Petersen, Larry Schembri, Rodrigo Sekkel, Gregory Thwaites, and Jonathan Witmer, as well as participants at the Fourth Joint Banco de Espana/Bank of Canada Workshop. We thank the Reserve Bank of Australia, de Nederlandsche Bank, the Norges Bank, the Reserve Bank of New Zealand, and the Swiss National Bank for their support in gathering historical projections data. We thank Knowledge and Information Services at the Bank of Canada for their support with data collection. Thank you also to Nazire Nergiz Dinçer and Barry Eichengreen for sharing their central-bank transparency with us and to Petra Geraats for helpful discussions about the data.

Abstract

We construct a 23-country panel data set to consider the effect of central bank projections and forward guidance on private-sector forecast disagreement. We find that central bank projections and forward guidance matter mainly for private-sector forecast disagreement surrounding upcoming policy rate decisions and matter less for private-sector macroeconomic forecasts. Further, neither central banks' provision of policy rate path projections nor their choice of policy rate assumption used in their macroeconomic projections appear to matter much for private-sector forecast disagreement.

Bank topics: Transmission of monetary policy, Central bank research, Inflation targets, Monetary policy, Monetary policy communications
JEL codes: D83, E37, E52, E58

Résumé

Nous collectons un ensemble de données de panel portant sur 23 pays afin d'examiner les effets des projections et des indications prospectives des banques centrales sur la divergence des prévisions du secteur privé. Nous constatons que ces projections et indications prospectives influent principalement sur la divergence des prévisions faites par le secteur privé au sujet des décisions à venir quant au taux directeur. Elles exercent en revanche moins d'influence sur la divergence des prévisions macroéconomiques du secteur privé. En outre, la divulgation par les banques centrales de leurs projections concernant la trajectoire du taux directeur et de l'hypothèse relative à cette trajectoire qu'elles utilisent dans leurs projections macroéconomiques n'a pas d'incidence notable sur la divergence des prévisions du secteur privé.

Sujets : Transmission de la politique monétaire, Recherches menées par les banques centrales, Cibles en matière d'inflation, Politique monétaire, Communications sur la politique monétaire
Codes JEL : D83, E37, E52, E58

Non-Technical Summary

A central bank's ability to guide expectations is critical for the efficacy of the monetary policy transmission mechanism. In recent decades, central banks have employed an increasing number of both conventional and unconventional communication tools to help the public anticipate future monetary policy actions. To study this issue, we construct a new, twenty-three country data set dating back to 1990 that records whether central banks provided each of six types of economic projections and two types of forward guidance. We also gather metadata about these projections, such as the policy rate path assumption used in economic projections. Our data are then used in conjunction with private-sector forecast data to estimate the impact of central banks' choice of providing economic projections and forward guidance on private-sector forecast disagreement.

We find that central bank projections and forward guidance matter mainly for private-sector forecast disagreement about upcoming policy rate decisions and matter less for private-sector macroeconomic forecasts. In particular, central bank projections of target variables appear to exert the greatest influence. That is, central bank projections of inflation and the output gap appear to matter more than unemployment projections, for example. Together, this suggests that private-sector forecasters use central bank projections primarily as monetary policy signals. We also find that neither central bank policy rate projections nor the policy rate path assumptions used in their economic projections matter much for private-sector forecaster disagreement.

1 Introduction

Central banks' ability to guide expectations is critical for the efficacy of the monetary policy transmission mechanism. In recent decades, central banks have employed an increasing number of both conventional and unconventional communication tools to help agents better anticipate future monetary policy actions. Numerous studies have assessed how this increased central bank transparency (via the provision of central bank projections, for example) has helped manage expectations by studying private-sector forecast disagreement (e.g. Crowe (2010), Ehrmann et al. (2012), Naszodi et al. (2016)). Less is understood, however, about the effectiveness of unconventional monetary policy tools and which types of central bank projections matter most for managing expectations.[1]

To study this issue, we construct a new, twenty-three country panel data set dating back to 1990 that records whether or not central banks provided six types of economic projections and two types of forward guidance. We also gather metadata about these projections, such as the policy rate path assumption used in economic projections (i.e. endogenous, constant, or market-implied). By constructing our own data set, we are able to assemble a much more complete picture of monetary policy communications. Unlike other closely related studies, we incorporate the provision of additional economic projections, such as unemployment and policy rate projections, as well as time-contingent and state-contingent forward guidance. Our data are then used in conjunction with private-sector forecast data to estimate the impact of central banks' choice of providing economic projections and forward guidance on private-sector forecast disagreement. To the best of our knowledge, this is the first paper to do so, and we offer two novel conclusions.

First, we find that central bank projections and forward guidance matter mainly for private-sector forecast disagreement surrounding upcoming policy rate decisions and matter less for private-sector macroeconomic forecasts. Additionally, central bank projections of target vari-

[1] Each of the studies above pointed out that it would be useful to analyze how central bank projections affect private-sector forecasts in more detail. See Crowe (2010), page 232, Ehrmann et al. (2012), page 1028, and Naszodi et al. (2016), page 166.

ables appear to exert the greatest influence. That is, central bank projections of inflation and the output gap appear to matter more than unemployment projections, for example.[2] Together, this suggests that private-sector forecasters use central bank projections primarily as monetary policy signals.

Second, we find that neither central bank policy rate projections nor the policy rate assumptions used in their economic projections matter much for forecaster disagreement. This provides some evidence that the ongoing debate in the literature about whether a central bank should release its policy rate projection may not be such be a crucial one (e.g. Faust and Leeper (2005), Rudebusch and Williams (2008), Woodford (2013), Obstfeld et al. (2016)), at least when glimpsed through the lens of private-sector forecast disagreement. The same might be said about the debate on central banks' choice of policy rate projection for their macroeconomic projections (e.g. Goodhart et al. (2009)).

A relatively small literature has focused on investigating this question while incorporating unconventional monetary policies implemented by central banks. Andrade et al. (2015) find that date-based forward guidance reduced forecaster disagreement in the United States. Kool and Thornton (2015) find that forward guidance reduced forecast dispersion in New Zealand, Sweden, and Norway, but not in the United States. Coenen et al. (2017) find that under effective lower bound (ELB) periods, state-contingent forward guidance reduced disagreement and that time-contingent forward guidance reduced disagreement if it was provided over relatively long horizons.

The forward guidance analysis in our paper is closely related to Kool and Thornton (2015) and Coenen et al. (2017) but differs in several respects. First, our sample group includes a larger and more diverse set of economies. Second, our sample period extends back further and includes both ELB and non-ELB periods. Third, we include additional variables in our estimation, such as the provision of unemployment and policy rate projections, as well as additional controls,

[2] The United States Federal Reserve, which has a mandate to promote maximum employment and stable prices, represents an important exception to this narrower interpretation of "target variables" as discussed in, for example, Svensson (2017).

such as financial-market volatility. Ultimately, these differences offer a new perspective on the effect of forward guidance on private-sector forecaster disagreement.

Our paper is organized as follows. Section 2 discusses our estimation methodology. Section 3 provides details on our data collection and the sample period used. Section 4 discusses our estimation results and section 5 concludes.

2 Methodology

Central banks release macroeconomic projections for a number of reasons. Geraats (2005) argues that central banks have a strong incentive to publish forward-looking analysis to enhance their credibility as inflation targeters, thereby reducing inflationary bias. Morris and Shin (2005) illustrate how central banks could improve the public's understanding of the underlying state of the economy provided central banks are better informed than other agents in the economy. Rudebusch and Williams (2008) discuss how releasing interest-rate projections could improve the public's understanding of the central bank's reaction function and thereby better align expectations.

Private-sector forecasters are typically the most avid analysts of central bank projections. Hubert (2015a) provides three hypotheses as to why central bank inflation forecasts could influence private-sector forecasts. First, central bank projections may be more accurate than private ones. Second, central banks may have a different information set from that of private-sector forecasters. Third, central bank projections may be a form of monetary policy signal.[3]

[3] Hubert (2014) found that publishing Federal Open Market Committee inflation forecasts reduced the dispersion of inflation expectations. In a five-country study, Hubert (2015a) suggests that although central bank projections influence private-sector forecasts, this effect cannot be attributed to forecasting performance. Hubert (2015b) provides evidence that European Central Bank inflation projections influence private-sector forecasts and that they convey useful monetary policy signals.

Each of the preceding hypotheses, if true, could lead to lower private-sector forecast dispersion and forecast error. A number of papers have considered the role of central bank projections on private-sector forecasts. For example, Romer and Romer (2000) find that Federal Open Market Committee (FOMC) projections provide signals to private-sector forecasters, which causes private-sector forecasters to update their forecasts accordingly. Fujiwara (2005) finds that central bank projections influence private-sector forecasts, but not the other way around.

To contribute to the literature, our approach aims to capture how the provision of central bank projections affects private-sector forecast disagreement and forecast error while incorporating a larger sample of economies and additional types of projections. To do so, we take a panel regression approach:

$$y_{it} = \alpha + \boldsymbol{\beta x_{it}} + \boldsymbol{\gamma c_{it}} + \lambda_i + \epsilon_{it} \qquad [1]$$

Overall, this empirical approach is most closely related to Naszodi et al. (2016), and to a lesser extent, Ehrmann et al. (2012) and Ehrmann (2015). For robustness, we re-estimate the models following the empirical approaches from these papers and our results are substantially unchanged. Further, we re-estimate the models using an even more stringent set of controls, including a series of time-country trends. Following Naszodi et al. (2016), we estimate the benchmark model using White (1980) standard errors, but our results are robust to other standard errors, such as Driscoll-Kraay standard errors (Driscoll and Kraay (1998)), which are robust to cross-sectional dependence, heteroskedasticity, and autocorrelation up to four lags.[4]

In equation [1], y_{it} corresponds to both a measure of forecast dispersion and forecast accuracy in country i in quarter t. Equation [1] is first estimated using forecast dispersion and then re-estimated using forecast accuracy. By including forecast accuracy alongside forecast dispersion, we can glean whether less forecast disagreement also coincided with less mean forecast error, which is important because it would not be desirable for central bank projections to reduce forecast disagreement at the cost of forecast accuracy. In the results, we report both sets of

[4] See the online appendix for all robustness checks.

results side by side. Our measure of forecast dispersion is the inter-decile range, which is the difference between the ninth and first deciles of a given forecast distribution (or, equivalently, the difference between the 90th and 10th percentiles). Forecast accuracy is measured as the absolute value of the mean forecast error.[5]

We are primarily interested in the relationship between the availability of particular central bank macroeconomic projections and private-sector forecasts. Hence, the key variables of interest are the x_{it} variables, which denote binary dummy variables that indicate whether a central bank in country i provided a given type of macroeconomic projection in quarter t. Crucially, these binary variables are tested jointly in an effort to disentangle the marginal effects of providing each type of central bank projection. Some multicollinearity issues prevent us from using all x_{it} variables. Specifically, we are able to include inflation, the output gap, unemployment, and interest-rate projections but must exclude domestic- and global-output projections.[6] As such, we also analyze each type of projection individually in our online appendix (as in Naszodi et al. (2016)). If the release of a particular type of central bank projection is associated with a reduction in forecast dispersion or forecast error, then the corresponding β should be negative.

We include several control variables aimed at controlling for different types of volatility, each of which would plausibly lead to higher forecaster disagreement. The control variables are denoted above by the vector $\mathbf{c_{it}}$. First, following Ehrmann et al. (2012) and Naszodi et al. (2016), we include the conditional volatility of the realized macroeconomic data j in country i at time t. Following Capistrán and Timmermann (2009) and Capistrán and Ramos-Francia (2010), conditional volatility is estimated using a GARCH(1,1) model. Following Ehrmann et al. (2012) and

[5] The related forecast-dispersion literature uses a number of measures. Mankiw et al. (2003), Dovern et al. (2012), and Ehrmann et al. (2012)) use interquartile range to avoid outliers. Naszodi et al. (2016)) use standard deviation, which offers richer insight into the distribution but does include outliers. Ehrmann (2015), however, uses the inter-decile range to gain a greater appreciation for changes in the full distribution while still excluding outliers (each 10% tail is discarded). We favor the inter-decile approach as we are able to observe changes to the central portion (80%) of the distribution without running the risk that outliers drive our results. Our results are robust to alternate measures of dispersion: inter-quartile range, standard deviation, and range (results included in the online appendix). We have one y_{it} for each type of private-sector forecast (Gross Domestic Product (GDP), Consumer Price Index (CPI), the rate on three-month government bills, and the ten-year government bond yield). Further, each private-sector forecast has two time horizons.

[6] The correlation between the inflation and domestic output projections is 0.91, so it is not possible to include both. We discuss this in more detail below.

Naszodi et al. (2016), we also include the absolute value of the change in West Texas Intermediate (WTI) oil prices. As in all of the studies above and the related literature, we also include country fixed effects, λ_i.

Next, we include two additional controls not included in the aforementioned related studies: financial-market volatility and the ELB. First, we attempt to control for some forms of financial-market volatility by including the VIX (the implied volatility from options on the Standard & Poors 500 stock index). Usefully, this volatility measure has low correlation with the various measures of conditional variance. Second, periods at the ELB may represent an exception to the normal relationship between the level of policy rates and forecast dispersion, so we also include a binary variable for the ELB. Each of these control variables is discussed in more detail in section 3.5.

In this study, we argue that inflation-targeting periods are significantly different regimes than non-inflation-targeting periods. Hence, the two should be modeled separately. As such, we restrict our sample to inflation-targeting periods only (see section 3.6 for details). We focus on the more stable inflation-targeting periods, wherein we can more reasonably disentangle the channels through which central bank projections operate. Restricting the sample also allows us to rule out another alternative explanation for the effects we observe. First, any observed reductions in forecast dispersion or forecast error should not be attributable to the transition to an inflation-targeting regime as all observations are within inflation-targeting periods. Second, the effects should not be attributable to the advent of either a monetary policy report or press release because such publications were already available in most cases by the time of inflation-targeting introduction.

3 Data

Our data analysis builds primarily on three papers. Ehrmann et al. (2012) is a twelve-country study of central bank transparency and private-sector forecast dispersion. The authors provide evidence that announcing a quantified inflation target and publishing inflation and output forecasts reduces dispersion. Naszodi et al. (2016) is a twenty-six-country study of central bank transparency and both private-sector accuracy and forecast dispersion. The authors provide evidence that central bank transparency improves both. Finally, using the sample from Ehrmann (2015), Coenen et al. (2017) find that, under ELB periods, state-contingent forward guidance reduced disagreement and that time-contingent forward guidance reduced disagreement if it was provided over relatively long horizons.

To study this issue, we first compile a new data set that records when each of twenty-three central banks released each of six types of projections on a quarterly basis dating back to 1990 (i.e. 15,840 observations). Our data afford us a great deal of variation in the types of forecasts released (ranging from few to many) and the frequency of the forecast releases (in most cases, from annual to quarterly). This data set is depicted in Figure 1. We then perform a series of panel regressions of forecaster dispersion on various central bank projections. The main regressions use four types of private-sector forecasts taken from Consensus Economics: inflation, output, the three-month government bill yield, and the ten-year government bond yield—each forecasted at two horizons. The variables of interest are one of six types of central bank projections: inflation, output, the output gap, unemployment, global Gross Domestic Product (GDP), and forward guidance (including policy rate projections).

3.1 Sample group

Our main sample group consists of twenty-three economies: fifteen advanced economies (Australia, Canada, the euro area, France, Germany, Italy, Japan, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States) and eight

emerging-market economies (Czech Republic, Hungary, Indonesia, Poland, Russia, Slovakia, South Korea, and Turkey).

The sample group was chosen based on a number of criteria. First, we seek to maintain comparability to the literature. This sample group heavily overlaps with those from Capistrán and Ramos-Francia (2010), Ehrmann et al. (2012), Ehrmann (2015), and, especially, Naszodi et al. (2016). Second, we chose central banks that are judged to be particularly transparent (see, for example, Eijffinger and Geraats (2006)). Such central banks are more likely to provide an array of central bank forecasts, thereby providing the data needed to test the effects of different types of central bank projections. Despite this, the sample group also provides some useful heterogeneity in terms of transparency. As judged by the Dincer and Eichengreen (2014) central bank transparency index, scores range from 5 (Norway, early years) to 15 (Sweden, recent years). These scores have been trending upwards as central banks release more and more macroeconomic projections and explain monetary policy decisions in greater detail. Each of the countries in this group also eventually transitions to an inflation target, which allows us to segregate our analysis into inflation-targeting and non-inflation-targeting periods (see Figure 2). Increases in transparency, however, are not limited to inflation-targeting periods, so transparency increases have taken place in both the advanced and emerging-market economies across our sample period (see Geraats (2009)). Third, historical macroeconomic data for each country are available from the Main Economic Indicators database on the Organisation for Economic Co-operation and Development (OECD) website, which allows us to use one data set to compute the forecast errors and conditional volatility for all countries and all periods (discussed in more detail below).

3.2 Dependent variables: private-sector forecast data

All private-sector forecast data come from Consensus Economics. The data are composed of point forecasts primarily from banks and economic research firms. We focus on private-sector forecasts of inflation, output, and interest rates. This distinction will be useful in the discussion of our results that follows.

The dependent variable, y_{it}, takes the form of either a measure of private-sector forecaster disagreement or private-sector absolute forecast error. In an attempt to reduce confusion, in this paper, the term *projections* will always refer to *central bank* projections and the term *forecasts* will always refer to *private-sector* forecasts. To measure disagreement, we calculate the range, inter-decile range, inter-quartile range, and standard deviation across all forecasters in country i and month t (each month corresponds to one quarter). The mean number of forecasts per sample is about seventeen for output and inflation forecasts and about eleven for interest rate forecasts. The survey participants are typically consistent over the sample period. Each of the four variables is forecasted at two horizons. Three-month and ten-year yields are each projected three and twelve months into the future, respectively (fixed-horizon forecasts). Both real domestic GDP growth rates and inflation rates are forecasted on a full-year basis for both the current year and the next year (fixed-event forecasts).

To measure forecast accuracy, we take the absolute value of the difference between the mean Consensus Economics forecast and the realized corresponding macroeconomic data. Fortunately, the OECD's Main Economic Indicators database provides a rich data set of realized macroeconomic data for all of the countries in our sample group. This includes GDP and CPI for our main tests and unemployment, consumption, production, and investment for our robustness tests. The realized data for three-month government rates, ten-year yields, and WTI oil prices are obtained from Thomson Reuters Datastream. This approach to measuring forecast accuracy is closely aligned with that of Ehrmann et al. (2012) and Naszodi et al. (2016).

3.3 Data frequency

The forecast data are available on a monthly basis but, for the purposes of this study, are collapsed into a quarterly frequency. Hence, we use the survey results for every third month. This was done for two of reasons. First, we better match the frequency of central bank projections, which, in general, are released quarterly. Second, this allows for a non-overlapping private-sector

forecast horizons for all variables forecasted at the three-month horizon (the shortest forecast horizon in the Consensus Economics data). We continue this logic for variables forecasted at the twelve-month horizon and the current year by then selecting the data for every fourth quarter. Similarly, we select every eighth quarter for variables that are forecasted to the end of the next year.

Crucially, we choose Consensus Economics survey months to represent a given quarter so that they always *follow* the release of a central bank projection. This allows us to ensure that central bank projections could have influenced private-sector forecasts. For example, we begin by choosing the Consensus Economics surveys from April, July, October of a given year, as well as January of the following year.[7] We attribute these surveys to the first, second, third, and fourth quarters of a given year respectively.[8] This is very similar to the approach taken by Andrade et al. (2016) to construct quarterly survey data from Blue Chip Financial Forecasts.

We then refine this approach in an additional step. We attempt to select the survey month that most immediately follows the corresponding central bank projections. Often, the April, July, October, and January survey months are appropriate for doing so (as discussed above). In many cases, however, a central bank released a projection early in the quarter and not again until the next quarter. In such cases, wherever practical, we choose a survey month earlier in the quarter to maintain roughly the same proximity between the central bank projection release and private-sector forecast release. Overall, our timing strategy is similar to that from Hubert (2015a) and other related studies.

Accordingly, in some cases, the selection of survey month necessarily varies across country and time. Over the sample period, central banks occasionally release their projections in different months and at different frequencies. The patterns of these releases are very consistent within countries, but there are nonetheless many instances in which they vary. For example, in 2000

[7] Each Consensus Economics survey is conducted at the beginning of the month.

[8] For the fixed-event inflation and output forecasts, we make an exception for the January survey, which would correspond to a different set of projected variable-years. Hence, for the Q4 forecast data, we revert to the survey from the month before, December.

and 2001, the Bank of Canada released its projections in February, before switching to January for the rest of our sample period. In such cases, we are then forced to change the usual Consensus Economics survey month for that country to ensure that it follows the new central bank projection release date.

3.4 Independent variables: central bank projections data

We constructed a new data set that records whether central bank i released a given macroeconomic projection in quarter t. These data were hand-collected from more than 2400 economic projection releases over the sample period. We recorded the existence of six types of macroeconomic projections: inflation, domestic output, global output, unemployment, the output gap, and forward guidance (including policy rate projections). Each variable is a binary variable that takes the value one when a macroeconomic projection was released by the central bank and zero otherwise. The primary source for these data are monetary policy reports, inflation reports, central bank bulletins, and other related central bank periodicals. For older forecasts, some of the periodicals are not available online, so to source the material, we reached out to a number of central banks, which kindly offered us their support.

Historically, central banks have often begun by first releasing inflation and domestic output projections, often following later with some combination of global-output, unemployment, output-gap, and, in some cases, policy rate projections (among other types of projections). Usefully, this release pattern varies widely from central bank to central bank. Some central banks chose to add extra types of projections only very gradually over time, while others decided to begin releasing a full suite of projections all at once. In general, the patterns of central bank releases are fairly systematic, but there is a great deal of variation both longitudinally and cross-sectionally. Over the years, central bank projection release patterns have changed. For instance, historically, releases switched frequency (e.g. from semi-annual to quarterly) and schedule (e.g. from Q1 to Q2). This heterogeneity affords us a great deal of variation in this large data set, which is plotted in Figure 1.

One restriction is that our binary variable for inflation projections is highly correlated with our binary variable for domestic output projections ($\rho = 0.91$). Hence, we drop the output projection and proceed with caution knowing that it is difficult to disentangle the effects of central bank inflation projections from output projections because they so often appear together. To better isolate the effect of each type of central bank projection, we include regressions that use only one central bank projection binary variable at a time in the online appendix.

Many central banks provide output-gap estimates but a key distinction must be made. Whereas some central banks only provide an estimate of the current output gap, others provide both this estimate as well as a projection. The purpose of this paper is to better understand the role of central bank projections in private-sector forecasts. So, for two reasons, we only score output gap *projections* as a one and leave aside *estimates*. Our hypothesis is that central bank projections of the future state of the economy affect private-sector forecast dispersion. We also do so for consistency: all other central bank projections are counted as a one only when a forward-looking projection is provided.

We consider two attributes of forward guidance as well as policy rate projections in our analysis. First, we recorded all instances when central banks released quantitative projections of their policy rates. Such projections are typically released in monetary policy reports. Rate projections were first released by the Reserve Bank of New Zealand (1997), then by the Norges Bank (2005), followed by the Sveriges Riksbank (2007), the Czech National Bank (2008), and most recently, by the FOMC (2012). These are identified as *Rate Projection* in the results tables.

Second, we recorded all instances of forward guidance in the more typical sense. Central banks often provide discussions of the likely path of the policy rate or a policy bias in press releases. Accordingly, we score all such cases as a one and a zero otherwise. To do this, we read all through monetary policy press releases from each central bank in our sample period and assigned a score of one when forward guidance was used and zero otherwise.

We categorize each instance of forward guidance as having either time-contingent attributes, state-contingent attributes, or both. For example, in 2017, the European Central Bank began providing forward guidance that had both time-contingent and state-contingent attributes. In some cases, central banks provide both a policy rate projection and time-contingent forward guidance, such as the Riksbank and the Reserve Bank of New Zealand. Most of the better-known cases of forward guidance are documented in Woodford (2013), Kool and Thornton (2015), Charbonneau and Rennison (2015), and Obstfeld et al. (2016), so we record these accordingly. Many less-frequently documented cases, such as forward guidance in Poland (see Baranowski and Gajewski (2016)) Australia, and earlier instances in New Zealand, however, also merit scores of one.

In our scoring methodology, forward guidance is simply any statement that articulates the probable future stance of monetary policy.[9] Specifically, time-contingent forward guidance is any forward-looking statement that provides insight into the future stance of monetary policy with reference to either an implicit or explicit time horizon. State-contingent forward guidance is any forward-looking statement that provides insight into the future stance of monetary policy with reference to some specific state of the world.

Typically, this state is closely related to the central bank's inflation target, but in some cases it is not. Most examples of forward guidance are fairly clear, but, admittedly, it was necessary to use judgment in some cases. Whenever possible, we relied on studies from each national central bank to corroborate our scoring (e.g. Fujiwara (2005), Andersson and Hofmann (2009), Kool and Thornton (2015), Charbonneau and Rennison (2015), Baranowski and Gajewski (2016), and Brubakk et al. (2017)).

[9] "Forward guidance in monetary policy means providing some information about future policy settings" (Svensson (2015), page 20).

3.5 Control variables: financial and economic data

Conditional volatility is included because forecaster dispersion is likely to be higher in times of volatile macroeconomic conditions. Following, Capistrán and Timmermann (2009), Capistrán and Ramos-Francia (2010), Ehrmann et al. (2012), and Csávás et al. (2012), our conditional volatility measures are the predicted values from a AR(1,2)-GARCH(1,1) model of the realized data for a given country and quarter. The macroeconomic variables are estimated at the quarterly frequency, and the rates and oil variables are measured at the monthly frequency.

Similarly, Ehrmann et al. (2012) hypothesize that large changes in oil prices would also be associated with heightened forecaster uncertainty and therefore greater forecast dispersion. To maintain comparability to their model and that of Naszodi et al. (2016), we also include the absolute value of the change in the price of WTI oil from the end of one month to the next. We also hypothesize that financial-market volatility might contribute to forecaster disagreement and test this by including the level of VIX. This variable is not included in other closely related studies, but we find that this control is usually significant. Both the oil and VIX data are sourced from Thomson Reuters Datastream.

3.6 Inflation targeters

As discussed, we split each country's sample into two mutually exclusive periods: inflation-targeting periods and non-inflation-targeting periods. All twenty-three central banks in our sample become inflation targeters at some point in the sample. Fortunately, the transition dates from non-inflation targeters to inflation targeters vary widely. As in most related studies (e.g. Crowe (2010), Capistrán and Ramos-Francia (2010) and Ehrmann et al. (2012)), we use the date of adoption to mark the beginning of inflation targeting. The dates were gathered primarily from Roger et al. (2005), Bank for International Settlements (2009), and Hammond (2012).

The first central bank to adopt an inflation target, the Reserve Bank of New Zealand, happened

to do so in the first quarter of our 110-quarter sample (Q1 1990). The last central bank to adopt an inflation target in our sample, the Central Bank of the Russian Federation, did so in the first quarter of 2015. The other twenty-one transitions are scattered rather evenly across our sample period (see Figure 2).

Categorizing each central bank as either an inflation targeter or non-inflation targeter has some limitations, however. For instance, Filardo and Genberg (2010) suggest that central banks may be regarded as inflation targeters even if they don't have an explicit inflation target. Similarly, a central bank may not be considered a credible inflation targeter even if it has an explicit inflation target. Filardo and Genberg (2010) also suggest that there may be regional benefits of being an inflation targeter. That is, if a certain country adopts inflation targeting, close-by countries could benefit. Overall, this suggests that there may be more latent aspects, such as credibility, related to inflation targeting that cannot be captured well by our indicator. We argue, however, that our inflation targeter indicator should nonetheless capture most of the benefits.

3.7 Effective lower bound

Further, we are interested in whether forecaster behaviour varies during periods at the ELB. Nearby rates forecasts may become less dispersed and more predictable because the scope for rate cuts is effectively absent. Rate increases may also be perceived as less likely in the short term (particularly if forward guidance is employed, but this should be detected by our forward-guidance variable). Similarly, nearby macroeconomic forecasts might be less dispersed as low-growth, low-inflation periods are anticipated. Forecasters might disagree on how long economic conditions will take to stabilize and, for that matter, how long it will take for central banks to unwind highly accommodative monetary policy.

This could actually result in *more* forecaster disagreement and error for longer-term forecasters. To detect these dynamics, we include an ELB variable in our panel regressions. The dummy variable takes the value 1 when the policy rate reached either the *announced ELB*, or, in the

absence of such a clear guideline, the zero lower bound. We searched central bank websites for announcements that quantify the ELB. There are numerous examples of central banks operating at an announced ELB in our sample, such as the Bank of Canada (2009–10) and, less explicitly, the European Central Bank (2014–17).

4 Results

Our results suggest that central bank projections matter mainly for private-sector forecast disagreement surrounding upcoming policy rate decisions and matter less for other macroeconomic forecasts. Three main reasons support this interpretation. First, we detect strong negative associations between the availability of central bank projections and private-sector *policy rate* forecast disagreement.[10] This suggests that central bank projections are used as inputs to private-sector policy rate forecasts. Second, we detect far fewer associations between the availability of central bank projections and private-sector *macroeconomic* forecast disagreement and error. This suggests that central bank projections are not really used as inputs to private-sector macroeconomic forecasts. Third, among central bank projections, those most closely related to the inflation target have the strongest associations (inflation, in particular, but the output gap as well), while others, such as unemployment, have much weaker associations. This suggests that central bank projections of their target variables are used as inputs to private-sector policy rate forecasts. The combination of these three observations suggests that private-sector forecasters use central bank projections primarily as monetary policy signals. We investigate these results and others in detail below.

[10] In this paper, we interpret the three-month Treasury bill yield as a close proxy for the central bank policy rate. Indeed, in some countries in our sample, when completing the Consensus Economics survey, private-sector forecasters are instructed to forecast the central bank policy rate instead of the three-month Treasury bill yield. The ten-year yield interpretation is less straightforward. Although the ten-year yield should correspond to the expected path of policy rates, this interpretation is obfuscated somewhat by term-premia expectations.

4.1 Central bank projections and private-sector rate forecasts

To consider the role of central bank projections in private-sector policy rate forecasts in more detail, we restrict the sample period. We split the sample into periods when central banks had implemented inflation targets and periods when they had not (i.e. the white space compared with the dark blue space in the charts in Figure 2). The regressions that follow apply to inflation-targeting periods only. This allows us to rule out many other plausible explanations for reductions in private-sector forecast error. Our control variables correct for macroeconomic and financial-market conditions but do not correct for other changes induced by central banks. The announcement of inflation targeting in each country, the introduction of monetary policy reports, and the introduction of press releases announcing interest rate decisions typically took place before each country's respective sample period begins. Hence, the reductions in forecast dispersion and forecast error observed below should not be attributable to other central bank communication innovations.

Below, we find that central bank projections are generally associated with lower private-sector forecaster disagreement and lower forecast error. Specifically, this applies for private-sector forecasts of short-term interest rates (columns 1 to 4 in Table 2), less for long-term yields (columns 5 to 8 in Table 2), and even less for inflation and domestic output (columns 1 to 8 in Table 3). Further, central banks' target-variable projections, such as inflation and the output gap, appear to matter more than other central bank projections, such as unemployment (rows 1 and 2 versus row 3). When the full sample is used, the coefficients in tables 2 and 3 are similar, albeit more negative and with smaller p-values, yet, for reasons discussed above, identification is more difficult when the full sample is used.

Related to our work, Mokhtarzadeh and Petersen (2017) perform an experimental study that considers how particular central bank projections affect macroeconomic expectations. The authors find that central bank projections can guide subjects' (i.e. forecasters') expectations to be more consistent with rational expectations. Specifically, central bank inflation and output-gap projections lead to increased forecast coordination as well as reduced forecast errors. These

results are closely aligned with our own in tables 2 and 3. In their study, the effects of central bank policy rate projections are more nuanced. In relatively certain periods (low variability in aggregate-demand shocks), central bank policy rate projections tend to improve subjects' forecasts. In relatively uncertain periods (high variability in aggregate-demand shocks), central bank policy rate projections may become more difficult to interpret. By contrast, we do not find evidence here that central bank policy rate projections tend to improve private-sector forecasts—whether in high- or low-volatility periods. More detailed investigation of forecast error, such as one using mean-squared error instead of absolute mean forecast error, however, could allow us to detect this nuance empirically.

4.2 Forward guidance

The results in Table 2 suggest that forward guidance is particularly important for *nearby* disagreement about rate expectations (column 1). These results suggest that forward guidance is not as important for private-sector forecasts of the *path of interest rates*. So, although forward guidance may transmit well to short-term rate expectations (columns 1 to 4), its ability to affect longer-term rates may be somewhat limited (columns 5 to 8). In particular, this result appears to be driven more by the time-contingent rather than state-contingent attributes of forward guidance. It is difficult to truly distinguish between these two types of forward guidance, however, because the two types frequently overlap. That is, central banks often use both at the same time.

In part, this interpretation may be obfuscated by the presence of term premia in longer-term rates, but, at a minimum, these results suggest that the monetary policy signaling channel of forward guidance does not dominate other channels (such as the portfolio-rebalancing channel) enough for us to detect its effects in forecaster disagreement. Overall, the results in Table 2 are broadly consistent with those in Table 3 in Coenen et al. (2017); however, the authors offer more nuanced interpretations with respect to subtypes of forward guidance and quantitative easing periods. The results are robust across various sub-regions (e.g. advanced economies, emerging-

market economies, the euro area), although, naturally, there are some regional differences.[11]

Table 3 in this paper, by contrast, shows that either type of forward guidance does not appear to be particularly important for inflation disagreement (columns 1 to 4).[12] In conjunction with the results discussed above, this might suggest that although the central bank can send a relatively clear signal about the path of monetary policy, the transmission mechanism from forward guidance to inflation disagreement is not particularly strong. However, time-contingent forward guidance may exert strong influence on longer-term growth expectations (Table 3, columns 7 and 8).

The results for the ELB coefficients mix both intuitive and somewhat surprising results. Columns 1 to 4 in Table 2 show that both forecast dispersion and forecast error for short-term rates tend to be substantially lower in ELB periods. Considering this result, it is then somewhat surprising that columns 5 to 8 in Table 2 show that both forecast dispersion and forecast error for long-term rates *do not* tend to be substantially lower in ELB periods. Perhaps the *path* of interest rates could be less clear than the levels in the near future and/or the magnitude of term premia could be very uncertain given macroeconomic uncertainty.

4.3 Limitations

Our findings thus far have shed light on several different areas of the provision of macroeconomic projections and forward guidance decisions made by central banks. However, we must acknowledge a number of limitations.

First, in this paper the provision of different macroeconomic projections are scored as dummy variables (as in much of the literature, see Ehrmann et al. (2012), Naszodi et al. (2016), Coenen et al. (2017)). We are unable to distinguish between the provision of output and inflation fore-

[11] These differences are demonstrated in the accompanying online appendix.

[12] By contrast, Coenen et al. (2017) find that the reduction in forecaster disagreement indeed extends to inflation and output growth.

casts as in the majority of central banks, they have always been released together. Hence, the significance we see on the inflation coefficient also captures the provision of output projections.

Second, there may be an endogeneity issues related to forward guidance. By definition, forward guidance—an unconventional monetary policy tool—is often released in times of financial or economic stress. As such, it is difficult to isolate the true *ceteris paribus* effects of the provision of forward guidance. However, this issue should make it more, not less, difficult to find significant results because forward guidance should tend to coincide with times of greater uncertainty and likely greater forecaster disagreement.

Third, our approach does not directly consider the role of quantitative easing. It is possible that some of the forward guidance results could be driven by the use of quantitative easing as well. This risk is mitigated in a number of ways. There are *many* more instances of forward guidance, both with time-contingent and state-contingent attributes, than there are instances of quantitative easing. Also, these forward guidance episodes are fairly pervasive across countries and time. Finally, some of the effects of quantitative easing should be picked up in our controls (namely, the VIX and conditional volatility).

4.4 Central bank policy rate projections

Many argue along the lines of Svensson (2015) that "A published policy rate should affect market expectations of future policy rates and thereby the yield curve and longer market rates that have an impact on economic agents decision and this way contribute to a more effective implementation of monetary policy." We look at this issue from a different angle—private-sector forecast disagreement. Overall, we find that the provision of central bank policy rate projections does not matter much for private-sector forecast dispersion.

To examine this issue, we recorded all instances when central banks released quantitative projections of their policy rates. Such projections are typically released in monetary policy reports.

Rate projections were first released by Reserve Bank of New Zealand (1997), then by the Norges Bank (2005), followed by the Sveriges Riksbank (2007), the Czech National Bank (2008), and most recently, by the FOMC (2012).

Tables and 2 and 3 each include a line for *Rate Projection*. In virtually all cases, the coefficients are statistically indistinguishable from zero, which suggests that central bank policy rate path projections may have limited effects on private-sector forecast disagreement and forecast accuracy. One reason could be that the policy rate projections are not seen as credible.[13] Market-implied policy rate paths (e.g., those extracted from forward-rate curves) frequently differ from central banks' policy rate paths. Svensson (2015) demonstrates these discrepancies in the United States, New Zealand, and especially, Sweden. In particular, the paper argues that the Sveriges Riksbank's policy rate path projections were not credible in September 2011 and other subsequent periods.[14]

Another reason could be that forward guidance (i.e. the wording used in press releases) dominates these quantitative projections as policy rate path projections are often accompanied by verbal forward guidance as well.[15] Finally, the inclusion of wide confidence intervals around central banks' rate-path projections could dilute their precision and blunt their impact.[16] Whatever the underlying reason, the evidence presented in this paper suggests that rate path projections do little to reduce forecast dispersion and forecast error. This does not, however, necessarily suggest that central banks' policy rate path projections do not affect policy rate expectations more broadly. Brubakk et al. (2017), for example, find that policy rate projections provided by the Norges Bank and Sveriges Riksbank succeeded in guiding market-implied interest rate projections in the desired direction.

[13] "The public might focus on, say, a projected interest rate one year ahead, and become disillusioned when, inevitably, the forecast turned out to be inaccurate" (Sims (2010), page 176).

[14] Svensson (2015), page 28, defines credibility as "the extent to which market expectations are in line with the published interest rate path, regardless of whether the interest rate path is appropriate in achieving the monetary policy objectives."

[15] "But central banks that have taken this course have done so in the context of detailed, regularly updated, inflation reports, of which interest rate forecasts are only one element, and often not the most newsworthy one" (Sims (2010), page 176).

[16] "Interest rate forecasts are usually displayed as fan charts that inhibit their interpretation as simple numerical targets" (Sims (2010), page 176).

4.5 Central bank policy rate path assumptions

Many papers have argued that central bank projections that rely on an endogenous policy rate path assumption are more informative than those that use market-implied or constant policy rate path assumptions (e.g. Svensson (2006), Galí (2011), and Woodford (2013)). Although there is a lively debate in the literature about this issue, the consensus appears to be that, at a minimum, central banks should make efforts to provide at least some information about their policy rate path assumptions (e.g. Goodhart et al. (2009)).

With an endogenous rate-path assumption, the public would, in theory, know that the central bank projections account for the likely response of that central bank to a given projected macroeconomic variable. Hence, the projection may be more realistic; it may be the central bank's best estimate of the progression of the projected macroeconomic variable. With an exogenous rate-path assumption (i.e. a market-implied or constant rate), the assumed policy rate path may differ from the one the central bank would actually take given the projected evolution of the macroeconomic variables. To the extent that the central bank may ultimately deviate from the assumed, exogenous path, and, to the extent that this deviation could affect the projected macroeconomic variables, the central bank's projection may be unrealistic. Accordingly, the projection may be less informative and ultimately increase private-sector forecast dispersion and/or private-sector forecast error. In this section, we attempt to test that hypothesis.

First, we recorded the rate-path assumptions used by central banks in their projections. The projection rate-path assumptions are primarily sourced from Hammond (2012), which are accurate as of 2012. We must also account for the time-varying nature of these assumptions as many central banks changed their policy rate assumption over our sample period (1990 to 2017). We augment the data from Hammond (2012) with the central banks' respective monetary policy (inflation) reports and with discussion from Bank for International Settlements (2009), Woodford (2013), Hubert (2015a) and Hubert (2015b). We categorize central bank projections into one

of three categories: those that use an endogenous, a market-implied, or a constant policy rate path assumption.[17] We then use these categorizations to sort our benchmark panel regressions from equation 1 into three sample groups. These data are depicted in Figure 3.

Tables 4 and 5 disaggregate the results from Tables and 2 and 3. In each, columns 1 and 2 show the full-sample results, but columns 3-4, 5-6, and 7-8, split the results by the policy rate-path assumption used in the central bank projections (endogenous, market-implied, and constant respectively). The results show that the magnitudes of reduction in forecast dispersion and forecast accuracy associated with each type of policy rate assumption—although negative, statistically significant, and economically significant in many cases—are, in general, statistically indiscernible from one another.[18] Many argue that an endogenous policy rate path assumption in projections should be more informative than an exogenous one. The results here, however, suggest that endogenous rate-path assumptions are no more useful for professional forecasters.

The *source* of central bank projections may also be important to private-sector forecasters. Projections provided by monetary policy decision-makers may be judged to have greater monetary policy signal content (Romer and Romer (2000) and Ellison and Sargent (2012)). Alternatively, committee-provided projections may be perceived as less accurate than staff-produced forecasts (Romer and Romer (2008)). At the same time, projections provided by monetary policy decision-makers may be seen as biased (Romer and Romer (2008) and Ellison and Sargent (2012)). One reason is that policy-makers may have different information sets and heterogeneous preferences, as outlined in Hansen et al. (2014).

To test some of these hypotheses, we gathered data on projection *source* from Hammond (2012),

[17] Central bank projections that use an endogenous policy rate path assumption are also referred to as unconditional forecasts in the literature, whereas those that use either a market-implied or a constant policy rate path assumption are also referred to as conditional forecasts in the literature.

[18] One exception might be central bank projections that use a market-implied policy rate path assumption (columns 5-6). Whereas the other results for inflation and the output gap (rows 1 and 2) are negative and significant, we do not observe this for projections using a market-implied policy rate assumption. Central banks currently using this approach include the Reserve Bank of Australia, the European Central Bank, the Bank of Japan, the Bank of Korea, the National Bank of Slovakia, and the Bank of England (the Bank of England also releases projections that use a constant interest-rate-path assumption). The Norges Bank has also used a market-implied rate-path assumption periodically in its history.

the central banks' respective monetary policy (inflation) reports, and discussion from Bank for International Settlements (2009), Woodford (2013), and Hubert (2015a). We categorized central bank projections into one of three types: committee-provided (i.e. monetary policy decision-makers), staff-provided, or more generally, central bank provided. We then use these to sort our benchmark panel regressions from equation [1] into two groups: (i) monetary policy committee projections, or (ii) central bank projections (i.e. staff projections or those from the central bank). The full suite of binary variables is depicted in Figure 3.

Similar to the results discussed above, we find that projections provided by monetary policy decision-makers do not have any greater impact than those provided by the staff or the central bank more generally (these results are included in the online appendix). What might explain these results? One interpretation is that projections are already a source of noisy information (Sims (2003)). The macroeconomic projection, regardless of rate-path assumption, is still the central bank's published projection. The difference in projection source or rate-path assumption may simply make an already noisy signal only slightly more or less noisy.[19] The overall value of central bank projections as monetary policy signals may remain intact regardless of the policy rate path assumption or projection source.

Our results are also broadly consistent with recent findings from Knüppel and Schultefrankenfeld (2017). To study this issue, the authors compare the predictive accuracy of Bank of England projections to those of the Banco Central do Brasil and find no statistical difference. From this, the authors conclude that "the choice of the interest rate assumption appears to be of minor relevance empirically." Our results, which are based on a much larger sample group and sample period, are aligned with this conclusion and suggest that both the policy rate path assumption and the projection source may not be so important after all.

[19] "Since people are unlikely to have loss functions that make minor deviations of forecast from actual interest rates important to them, they are unlikely to focus narrow attention on interest rate point forecasts when these are just one part of a richer presentation of information" (Sims (2010), page 176).

5 Conclusion

In this paper, we have presented estimates of the effect of providing various types of central bank projections and forward guidance on private-sector forecast disagreement. Our results suggest that central bank projections and forward guidance matter mainly for private-sector forecast disagreement surrounding upcoming policy rate decisions and matter less for other private-sector macroeconomic forecasts. In particular, central bank projections of target variables appear to exert the greatest influence. This suggests that private-sector forecasters may use central bank projections principally as monetary policy signals. A study of the relationship between the revisions to central bank projections and revisions to private-sector forecasts would allow for a better assessment of the role of central bank projections as monetary policy signals and this is left for future research.

Additionally, there are ongoing debates in the literature about whether a central bank should release its policy rate projection and about what policy rate path assumption a central bank should use in its macroeconomic projections. We find that neither choice appears to matter much for private-sector forecast disagreement. At least when glimpsed through the lens of disagreement, this provides some evidence that these particular central bank communication choices may not be so crucial.

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A Appendix: Tables and Figures

Table 1: **Summary statistics for private-sector forecast dispersion and absolute forecast error (inflation-targeting periods only)**

	Mean	Standard Deviation	Count	Minimum	Maximum
Inter-decile range					
3M (3M)	0.48	0.48	1069	0.00	6.50
3M (12M)	0.92	0.59	1069	0.02	6.50
10Y (3M)	0.67	0.48	1069	0.05	6.00
10Y (12M)	0.98	0.56	1069	0.20	6.10
CPI (CY)	0.46	0.37	1069	0.00	3.70
CPI (NY)	0.90	0.53	1069	0.13	5.06
GDP (CY)	0.63	0.41	1069	0.02	3.90
GDP (NY)	1.02	0.47	1069	0.20	4.40
Absolute forecast error					
3M (3M)	0.48	0.63	1069	0.00	7.09
3M (12M)	0.96	0.92	1069	0.00	6.73
10Y (3M)	0.51	0.47	1069	0.00	6.43
10Y (12M)	0.93	0.75	1069	0.00	5.57
CPI (CY)	0.26	0.31	1069	0.00	2.74
CPI (NY)	0.80	0.66	1069	0.00	5.14
GDP (CY)	0.69	0.66	1069	0.00	8.14
GDP (NY)	1.17	1.25	1069	0.00	11.64

This table shows summary statistics for the dependent variables (inflation-targeting periods only). The key independent variables (central bank projection dummy variables) are charted in Figure 1.

Row interpretations (examples):
3M (3M) refers to the fixed-window forecast of the three-month rate in three months' time.
CPI (CY) refers to the fixed-event forecast of inflation (CPI) for the current year (CY).

Table 2: **Private-sector rate forecasts in inflation-targeting periods: forecast dispersion and absolute forecast error**

	3-month government bill rate				**10-year government bond yield**			
	3-month forecast horizon		12-month forecast horizon		3-month forecast horizon		12-month forecast horizon	
	Dispersion [1]	Error [2]	Dispersion [3]	Error [4]	Dispersion [5]	Error [6]	Dispersion [7]	Error [8]
Inflation	-0.25***	-0.22*	-0.21	-0.62**	-0.10	-0.15**	0.06	0.14
	(0.08)	(0.12)	(0.14)	(0.29)	(0.06)	(0.06)	(0.12)	(0.34)
Output Gap	-0.09	-0.19**	-0.31**	-0.39	-0.09	-0.02	-0.31**	-0.10
	(0.07)	(0.09)	(0.13)	(0.27)	(0.06)	(0.02)	(0.11)	(0.20)
Unemployment	0.06	0.07	-0.26**	-0.11	0.05	0.02	-0.11	-0.02
	(0.06)	(0.11)	(0.11)	(0.18)	(0.06)	(0.06)	(0.09)	(0.31)
Rate Projection	0.07	-0.06	0.09	0.23	0.04	-0.05	0.11	-0.01
	(0.09)	(0.19)	(0.12)	(0.33)	(0.07)	(0.08)	(0.14)	(0.19)
FG Time-contingent	-0.10***	0.00	0.03	-0.04	-0.01	0.04	0.06	-0.09
	(0.03)	(0.08)	(0.10)	(0.17)	(0.04)	(0.07)	(0.08)	(0.14)
FG State-contingent	0.03	0.16	-0.03	-0.73**	-0.01	0.08	0.02	0.30*
	(0.03)	(0.12)	(0.07)	(0.33)	(0.05)	(0.11)	(0.08)	(0.16)
Effective lowerbound	-0.09***	-0.15**	-0.24***	-0.30***	0.06	0.01	0.04	0.05
	(0.03)	(0.06)	(0.08)	(0.08)	(0.04)	(0.03)	(0.05)	(0.09)
Constant	0.49***	0.29**	1.03***	1.43***	0.48***	0.49***	0.85***	0.96***
	(0.05)	(0.11)	(0.09)	(0.18)	(0.05)	(0.06)	(0.13)	(0.21)
Adjusted R^2	0.15	0.13	0.30	0.11	0.31	0.05	0.10	0.01
N	1487	1445	379	357	1194	1163	305	289

This table shows summary statistics from panel regressions with country fixed effects and White (1980) standard errors.
Rows correspond to binary variables indicating the availability of a type of *central bank projection* or forward guidance (FG).
Standard errors in parentheses. The control variables are suppressed here for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3: **Private-sector macro forecasts in inflation-targeting periods: forecast dispersion and absolute forecast error**

	Inflation rate				**Domestic growth**			
	Current-year forecast		Next-year forecast		Current-year forecast		Next-year forecast	
	Dispersion [1]	Error [2]	Dispersion [3]	Error [4]	Dispersion [5]	Error [6]	Dispersion [7]	Error [8]
Inflation	-0.07	-0.20	0.00	-0.15	-0.12	-0.12	-0.05	0.28
	(0.08)	(0.12)	(0.16)	(0.27)	(0.08)	(0.16)	(0.11)	(0.52)
Output Gap	0.01	0.07	-0.15	0.36**	-0.02	0.08	0.09	-0.01
	(0.09)	(0.13)	(0.12)	(0.16)	(0.14)	(0.13)	(0.07)	(0.97)
Unemployment	-0.20***	-0.14	-0.24*	-0.21	0.03	-0.13	-0.12*	0.40
	(0.06)	(0.12)	(0.13)	(0.22)	(0.08)	(0.12)	(0.06)	(0.49)
Rate Projection	0.01	-0.16	0.04	0.02	0.24	0.10	0.25*	0.96
	(0.12)	(0.15)	(0.20)	(0.46)	(0.15)	(0.28)	(0.13)	(0.82)
FG Time-contingent	-0.00	0.07	0.23	0.26	-0.04	0.10	-0.22***	-0.50
	(0.07)	(0.12)	(0.19)	(0.30)	(0.05)	(0.15)	(0.06)	(0.36)
FG State-contingent	0.20	-0.08	-0.26	0.14	-0.04	-0.04	-0.16	-0.82*
	(0.13)	(0.10)	(0.17)	(0.22)	(0.09)	(0.35)	(0.17)	(0.45)
Effective lower bound	0.14**	0.02	0.04	0.25	-0.03	-0.38***	0.04	-0.62**
	(0.06)	(0.06)	(0.14)	(0.25)	(0.05)	(0.09)	(0.08)	(0.25)
Constant	0.51***	0.58***	0.94***	1.09***	0.25*	0.52**	0.97***	-0.04
	(0.10)	(0.08)	(0.16)	(0.33)	(0.13)	(0.21)	(0.09)	(0.43)
Adjusted R^2	0.21	0.06	0.09	0.03	0.42	0.06	0.08	0.18
N	405	380	194	169	400	378	192	170

This table shows summary statistics from panel regressions with country fixed effects and White (1980) standard errors.
Rows correspond to binary variables indicating the availability of a type of *central bank projection* or forward guidance (FG).
Standard errors in parentheses. The control variables are suppressed here for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: **Private-sector rate forecasts in inflation-targeting periods split by policy rate assumption**

	3-month government bill rate forecast at the 3-month forecast horizon							
	Full sample		Endogenous rate		Market rate		Constant rate	
	Dispersion [1]	Error [2]	Dispersion [3]	Error [4]	Dispersion [5]	Error [6]	Dispersion [7]	Error [8]
Inflation	-0.25***	-0.22*	-0.51	-0.60**	0.07*	0.15*	-0.28***	-0.34***
	(0.08)	(0.12)	(0.32)	(0.26)	(0.04)	(0.08)	(0.08)	(0.10)
Output Gap	-0.09	-0.19**	-0.12	-0.14	0.01	-0.06	-0.10	-0.21
	(0.07)	(0.09)	(0.09)	(0.10)	(0.05)	(0.07)	(0.14)	(0.16)
Unemployment	0.06	0.07	0.13	0.05	-0.09***	-0.07	-0.03	0.12
	(0.06)	(0.11)	(0.08)	(0.16)	(0.03)	(0.05)	(0.07)	(0.08)
Rate Projection	0.07	-0.06	0.18	-0.13	0.12***	0.00	-	-
	(0.09)	(0.19)	(0.11)	(0.31)	(0.04)	(0.07)	-	-
FG Time-contingent	-0.10***	0.00	-0.11	0.10	-0.14***	0.12	-0.05	-0.30***
	(0.03)	(0.08)	(0.06)	(0.16)	(0.04)	(0.09)	(0.04)	(0.10)
FG State-contingent	0.03	0.16	0.07**	0.26	0.02	0.10	0.05	-0.30***
	(0.03)	(0.12)	(0.03)	(0.16)	(0.05)	(0.13)	(0.19)	(0.09)
Effective lower bound	-0.09***	-0.15**	-0.18***	-0.35**	-0.08*	-0.23***	-0.13***	-0.19**
	(0.03)	(0.06)	(0.05)	(0.11)	(0.03)	(0.05)	(0.04)	(0.07)
Constant	0.49***	0.29**	0.78***	0.99**	0.15***	-0.38***	0.54***	0.34***
	(0.05)	(0.11)	(0.16)	(0.39)	(0.03)	(0.09)	(0.06)	(0.11)
Adjusted R^2	0.15	0.13	0.13	0.12	0.38	0.36	0.16	0.11
N	1487	1445	482	463	423	406	631	623

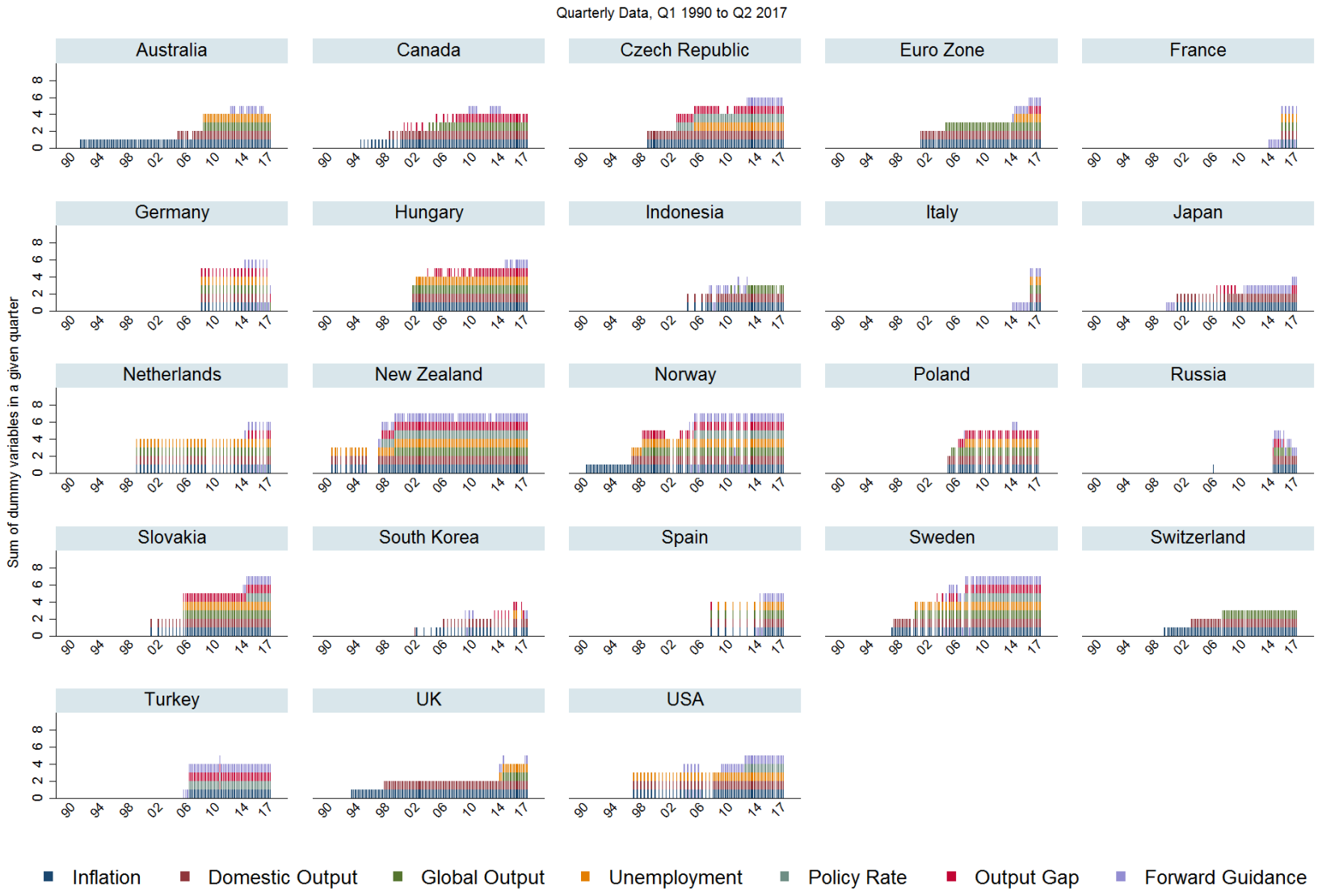
Rows correspond to binary variables indicating the availability of a type of *central bank projection* or forward guidance (FG). *Endogenous rate*, for example, refers to central bank projections produced using an endogenous policy rate assumption. This table shows summary statistics from panel regressions with country fixed effects and White (1980) standard errors. Standard errors in parentheses. The control variables are suppressed here for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: **Private-sector inflation forecasts in inflation-targeting periods split by policy rate assumption**

	Inflation rate forecast for the current year							
	Full sample		Endogenous rate		Market rate		Constant rate	
	Dispersion [1]	Error [2]	Dispersion [3]	Error [4]	Dispersion [5]	Error [6]	Dispersion [7]	Error [8]
Inflation	-0.07	-0.20	-0.05	-0.10*	-0.26	-0.47*	-0.12	-0.64***
	(0.08)	(0.12)	(0.10)	(0.05)	(0.16)	(0.22)	(0.15)	(0.13)
Output Gap	0.01	0.07	0.12	0.16	-0.03	-0.06	0.12	-0.02
	(0.09)	(0.13)	(0.14)	(0.10)	(0.11)	(0.24)	(0.18)	(0.21)
Unemployment	-0.20***	-0.14	-0.20*	-0.55***	0.14	0.24	-0.25*	0.20**
	(0.06)	(0.12)	(0.10)	(0.07)	(0.08)	(0.20)	(0.12)	(0.09)
Rate Projection	0.01	-0.16	-0.13	-0.34**	-0.07	0.13	-	-
	(0.12)	(0.15)	(0.21)	(0.11)	(0.11)	(0.13)	-	-
FG Time-contingent	-0.00	0.07	-0.06	0.10	0.07	-0.02	-0.22	-0.17
	(0.07)	(0.12)	(0.06)	(0.26)	(0.16)	(0.07)	(0.22)	(0.24)
FG State-contingent	0.20	-0.08	0.13*	-0.12	0.02	0.02	1.35	0.00
	(0.13)	(0.10)	(0.06)	(0.17)	(0.09)	(0.14)	(0.97)	(.)
Effective lower bound	0.14**	0.02	-0.13	-0.04	0.10	0.06	0.21	0.03
	(0.06)	(0.06)	(0.08)	(0.21)	(0.09)	(0.05)	(0.13)	(0.07)
Constant	0.51***	0.58***	0.75***	0.99***	0.21	0.51***	0.60***	0.78***
	(0.10)	(0.08)	(0.13)	(0.17)	(0.14)	(0.13)	(0.15)	(0.17)
Adjusted R^2	0.21	0.06	0.38	0.09	0.26	-0.02	0.39	0.14
N	405	380	125	116	119	106	168	163

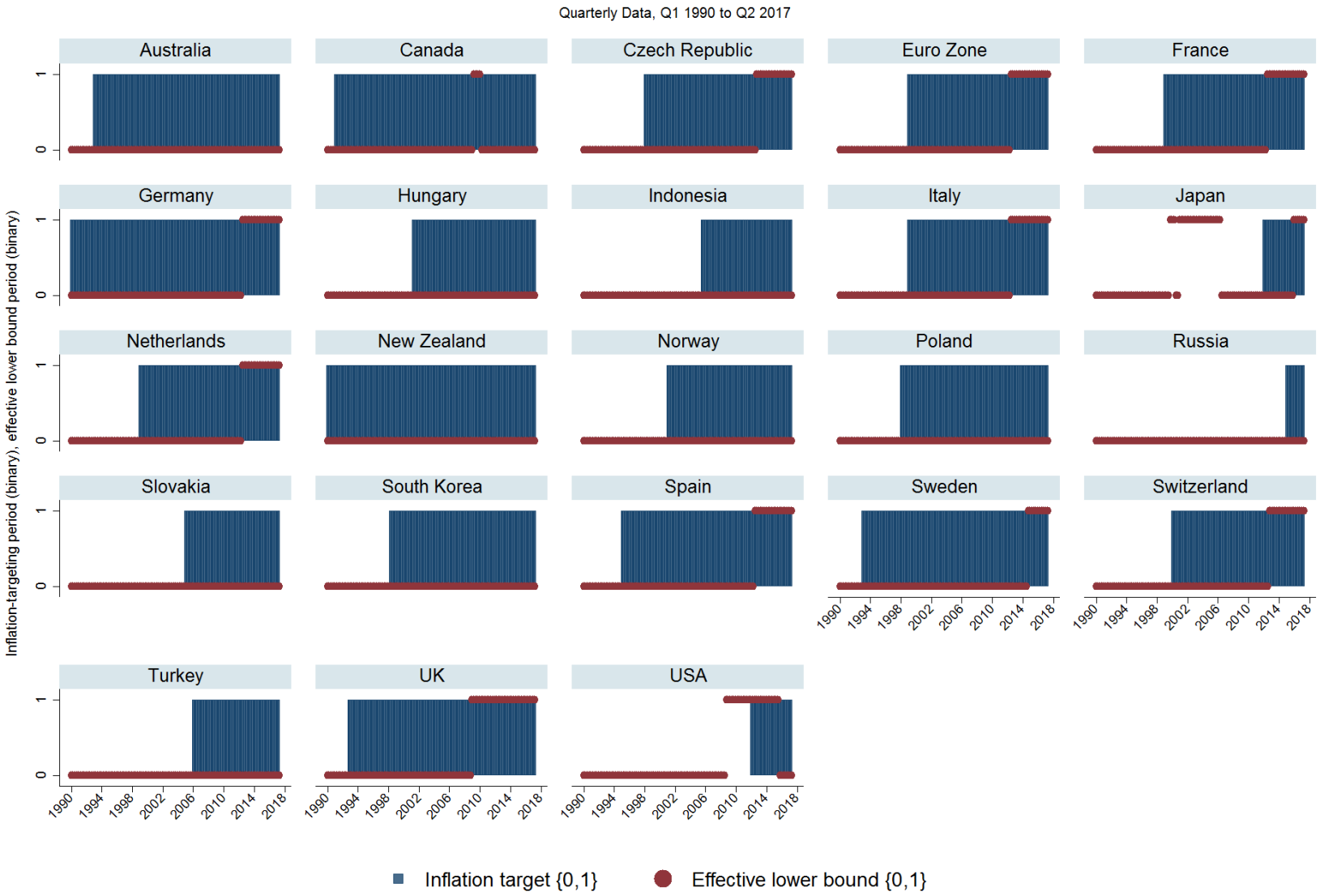
Rows correspond to binary variables indicating the availability of a type of *central bank projection* or forward guidance (FG). *Endogenous rate*, for example, refers to central bank projections produced using an endogenous policy rate assumption. This table shows summary statistics from panel regressions with country fixed effects and White (1980) standard errors. Standard errors in parentheses. The control variables are suppressed here for brevity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure 1: **Types of projections provided by central banks over time**



Note: The figure is a stacked bar chart of the dummy variables used in the panel regressions. The x-axis corresponds to quarterly observations.

Figure 2: **Inflation-targeting and effective lower bound periods by central bank**



Note: Dark blue space indicates an inflation-targeting period. Red dots indicate that the country was at the ELB that quarter.

Figure 3: **Central bank projections: policy rate assumption (PRA) and projection source (PS)**

Notes: Stacked bar chart of the dummy variables. Key data source: Hammond (2012). PRA: policy-rate assumption; PS: projection source. Note: the PRA for Indonesia is a scenario.