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

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We construct a 23-country panel data set to consider the effect of central bank projections and forward guidance on private-sector forecasts. Despite the strong arguments in the literature in favor of releasing central bank policy rate projections, we find that the provision of these projections reduces neither private-sector forecast dispersion nor forecast error. Further, the policy rate assumption that central banks use in their macroeconomic projections has not appeared to matter much for private-sector forecasts. We also find that forward guidance tends to reduce the dispersion and error of interest rate forecasts but less so for macroeconomic forecasts. This is consistent with the idea in the literature that forward guidance can lower interest rate forecast disagreement without reducing macroeconomic forecast disagreement because forward guidance can be interpreted by forecasters as either Delphic or Odyssean.

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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, Eijffinger, and Fratzscher 2012; Naszodi et al. 2016; Lustenberger and Rossi 2017, 2020). 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, 23-country panel data set dating back to 1990 that records whether central banks provided six types of economic projections and three 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 more complete picture of monetary policy communication. Unlike other closely related studies, we incorporate the publication of additional economic projections, such as unemployment and policy rate projections, as well as qualitative, time-contingent, and state-contingent forward guidance. Our data are then used in conjunction with private-sector forecast data to estimate the impact of the provision of economic projections and forward guidance on private-sector forecast disagreement and forecast error. We are able to offer the following conclusions.

We find that the provision of central bank policy rate projections reduces neither private-sector forecast dispersion nor forecast error. In fact, when it comes to private-sector interest rate forecast dispersion, we find evidence that central bank policy rate projections

[1]Three 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, p. 232), Ehrmann, Eijffinger, and Fratzscher (2012, p. 1028), and Naszodi et al. (2016, p. 166).

can actually increase forecast disagreement. It could be that central bank policy rate projections are difficult to interpret, especially in periods of heightened macroeconomic uncertainty. Central bank policy rate projections could also lose credibility over time if they have proven to be inaccurate in the past. Another possibility is that any signal conveyed by policy rate projections is dampened by the flood of information simultaneously released by central banks. The inclusion of wide confidence intervals around central banks' policy rate projections could add noise to the signal as well.

We also studied central bank inflation projections and found that they have tended to reduce both the forecast dispersion and forecast error of private-sector interest rate forecasts. Central bank inflation projections appear to have more influence over private-sector interest rate forecasts than macroeconomic forecasts, which suggests that inflation projections may primarily be used by private-sector forecasters to help forecast the path of monetary policy. In fact, central bank unemployment projections actually appear to increase private-sector disagreement and forecast error. One possibility is that some private-sector forecasters perceive unemployment projections as less important to inflation-targeting central banks than, for example, inflation projections or forward guidance. Surprisingly, central bank output gap projections appear to have fairly weak influence on private-sector forecast disagreement and forecast error. Nonetheless, the more projections a central bank released, the lower private-sector forecast dispersion and error tended to be, particularly for private inflation forecasts. This suggests that a larger set of central bank projections indeed provides more information.

We find that forward guidance tends to reduce private-sector interest rate forecast dispersion and forecast error, but the effect is weaker for inflation or domestic output forecast disagreement and error. These results add to the evidence provided by Andrade et al. (2019) that when the Federal Reserve used time-contingent forward guidance, private-sector short-term interest rate forecast disagreement fell to a historical low but some of those same forecasters revised their macroeconomic forecasts in opposite directions. One group, optimistic forecasters, tended to revise their macroeconomic forecasts upward. A second group, pessimistic forecasters, tended to revise their macroeconomic forecasts downward. Using the terminology of Campbell et al. (2012), forward guidance can be

Odyssean and signal a more accommodative stance of monetary policy in the future, which is good news, or it can be Delphic and signal that the macroeconomic outlook is worse than previously understood, which is bad news. Our paper suggests that the forecaster heterogeneity observed in the United States after the financial crisis in Andrade et al. (2019) is likely to be a more general phenomenon. As such, central banks should take great care in crafting their communication to avoid inadvertently providing Delphic forward guidance instead of the intended Odyssean forward guidance.

Finally, there are ongoing debates in the literature about whether a central bank should release its policy rate projection (e.g., Faust and Leeper 2005; Rudebusch and Williams 2008; Woodford 2013; Obstfeld et al. 2016) and about what policy rate path assumption a central bank should use in its macroeconomic projections (e.g., Goodhart 2009). We conclude that neither choice appears to have much influence on private-sector forecast disagreement or forecast error. At least when glimpsed through the lens of private-sector forecasts, these particular central bank communication choices are not obvious.

A relatively small literature has focused on private-sector forecaster expectations while incorporating forward guidance. Campbell et al. (2012) use survey data to show that the Federal Reserve has been able to influence private macroeconomic forecasts using forward guidance. The authors find that the responses of private-sector forecasts to unanticipated increases in forward guidance (or the "path factor;" see Gürkaynak, Sack, and Swanson 2005 for details) were opposite to those predicted by a standard New Keynesian model. They reason that private-sector forecasters must believe that central bank (the Federal Open Market Committee (FOMC) in this case) policy surprises must contain useful macroeconomic information. Kool and Thornton (2015) find that forward guidance reduced forecast dispersion in New Zealand, Sweden, and Norway, but not in the United States. Lustenberger and Rossi (2017) show that public information is less precise than private information during forward-guidance periods. 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.

A number of theoretical papers have also considered the role of forward guidance at the zero lower bound. For example, Eggertsson and Woodford (2003) show that unconventional monetary policy can help avoid a major recession once the economy has hit the zero lower bound. By contrast, McKay, Nakamura, and Steinsson (2016) use an incomplete-markets model to show that forward guidance at the zero lower bound may not be as effective as implied by mainstream macroeconomic models and Eggertsson and Woodford (2003).

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 numerous additional controls. Fourth, we address an econometric issue pointed out in Lustenberger and Rossi (2020). These differences allow us to offer a new perspective on the effect of forward guidance on private-sector forecasts. 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.[2]

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 FOMC projections provide signals to private-sector forecasters, which causes private-sector forecasters to update their forecasts accordingly. 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 use the following two-way fixed-effects estimator:

$$y_{it} = \alpha + \mathbf{x_{it}}\boldsymbol{\beta} + \mathbf{c_{it}}\boldsymbol{\gamma} + \lambda_i + \lambda_t + \epsilon_{it}. \tag{1}$$

y_{it} refers to the natural logarithm of either private-sector forecast dispersion or private-sector absolute forecast error. x_{it} is a vector of central bank projection and forward-guidance dummy variables ($x_{it} \in \{0, 1\}$). c_{it} is a vector of control variables. λ_i refers to country fixed effects, λ_t refers to quarterly time fixed effects, and ϵ_{it} is an error term. This empirical approach is closely related to Ehrmann, Eijffinger, and Fratzscher (2012), Ehrmann (2015), Naszodi et al. (2016), and Lustenberger and Rossi (2020). We estimate the benchmark model using standard errors clustered at the country level that are robust to heteroskedasticity and serial correlation (see Stock and Watson 2008 and Lustenberger and Rossi 2020).[3]

Our main measure of forecast dispersion is the natural logarithm of the interdecile range, which is the difference between the ninth

[2]Hubert (2014) found that publishing FOMC 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.

[3]The results are robust to bootstrapped standard errors as well. See the online appendix on the IJCB website (http://www.ijcb.org) for details.

and first deciles of a given forecast distribution. Forecast error is measured as the natural logarithm of the absolute value of the mean forecast error. By including both measures, we can glean whether less forecast disagreement has 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.

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 or forward guidance in quarter t. These binary variables are tested jointly in an effort to disentangle the marginal effects of providing each type of central bank projection. 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. Some multicollinearity issues prevent us from using all x_{it} variables. Specifically, we are able to include inflation, the output gap, unemployment, policy rate projections, and three types of forward guidance but must exclude domestic and global output projections. The correlation between the inflation and domestic output projections, for example, is 0.91, so it is not sensible to include both. Global output projections are excluded for a similar reason. Hence, we 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. However, we use all six central bank projections later in the paper when we replace the central bank projection dummy variables from x_{it} with a variable that counts the number of projections released by the central bank (we simply sum each of the six central bank projection dummy variables for a given quarter and country). This allows us to test the hypothesis that releasing more central bank projections provides more information and, if so, how so.

We include several control variables to adjust for different types of volatility. The control variables are denoted above by the vector c_{it}. First, following Ehrmann, Eijffinger, and Fratzscher (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 (for more detail see subsection 3.5). Following Ehrmann, Eijffinger, and Fratzscher (2012) and Naszodi et al. (2016), we include the absolute value of the change in West Texas Intermediate (WTI) oil prices. As in Lustenberger and Rossi (2020), we attempt to control for some forms of financial market volatility by including the VIX (the implied volatility from options on the Standard & Poor's 500 stock index). Usefully, this volatility measure has low correlation with the various measures of conditional variance. As in all of the studies above and the related literature, we include country fixed effects, λ_i. Additionally, we also include quarterly time fixed effects, λ_t. When we use the forecast dispersion and error of either inflation or domestic output as dependent variables, we also add binary variables indicating the quarter (i.e., Q2, Q3, Q4) because of the fixed-event nature of these forecasts. We elaborate in subsection 3.2.

Next, we include a number of binary control variables (c_{it}) not included in the aforementioned (related) studies. We include a variable indicating whether a country's central bank had adopted an inflation target in a given quarter, as it is reasonable to assume that the presence of an inflation target may influence private-sector forecasts of macroeconomic variables. Periods at the effective lower bound may represent an exception to the normal relationship between the level of policy rates and forecast dispersion, for example, and so we include an indicator variable for the ELB in all regressions. For similar reasons, we include a variable that indicates whether a central bank had an active quantitative easing (QE) program in a given quarter and country. Although we implicitly adjust for the effect of many crisis periods by virtue of our numerous volatility variables and the ELB and QE variables, the global financial crisis probably represents a unique case and so we include an indicator variable for this period. We also seek to disentangle the influence of central bank projections and forward guidance from the publication of a monetary policy report or a monetary policy decision. Hence, we include one variable indicating whether a monetary policy report (or inflation report, other equivalent, etc.) was released in a given quarter and country and one variable indicating whether a central bank made a monetary policy decision in a given quarter and country. Finally, to account for different currency regimes, we include a variable indicating whether a country either had a de facto currency peg or was a member of a currency union in a given quarter.

3. Data

Our data analysis builds primarily on three papers. Ehrmann, Eijffinger, and Fratzscher (2012) is a 12-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 26-country study of central bank transparency and both private-sector accuracy and forecast dispersion. The authors provide evidence that central bank transparency reduces both. Using the sample from Ehrmann (2015), Coenen et al. (2017) find that, during ELB periods, state-contingent forward guidance reduced disagreement and that time-contingent forward guidance reduced disagreement if guidance was provided over relatively long horizons.

3.1 Sample Group

Our sample group consists of 23 economies: 15 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 8 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, Eijffinger, and Fratzscher (2012), Ehrmann (2015), and, especially, Naszodi et al. (2016). Second, we chose central banks that are, *at present*, judged to be particularly transparent (see, for example, Eijffinger and Geraats 2006 and Dincer and Eichengreen 2014). Such central banks are more likely to provide an array of central bank forecasts at some point in the sample period, 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 6.5 (Norway, early years) to 15 (Sweden, recent years). These scores have been trending upward as central banks release more and more macroeconomic projections and explain monetary policy decisions in greater detail. 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.

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, the three-month government bill rate, and the 10-year government bond yield. Each of the four types are forecasted at two horizons. 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. The mean number of forecasts per sample is about 17 for output and inflation forecasts and about 11 for interest rate forecasts. Forecasts of the 10-year government bond yield are not available for some economies, such as the euro area, which of course, does not have a 10-year government bond. For the same reason, there is no Consensus Economics forecast of the euro-area three-month treasury bill either.[4] The survey participants are typically consistent over the sample period. Each of the four variables is forecasted at two horizons. The 3-month and 10-year yields are each projected 3 and 12 months into the future, respectively (fixed-horizon forecasts).[5] Both real gross domestic product (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).

[4]The results are robust to the omission of the euro-area data (see the online appendix).

[5]More precisely, the projections are 3.5 and 12.5 months into the future, respectively.

To measure disagreement, we use the natural logarithm of the range, interdecile range, interquartile range, and standard deviation across all forecasters in country i and month t (each month corresponds to one quarter).[6] To measure forecast accuracy, we use the natural logarithm of the absolute value of the difference between the mean Consensus Economics forecast and the realized corresponding macroeconomic data (latest-available vintage).[7] The OECD's Main Economic Indicators database provided a rich data set of realized macroeconomic data for all of the countries in our sample group. The realized data for three-month government rates, 10-year yields, and WTI oil prices were obtained from Thomson Reuters Datastream.

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 reasons. First, we better match the frequency of central bank projections, which, in general, are released quarterly. We hypothesize that the information effects conveyed by the release of central bank projections persist beyond just one month, probably for about one quarter.

Second, it would be very difficult to create a monthly version of our data. 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,

[6]The related forecast-dispersion literature uses a number of measures. Mankiw, Reis, and Wolfers (2003), Dovern, Fritsche, and Slacalek (2012), and Ehrmann, Eijffinger, and Fratzscher (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 interdecile range to gain a greater appreciation for changes in the full distribution while still excluding outliers (each 10 percent tail is discarded). In all cases, we use the natural logarithm of these measures of dispersion (see Lustenberger and Rossi 2020 for an explanation of how this leads to better-behaved residuals).

[7]This approach to measuring forecast accuracy is closely aligned with that of Ehrmann, Eijffinger, and Fratzscher (2012) and Naszodi et al. (2016). An alternate approach to calculating forecast error is to use the consensus forecast from December of a given year (akin to a nowcast) instead of the realized data. Our results are robust to this method (see the online appendix).

we begin by choosing the Consensus Economics surveys from April, July, and October of a given year, as well as January of the following year.[8] We attribute these surveys to the first, second, third, and fourth quarters of a given year, respectively.[9] In some cases, the central bank projection release date is known precisely, and in others it is known only approximately. For example, sometimes it was only possible to narrow the release date of a particular central bank projection down to a particular month. Although the approximate timing was adequate to assign central bank projections to their appropriate quarter, this would not be true for a monthly data frequency.

We then refine this survey forecast month selection 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.[10] 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 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 that we use for that

[8]Each Consensus Economics survey is conducted near the beginning of the month.

[9]This is very similar to the approach taken by Andrade et al. (2016) to construct quarterly survey data from Blue Chip Financial Forecasts. 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.

[10]Overall, our timing strategy is similar to that from Hubert (2015a) and other related studies.

country to ensure that it follows the new central bank projection release date.

3.4 Central Bank Projections Data and Forward Guidance

We constructed a new data set that records whether central bank i released a given macroeconomic projection in quarter t between 1990:Q1 and 2017:Q2. These data were hand-collected from more than 2,400 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 the policy rate. Each variable is a binary variable that takes the value of 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 were 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 semiannually to quarterly) and schedule (e.g., from Q1 to Q2). This variation affords us a great deal of heterogeneity in this large data set, which is plotted in figure A.1 in the online appendix.

To assemble euro-area central bank projections and forward-guidance data, we took two basic approaches. First, for central bank projections, we used the domestic projections released by the national central banks. The private-sector forecasters in our sample provide forecasts for their respective countries. We argue that when it comes to forecasting domestic output growth in the Netherlands, for example, central bank projections for the Netherlands are more relevant than projections for the euro area as a whole. Hence, when De Nederlandsche Bank provided domestic projections, we recorded this in our data. However, there is one important exception to this approach. We also included private-sector forecasts for the euro area as a whole in our sample. For this broader region, we used the projections for the euro area as a whole, which are provided by the European Central Bank (ECB). For forward guidance, we use the forward guidance of the ECB. That is, when the ECB released forward guidance, this forward guidance would be reflected not only in our euro-area data but also in our data for each euro-area country in our sample.[11] Because the ECB sets monetary policy for the euro area as a whole, ECB forward guidance should influence private-sector forecasts in each euro-area country.

We recorded all instances of output gap projections, but many central banks provide output gap estimates, so a key distinction must be made. Whereas some central banks only provide an estimate of the current output gap, others provide both this estimate and 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 scored output gap *projections* as a one and left aside *estimates*. Our hypothesis is that central bank projections of the future state of the economy affect private-sector forecast dispersion and/or forecast error. We also did so for consistency: all other central bank projections were counted as a one only when a forward-looking projection was provided.

We recorded all instances of forward guidance in each country. Central banks often provide discussions of the likely path of the policy rate or a policy bias in press releases. We scored all such cases as a one and a zero otherwise. To do this, we read all 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. Forward guidance is often conceptualized as an unconventional monetary tool to be used at the effective lower bound. In

[11]Naturally, the same logic applies for quantitative easing.

fact, forward guidance is often used during periods away from the effective lower bound.

We categorized each instance of forward guidance as having either time-contingent attributes, state-contingent attributes, qualitative attributes, or some combination thereof. In our scoring methodology, forward guidance is simply any statement that articulates the probable future stance of monetary policy.[12] Specifically, time-contingent forward guidance is a statement that provides information about the probable stance of monetary policy at a specific time in the future. State-contingent forward guidance is any forward-looking statement that provides information about the central bank's monetary policy reaction function that is either more specific than (e.g., quantitative) or substantially different from the central bank's mandate. Typically, this state is closely related to the central bank's inflation target, but in some cases it is not. Qualitative forward guidance is that which does not fall into either category but nonetheless meets the definition of forward guidance above.

Most examples of forward guidance are fairly clear, but, admittedly, it was necessary to use judgment in some cases.[13] Occasionally, central banks provided 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 Moessner and Nelson (2008), Campbell et al. (2012), Woodford (2013), Charbonneau and Rennison (2015), Kool and Thornton (2015), Obstfeld et al. (2016), and Moessner, Jansen, and de Haan (2017), so we record these accordingly. Whenever possible, we also relied on studies published by each central bank to corroborate our scoring (e.g., Andersson and Hofmann 2009, Brubakk, ter Ellen, and Xu 2017, and Coenen et al. 2017). 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 merited scores of one. We offer some examples of forward guidance and how they were categorized below.

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

[13] For more in-depth discussion of the definitions of forward guidance, the forward-guidance literature, and forward-guidance examples, see Sutherland (2020), available online.

The Federal Open Market Committee is a good example because it has used all three types of forward guidance in its history. Earlier in the history of the Committee's use of forward guidance, it tended to favor qualitative forward guidance, such as this example from December 13, 2005:

> The Committee judges that some further measured policy firming is likely to be needed to keep the risks to the attainment of both sustainable economic growth and price stability roughly in balance.

The FOMC later introduced time-contingent forward guidance, such as this statement on August 9, 2011:

> The Committee currently anticipates that economic conditions—including low rates of resource utilization and a subdued outlook for inflation over the medium run—are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013.

Finally, the FOMC introduced perhaps the quintessential example of state-contingent forward guidance on December 12, 2012:

> To support continued progress toward maximum employment and price stability, the Committee expects that a highly accommodative stance of monetary policy will remain appropriate for a considerable time after the asset purchase program ends and the economic recovery strengthens. In particular, the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored.

Of course, examples from other central banks abound. There are numerous examples of forward guidance in earlier years, such as this time-contingent forward guidance from the Reserve Bank of New Zealand (RBNZ) on September 1, 1997: "Our projections point to further, but quite small, easings in the first two quarters of

1998 before emerging inflationary pressures lead us to expect monetary conditions to enter another tightening phase." This particular RBNZ forward guidance was also released alongside a projection of the 90-day bank-bill yield. On April 12, 2005, the Bank of Canada used a good example of qualitative forward guidance: "In line with this outlook, a reduction of monetary stimulus will be required over time." On August 7, 2013, the Bank of England used the following state-contingent forward guidance: "In particular, the MPC intends not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to the conditions below."

We also consider policy rate projections and quantitative easing 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 Norges Bank (2005), followed by 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 created a dummy variable indicating when a central bank was engaged in an active quantitative easing program. We define a quantitative easing program as the expansion of reserves to purchase bonds or other assets. The examples of quantitative easing in our sample include the Federal Reserve, the Bank of England, Sveriges Riksbank, the Bank of Japan, and the European Central Bank.

3.5 Control Variables

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, Eijffinger, and Fratzscher (2012), and Naszodi et al. (2016), our conditional volatility measures are the predicted values from a GARCH(1,1) model of the realized data (π_{it} below) for a given country i and quarter t. We estimate the following model for each type of dependent variable (inflation, domestic output, three-month rate, 10-year yield) in each country (23 countries times four types of dependent variable[14]:

$$\pi_{it} = \lambda_0 + \lambda_1 \pi_{i,t-1} + \lambda_2 \pi_{i,t-2} + \epsilon_{it} \quad (2)$$

$$\epsilon_{it} \sim N(0, \sigma_{it}^2) \quad (3)$$

$$\sigma_{i,t+1}^2 = \omega + \alpha_1 \epsilon_{it}^2 + \beta_1 \sigma_{it}^2. \quad (4)$$

In the mean equation, we include the first two lags of the relevant variable (e.g., realized inflation, or domestic output, etc.) as in Ehrmann, Eijffinger, and Fratzscher (2012) and Naszodi et al. (2016).

Similarly, Ehrmann, Eijffinger, and Fratzscher (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 typically not included in other closely related studies, but we find that this control is usually significant (as do Lustenberger and Rossi 2020). Both the oil and VIX data were obtained from Thomson Reuters Datastream. We also include a binary variable for the financial crisis of 2008 to 2009 and we use the dates from Chor and Manova (2012) to create this variable.

As discussed, we include a control variable for inflation-targeting periods. All 23 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., Capistrán and Ramos-Francia 2010, Crowe 2010, and Ehrmann, Eijffinger, and Fratzscher 2012), we use the date of adoption to mark the beginning of inflation targeting. The dates were gathered primarily from Roger and Stone (2005), Bank for International Settlements (2009), and Hammond (2012). The first central bank to adopt an inflation target, the Reserve

[14]In our panel regressions, we use the same estimate of conditional volatility for both forecast horizons for a given type of dependent variable.

Table 1. Inflation-Targeting and Effective Lower Bound Periods by Central Bank

Country	Inflation Targeting	Effective Lower Bound
Australia	1993:Q1–2017:Q2	
Canada	1991:Q1–2017:Q2	2009:Q2–2010:Q2
Czech Republic	1998:Q1–2017:Q2	2012:Q4–2017:Q2
Euro Zone	1999:Q1–2017:Q2	2012:Q3–2017:Q2
France	1999:Q1–2017:Q2	2012:Q3–2017:Q2
Germany	1990:Q1–2017:Q2	2012:Q3–2017:Q2
Hungary	2001:Q2–2017:Q2	
Indonesia	2005:Q3–2017:Q2	
Italy	1999:Q1–2017:Q2	2012:Q3–2017:Q2
Japan	2012:Q1–2017:Q2	1999:Q3–2000:Q3 2001:Q2–2006:Q2 2016:Q1–2017:Q2
Netherlands	1999:Q1–2017:Q2	2012:Q3–2017:Q2
New Zealand	1990:Q1–2017:Q2	
Norway	2001:Q1–2017:Q2	
Poland	1998:Q1–2017:Q2	
Russia	2015:Q1–2017:Q2	
Slovakia	2005:Q1–2017:Q2	2012:Q3–2017:Q2
South Korea	1998:Q2–2017:Q2	
Spain	1995:Q1–2017:Q2	2012:Q3–2017:Q2
Sweden	1993:Q1–2017:Q2	2014:Q4–2017:Q2
Switzerland	2000:Q1–2017:Q2	2003:Q1–2004:Q2 2009:Q2–2017:Q2
Turkey	2006:Q1–2017:Q2	
United Kingdom	1992:Q4–2017:Q2	2009:Q1–2017:Q2
United States	2012:Q1–2017:Q2	2012:Q3–2015:Q4

Bank of New Zealand, happened to do so in the first quarter of our 110-quarter sample (1990:Q1). 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 21 transitions are scattered rather evenly across our sample period (see table 1).

Further, we created a control variable indicating whether a central bank was at the effective lower bound in a given quarter. 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 variables). Similarly, nearby macroeconomic forecasts might be less dispersed as low-growth, low-inflation periods are anticipated. Conversely, 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 of one 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).

We also created an MPR (monetary policy report) dummy variable as well as a policy rate decision dummy variable. To create the MPR dummy, we went through our records and, where necessary, central bank websites, to determine when a central bank released its monetary policy report and when it did not. When the report was released, the MPR dummy takes the value of one and zero otherwise. There are some cases when the form of the MPR is less obvious than others. For example, for the Swiss National Bank, we use the press release as the monetary policy report. There are some other examples where we use, for example, an economic bulletin that strongly resembles a monetary policy report. This typically happens in earlier years. To create a policy rate decision dummy variable, we created three separate dummy variables and then combined them. First, we created a dummy variable to indicate when a scheduled policy rate decision occurred. Second, we created a dummy variable to indicate when an unscheduled policy rate decision occurred. Third, for earlier years before scheduled policy rate decision dates, we follow the approach of Champagne and Sekkel (2018) and consider that changes in the central bank's policy rate target variable (for example, a three-month Treasury-bill rate) are essentially de facto policy rate decisions. We combine (sum) these three variables into our final policy rate decision dummy variable.

3.6 Central Bank Projections: Policy Rate Path Assumptions and Source

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 2009). With an endogenous rate path assumption, the public would, in theory, know that the central bank projections account for the likely policy 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. 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). 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 update 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), and Hubert (2015a, 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.[15] We then use these categorizations to sort our benchmark panel regressions from equation (1) into three sample groups. These data are depicted in figure A.2 in the online appendix.[16]

The *source* of central bank projections may also be important to private-sector forecasters. Projections provided by monetary policy decisionmakers 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 decisionmakers may be seen as biased (Romer and Romer 2008 and Ellison and Sargent 2012). One reason is that policymakers may have different information sets and heterogeneous preferences, as outlined in Hansen, McMahon, and Rivera (2014). To test some of these hypotheses, we gathered data on projection source from Hammond (2012), 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 decisionmakers), 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).

[15]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.

[16]This figure also shows that the Bank of England releases two sets of projections: one set that uses a market-implied policy rate assumption and another set that uses a constant policy rate assumption. Initially, the Bank of England only released projections that used a constant policy rate assumption. Later, it added a second set that use a (in some cases more realistic) market-implied policy rate assumption.

4. Results

Our benchmark results (equation (1)) can be found in table 2 and table 3. The results for the same regressions but using the natural logarithm of the range and standard deviation as the dependent variables (instead of the interdecile range) are shown in table 4 and table 5. The results for the natural logarithm of the interquartile range are included in the online appendix to economize on space. The results for the control variables can also be found in the online appendix.

4.1 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." To test this the idea, table 2 and table 3 each include a line for "Rate Projection." Overall, we find that the provision of central bank policy rate projections reduces neither private-sector forecast dispersion nor forecast error. In fact, when it comes to private-sector interest rate forecast dispersion, we find evidence that policy rate projections can actually increase forecaster disagreement.

More specifically, policy rate projections tended to increase dispersion particularly for short-term rate forecasts and particularly at short-term forecast horizons. This suggests that central bank policy rate projections probably have the most influence on private-sector forecasts of nearby policy rate decisions. The increase in dispersion is much more prominent when considering forecasts clustered toward the central portion of the forecast distribution. That is, the effect is most significant when using the interquartile range of short-term rates forecasts, less significant when using the interdecile range, and not significant when using the range or standard deviation (although the estimated effect is still positive).[17]

[17]The results using the interquartile range are shown in the online appendix. Note that we use the natural logarithm of each of the aforementioned dispersion measures as the dependent variable in our regressions.

Table 2. Private-Sector Rate Forecasts: Natural Logarithm of the 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	−0.20**	−0.28*	−0.19**	−0.29**	−0.23***	−0.38*	−0.10	−0.23
	(0.09)	(0.14)	(0.07)	(0.12)	(0.07)	(0.21)	(0.07)	(0.16)
Output Gap	−0.14	−0.17	−0.06	−0.07	−0.06	0.16	−0.06	0.05
	(0.10)	(0.16)	(0.08)	(0.12)	(0.09)	(0.13)	(0.05)	(0.09)
Unemployment	0.15	0.45***	0.11	0.46***	0.19**	0.18	0.15*	0.20
	(0.09)	(0.14)	(0.08)	(0.16)	(0.08)	(0.18)	(0.08)	(0.16)
Rate Projection	0.21*	−0.01	0.19*	−0.13	0.06	−0.09	0.15	0.07
	(0.11)	(0.23)	(0.11)	(0.22)	(0.08)	(0.17)	(0.09)	(0.16)
FG Time Contingent	−0.17	0.04	−0.14	0.29	−0.07	−0.00	−0.19*	0.11
	(0.14)	(0.20)	(0.11)	(0.25)	(0.06)	(0.16)	(0.09)	(0.13)
FG Qualitative	−0.02	−0.11	−0.09	−0.16	0.01	0.04	−0.01	0.08
	(0.09)	(0.07)	(0.06)	(0.11)	(0.03)	(0.06)	(0.03)	(0.09)
FG State Contingent	0.17	0.19	0.06	−0.33*	−0.09	0.09	−0.13**	0.11
	(0.15)	(0.18)	(0.12)	(0.17)	(0.06)	(0.16)	(0.05)	(0.10)
Quantitative Easing	−0.27	0.08	−0.34	0.45	−0.01	−0.01	0.01	−0.15
	(0.22)	(0.34)	(0.24)	(0.27)	(0.08)	(0.09)	(0.05)	(0.11)
Effective Lower Bound	−0.33**	0.02	−0.18**	−0.25	0.14*	0.24	0.24***	0.27*
	(0.15)	(0.15)	(0.08)	(0.18)	(0.07)	(0.16)	(0.05)	(0.14)
Adjusted R^2	0.42	0.22	0.49	0.27	0.27	0.30	0.25	0.40
N	1,864	1,827	1,868	1,761	1,536	1,505	1,536	1,457

Notes: Panel regressions with country and quarterly fixed effects. Standard errors (parentheses) are clustered by country. Control variables are suppressed. Column interpretation: "3-Month Government Bill Rate, 3-Month Forecast Horizon (Dispersion)": In this case the dependent variable is the natural logarithm of the interdecile range of *private forecasts* of the three-month government bill rate in three months' time. Row interpretation: rows correspond to binary variables indicating the presence of a *central bank projection*, forward guidance, quantitative easing, or the effective lower bound. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 3. Private-Sector Macro Forecasts: Natural Logarithm of the Forecast Dispersion and Absolute Forecast Error

	Inflation Rate				Real Gross Domestic Product			
	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	−0.14	−0.08	−0.11	−0.36*	−0.10*	−0.26*	−0.11**	−0.16
	(0.11)	(0.13)	(0.09)	(0.18)	(0.05)	(0.15)	(0.05)	(0.14)
Output Gap	−0.13	−0.23	−0.16	0.04	−0.03	0.19	−0.07	0.02
	(0.11)	(0.15)	(0.10)	(0.16)	(0.05)	(0.12)	(0.05)	(0.17)
Unemployment	0.03	0.12	0.06	0.22	0.19***	0.13	0.06	0.37**
	(0.15)	(0.17)	(0.13)	(0.20)	(0.05)	(0.15)	(0.06)	(0.14)
Rate Projection	−0.28	−0.37	−0.19	−0.47	−0.07	−0.18	−0.00	0.11
	(0.22)	(0.32)	(0.20)	(0.29)	(0.07)	(0.18)	(0.07)	(0.26)
FG Time Contingent	0.12	0.04	0.12	0.15	0.08	0.21	0.01	−0.08
	(0.12)	(0.15)	(0.12)	(0.20)	(0.08)	(0.21)	(0.07)	(0.18)
FG Qualitative	−0.00	0.04	0.03	0.04	−0.03	0.12	−0.05	−0.12
	(0.06)	(0.10)	(0.05)	(0.11)	(0.03)	(0.09)	(0.04)	(0.11)
FG State Contingent	−0.07	−0.15	−0.03	−0.22*	−0.01	0.20	−0.12	0.02
	(0.10)	(0.15)	(0.08)	(0.12)	(0.04)	(0.25)	(0.07)	(0.18)
Quantitative Easing	0.25*	0.29*	0.12	−0.11	0.08	−0.03	0.05	−0.36
	(0.12)	(0.17)	(0.09)	(0.22)	(0.08)	(0.16)	(0.05)	(0.22)
Effective Lower Bound	−0.08	−0.03	0.12	0.20	0.04	−0.20	0.18***	−0.23
	(0.19)	(0.13)	(0.11)	(0.16)	(0.04)	(0.15)	(0.06)	(0.20)
Adjusted R^2	0.28	0.24	0.25	0.17	0.55	0.16	0.29	0.22
N	2,070	2,026	2,079	1,934	1,971	1,929	1,971	1,841

Notes: Panel regressions with country and quarterly fixed effects. Standard errors (parentheses) are clustered by country. Control variables are suppressed. Column interpretation: "Inflation Rate, Current-Year Forecast (Dispersion)": In this case the dependent variable is the natural logarithm of the interdecile range of *private forecasts* of the inflation rate (current year). Row interpretation: rows correspond to binary variables indicating the presence of a *central bank projection*, forward guidance, quantitative easing, or the effective lower bound. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4. Private-Sector Rate Forecasts: Natural Logarithm of the Forecast Range and Standard Deviation (S.D.)

	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	
	Range (1)	S.D. (2)	Range (3)	S.D. (4)	Range (5)	S.D. (6)	Range (7)	S.D. (8)
Inflation	−0.20*	−0.25**	−0.18**	−0.17**	−0.22***	−0.24***	−0.09	−0.13*
	(0.10)	(0.09)	(0.08)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)
Output Gap	−0.16	−0.11	−0.10	−0.10	−0.08	−0.07	−0.05	−0.05
	(0.10)	(0.12)	(0.08)	(0.07)	(0.09)	(0.08)	(0.06)	(0.05)
Unemployment	0.15	0.24**	0.10	0.11	0.19**	0.20**	0.11	0.14*
	(0.12)	(0.10)	(0.08)	(0.07)	(0.08)	(0.09)	(0.08)	(0.08)
Rate Projection	0.14	0.14	0.10	0.13	0.04	0.04	0.14	0.13
	(0.14)	(0.11)	(0.10)	(0.09)	(0.10)	(0.08)	(0.09)	(0.09)
FG Time Contingent	−0.25*	−0.26	−0.14	−0.12	−0.06	−0.04	−0.21**	−0.15**
	(0.15)	(0.17)	(0.12)	(0.10)	(0.09)	(0.06)	(0.08)	(0.06)
FG Qualitative	−0.03	−0.09	−0.08*	−0.08*	0.02	0.00	0.01	−0.00
	(0.08)	(0.11)	(0.04)	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)
FG State Contingent	0.14	−0.21	0.01	0.03	−0.09	−0.09	−0.13***	−0.13***
	(0.14)	(0.28)	(0.11)	(0.10)	(0.05)	(0.05)	(0.03)	(0.04)
Quantitative Easing	−0.21	−0.42	−0.27	−0.29	−0.01	−0.02	0.02	0.01
	(0.20)	(0.28)	(0.19)	(0.19)	(0.08)	(0.07)	(0.07)	(0.06)
Effective Lower Bound	−0.28**	−0.09	−0.14*	−0.16**	0.13*	0.16**	0.18***	0.22***
	(0.13)	(0.20)	(0.07)	(0.07)	(0.07)	(0.06)	(0.04)	(0.04)
Adjusted R^2	0.43	0.21	0.50	0.52	0.26	0.31	0.23	0.28
N	1,866	1,867	1,869	1,869	1,536	1,536	1,536	1,536

Notes: Panel regressions with country and quarterly fixed effects. Standard errors (parentheses) are clustered by country. Control variables are suppressed. Column interpretation: "3-Month Government Bill Rate, 3-Month Forecast Horizon (S.D.)": In this case the dependent variable is the natural logarithm of the standard deviation of *private forecasts* of the three-month government bill rate in three months' time. Row interpretation: rows correspond to binary variables indicating the presence of a *central bank projection,* forward guidance, quantitative easing, or the effective lower bound. *$p < 0.10$, **$p < 0.05$, *** $p < 0.01$.

Table 5. Private-Sector Macro Forecasts: Natural Logarithm of the Forecast Range and Standard Deviation

	Inflation Rate				Real Gross Domestic Product			
	Current-Year Forecast		Next-Year Forecast		Current-Year Forecast		Next-Year Forecast	
	Range (1)	S.D. (2)	Range (3)	S.D. (4)	Range (5)	S.D. (6)	Range (7)	S.D. (8)
Inflation	−0.13	−0.14	−0.11	−0.12	−0.13***	−0.13***	−0.06	−0.10*
	(0.09)	(0.10)	(0.09)	(0.09)	(0.04)	(0.05)	(0.06)	(0.05)
Output Gap	−0.15	−0.13	−0.14	−0.14	−0.02	−0.00	−0.06	−0.05
	(0.11)	(0.10)	(0.10)	(0.10)	(0.04)	(0.04)	(0.05)	(0.04)
Unemployment	−0.03	0.01	0.01	0.05	0.09*	0.12**	−0.05	0.02
	(0.14)	(0.13)	(0.13)	(0.13)	(0.05)	(0.05)	(0.06)	(0.06)
Rate Projection	−0.26	−0.27	−0.26	−0.22	−0.13*	−0.09	−0.11	−0.06
	(0.24)	(0.23)	(0.21)	(0.20)	(0.07)	(0.07)	(0.07)	(0.07)
FG Time Contingent	0.18	0.16	0.13	0.13	0.10	0.08	−0.02	−0.02
	(0.14)	(0.13)	(0.13)	(0.13)	(0.06)	(0.06)	(0.08)	(0.06)
FG Qualitative	0.01	0.01	0.02	0.03	−0.02	−0.00	−0.02	−0.03
	(0.07)	(0.07)	(0.05)	(0.05)	(0.03)	(0.03)	(0.05)	(0.05)
FG State Contingent	−0.04	−0.04	0.01	−0.01	0.06	0.03	−0.08	−0.09
	(0.07)	(0.07)	(0.09)	(0.08)	(0.04)	(0.04)	(0.06)	(0.06)
Quantitative Easing	0.13	0.13	0.12	0.12	0.06	0.05	0.03	0.02
	(0.08)	(0.09)	(0.08)	(0.08)	(0.08)	(0.08)	(0.06)	(0.05)
Effective Lower Bound	0.09	0.11	0.13	0.15	0.06	0.07	0.13	0.17**
	(0.10)	(0.10)	(0.11)	(0.11)	(0.06)	(0.05)	(0.08)	(0.06)
Adjusted R^2	0.45	0.49	0.24	0.28	0.52	0.58	0.25	0.33
N	2,079	2,079	2,079	2,079	1,971	1,971	1,971	1,971

Notes: Panel regressions with country and quarterly fixed effects. Standard errors (parentheses) are clustered by country. Control variables are suppressed. Column interpretation: "Inflation Rate, Current-Year Forecast (S.D.)": In this case the dependent variable is the natural logarithm of the standard deviation of *private forecasts* of the inflation rate for the current year. Row interpretation: rows correspond to binary variables indicating the presence of a *central bank projection*, forward guidance, quantitative easing, or the effective lower bound. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

An interesting and important caveat is in order. In the first half of our sample (pre-2006), rate projections actually reduced dispersion and forecast error. Again, the effect is most prominent for short-term rates and at shorter forecast horizons. For context, this estimated (pre-2006) effect should be dominated by the policy rate forecast of the Reserve Bank of New Zealand (released from 1997 onward). In the second half of our sample (2006 and beyond), the availability of policy rate projections tended to increase forecast dispersion and error. This latter half of the sample includes policy rate projections from all countries that released them in our sample.

A number of alternatives could explain this observed effect. Perhaps central bank policy rate projections ceased to lower forecast dispersion and error at some point (with the effect eventually transitioning from negative to positive). The global financial crisis and, later, the European financial crisis took place in the latter half of our sample period, so although we adjust for three forms of volatility and include a dummy variable for the global financial crisis, higher levels of uncertainty may influence the interpretation of policy rate projections. Mokhtarzadeh and Petersen (2017) perform an experimental study that considers how particular central bank projections affect macroeconomic expectations. The authors find that 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.

Central bank policy rate projections could also lose credibility over time if they have proven to be inaccurate in the past.[18] 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

[18] "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, p. 176).

periods.[19] It is possible that the policy rate projections of the Norges Bank (introduced 2005), the Sveriges Riksbank (2007), the Czech National Bank (2008), and the FOMC (2012) tended to increase forecast dispersion while those of the Reserve Bank of New Zealand (1997) tended to decrease forecast dispersion. This seems unlikely, however, given that Svensson (2015) also found discrepancies between the policy rate projections of the Reserve Bank of New Zealand and the market-implied policy rate paths.

Another possibility is that other information communicated simultaneously by the central bank (e.g., central bank projections, forward guidance, the text from monetary policy reports, the text from press releases, the dialogue in press conferences, etc.) dominates these quantitative projections, as policy rate path projections are often accompanied by verbal forward guidance as well.[20]

Finally, the inclusion of wide confidence intervals around central banks' rate path projections could add too much noise to the signal.[21] Whatever the underlying reason, the evidence presented in this paper suggests that policy rate path projections do little to reduce forecast dispersion and forecast error, and in the case of interest rate forecasts, even increase dispersion and error. These possibilities do not, however, necessarily imply that central banks' policy rate path projections do not affect policy rate expectations more broadly. Brubakk, ter Ellen, and Xu (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.

The effect of policy rate projections on private-sector inflation and domestic output forecasts is less clear. Policy rate projections may decrease both forecast dispersion and error for private-sector

[19] Svensson (2015, p. 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."

[20] "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, p. 176).

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

inflation forecasts (at both horizons), but the corresponding standard errors are too large to draw any meaningful conclusions. Overall, policy rate projections have had an unclear effect on private-sector growth forecasts. In the first half of our sample, policy rate projections appeared to reduce the dispersion of private-sector growth forecasts, especially for the current-year forecasts (see the online appendix). This suggests that, during this subsample at least, policy rate projections provided information to private-sector forecasters about the outlook for the economy.

4.2 Central Bank Inflation, Output Gap, and Unemployment Projections

Overall, central bank inflation projections have tended to reduce both the forecast dispersion and forecast error of private-sector interest rate forecasts (table 2). Central bank inflation projections also appear to have reduced dispersion and forecast error of private-sector macroeconomic forecasts, but the effect is not as strong. That central bank inflation projections appear to have more influence over private-sector interest rate forecasts suggests that inflation projections may primarily be used by private-sector forecasters to help forecast the path of monetary policy.

Central bank unemployment projections actually appear to increase private-sector disagreement and forecast error. Again, the effect is stronger for private-sector interest rate forecasts. The effect of unemployment projections on interest rate forecasts appears to be driven, to some extent, by projections using a constant policy rate assumption, the first half of the sample (pre-2006), and forecasts coming from the Monetary Policy Committee. One possibility is that some private-sector forecasters perceive unemployment projections as less important to inflation-targeting central banks than, for example, inflation projections or policy rate projections. As such, the interpretation of these projections may be particularly diffuse.

Overall, central bank output gap projections appear to have fairly weak influence on private-sector forecast disagreement and forecast error. The majority of coefficients on output gap projections are negative, but the standard errors are large. This is a somewhat surprising result because output gap projections often feature heavily in central bank communication. In principle, output gap projections should be rather important for the future path of monetary policy. In light of this, more research on the influence of output gap projections, such as that in Mokhtarzadeh and Petersen (2017) and Champagne, Poulin-Bellisle, and Sekkel (2018) would be useful.

4.3 Forward Guidance

Overall, we find that forward guidance tends to reduce private-sector interest rate forecast dispersion and forecast error. This is apparent in table 2 and is clearer in table 4. By contrast, table 3 and table 5 show that forward guidance does not appear to significantly reduce inflation or domestic output forecast disagreement or error. This suggests that although central banks can reduce forecaster disagreement about the future path of monetary policy, it may be more difficult to reduce forecaster disagreement about future inflation rates and domestic output growth. Why might this be?

Andrade et al. (2019) find that when the Federal Reserve used time-contingent forward guidance, private-sector short-term interest rate forecast disagreement fell to a historical low. That is, forecasters agreed that the policy rate would remain low for long. Interestingly, when the authors analyzed how those same forecasters revised their macroeconomic forecasts, they observed two distinct groups. One group, optimistic forecasters, tended to revise their macroeconomic forecasts upward. A second group, pessimistic forecasters, tended to revise their macroeconomic forecasts downward. In other words, although these two groups of forecasters were exposed to the same central bank signal, they arrived at two different conclusions about what this meant for the future state of the economy.

This implies that, using the terminology of Campbell et al. (2012), dovish forward guidance, for example, can be *Odyssean* and signal a more accommodative stance of monetary policy in the future, which is good news, or it can be *Delphic* and signal that the macroeconomic outlook is worse than previously understood, which is bad news. Andrade et al. (2019) is confined to the United States and to the few years following the global financial crisis. The results shown in this paper, which considers data that span 23 countries and over 27 years, suggests that the forecaster heterogeneity observed in Andrade et al. (2019) is likely to be a more general phenomenon. As such, central banks should take great care in crafting their communication to avoid inadvertently providing Delphic forward guidance instead of the intended Odyssean forward guidance.

Notably, these reductions in dispersion and error are not especially limited to or concentrated within any particular attribute of forward guidance. It is somewhat surprising that it was not possible to detect that three different approaches to forward guidance lead to distinct outcomes. As such, some more research on the influence of forward guidance and its attributes, such as that in working papers Coenen et al. (2017) and Sutherland (2020), would be useful. Although not the focus of this paper, it is interesting to note that quantitative easing does not appear to influence private-sector forecast disagreement very much. Subsample analysis suggests that the quantitative easing results vary greatly by country, however, so a country-by-country approach would probably be better. Interestingly, at the effective lower bound, private-sector forecast dispersion of the three-month Treasury-bill rate is lower, but forecast dispersion of the 10-year Treasury-bond yield is higher.

4.4 Central Bank Policy Rate Assumptions

Many argue that an endogenous policy rate path assumption in projections should be more informative than an exogenous one. The results shown in our online appendix, however, suggest that endogenous rate path assumptions are no more useful for professional forecasters at least. Our estimates 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. Our results are also broadly consistent with results from Knüppel and Schultefrankenfeld (2017). To study this issue, the authors compare the predictive accuracy of Bank of England projections with 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 the policy rate path assumption may not be so important after all.

4.5 The Source of Central Bank Projections

Similar to the results discussed above, we find that projections provided by monetary policy decisionmakers 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.[22] The overall value of central bank projections as monetary policy signals may remain intact regardless of the policy rate path assumption or projection source.

4.6 Does the Number of Central Bank Projections Matter?

We have already considered how particular central bank projections influenced private-sector forecasts. What about the aggregate effect of numerous central bank projections? When central banks provide a whole set of projections, does this provide more information than merely providing one or two important projections, such as inflation or output? To analyze this question, we create a new variable that simply counts the number of projections released by a given central bank in a given quarter. To do so, we sum our six binary central bank projections variables. Accordingly, the minimum value is zero and the maximum value is six.

We find that, in general, the more central bank projections a central bank provided, the lower forecast dispersion and forecast error tended to be (see the online appendix for details). This result is strongest for private-sector inflation forecast dispersion and error. Perhaps a larger suite of central bank projections allows private-sector forecasters to understand the assumptions underlying, say, a central bank's inflation projection. This display of technical ability

[22] "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, p. 176).

could not only increase the credibility of a given central bank projection but also allow private-sector forecasters to compare the central bank's other macroeconomic assumptions with each of their own. To the extent that central banks have strong analytical capabilities, a larger set of central bank projections could also help private-sector forecasters better understand the prevailing macroeconomic landscape and thereby improve their forecasts.

4.7 Limitations

Before concluding, we must acknowledge two key limitations. First, in this paper the provision of different macroeconomic projections are scored as dummy variables (as in much of the literature; see Ehrmann, Eijffinger, and Fratzscher 2012, Naszodi et al. 2016, Coenen et al. 2017). We are unable to distinguish between the provision of output and inflation forecasts as, for 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 issue 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 observe reductions in forecast disagreement because forward guidance should tend to coincide with times of greater uncertainty and likely greater forecaster disagreement.

5. Conclusion

In this paper, we have presented estimates of the effect of publishing various types of central bank projections and forward guidance on private-sector forecast disagreement and forecast error. We draw a number of conclusions. First, we find that the provision of central bank policy rate projections reduces neither private-sector forecast dispersion nor forecast error. In fact, when it comes to private-sector interest rate forecast dispersion, we find evidence that central bank policy rate projections can actually increase forecaster disagreement.

It could be that policy rate projections are difficult to interpret, especially in periods of heightened macroeconomic uncertainty. Central bank policy rate projections could also lose credibility over time if they have proven to be inaccurate in the past. Another possibility is that any signal conveyed by policy rate projections is dampened by the flood of information simultaneously released by central banks. Additionally, the inclusion of wide confidence intervals around central banks' policy rate projections could add too much noise to the signal.

We also studied central bank inflation projections and found that they have tended to reduce both the forecast dispersion and forecast error of private-sector interest rate forecasts. That central bank inflation projections appear to have more influence over private-sector interest rate forecasts than macroeconomic forecasts suggests that inflation projections may primarily be used by private-sector forecasters to help forecast the path of monetary policy. Central bank unemployment projections actually appear to increase private-sector disagreement and forecast error. One possibility is that private-sector forecasters perceive unemployment projections as less important to inflation-targeting central banks than, for example, inflation projections or forward guidance. Surprisingly, central bank output gap projections appear to have fairly weak influence on private-sector forecast disagreement and forecast error. Nonetheless, the more projections a central bank released, the lower private-sector forecast dispersion and error tended to be, particularly for private inflation forecasts. This suggests that a larger set of central bank projections indeed provides more information.

We also find that forward guidance tends to reduce private-sector interest rate forecast dispersion and forecast error, but it does not appear to significantly reduce inflation or domestic output forecast disagreement or error. These results add to the evidence provided by Andrade et al. (2019) that when the Federal Reserve used time-contingent forward guidance, private-sector short-term interest rate forecast disagreement fell to a historical low but some of those same forecasters revised their macroeconomic forecasts in opposite directions. One group, optimistic forecasters, tended to revise their macroeconomic forecasts upward. A second group, pessimistic forecasters, tended to revise their macroeconomic forecasts downward.

Using the terminology of Campbell et al. (2012), forward guidance can be *Odyssean* and signal a more accommodative stance of monetary policy in the future, which is good news, or it can be *Delphic* and signal that the macroeconomic outlook is worse than previously understood, which is bad news. Our paper suggests that the forecaster heterogeneity observed in the United States after the financial crisis in Andrade et al. (2019) is likely to be a more general phenomenon. As such, central banks should take great care in crafting their communication to avoid inadvertently providing Delphic forward guidance instead of the intended Odyssean forward guidance.

Finally, 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 conclude that neither choice appears to have much influence on private-sector forecast disagreement or forecast error. At least when glimpsed through the lens of private-sector forecasts, these particular central bank communication choices are not obvious.

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