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Forward Guidance and Expectation Formation: A Narrative Approach

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Abstract

How forward guidance influences expectations is not yet fully understood. To study this issue, I construct central bank data that includes forward guidance and its attributes, central bank projections, and quantitative easing, which I combine with survey data. I describe how, when, and where forward guidance has worked. I find that forecasters revise their interest rate forecasts in the intended direction by five basis points on average following a change in forward guidance. I provide country estimates for The Federal Reserve, European Central Bank, Bank of England, Bank of Canada, Reserve Bank of Australia, Reserve Bank of New Zealand, Sveriges Riksbank, and Norges Bank. I offer preliminary evidence that commitment-based forward guidance is exceedingly rare, but can strongly amplify forward guidance. Finally, I provide estimates of the extent to which this effect may be attributable to central bank information effects.

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1 Introduction

Forward guidance is a central bank statement that provides direct information about the probable state of monetary policy in the future. Its purpose is to influence interest rate expectations. This paper investigates *how* forward guidance influences interest rate expectations. Eggertsson and Woodford (2003) showed that forward guidance can help avoid a major recession once the central bank policy rate has reached the zero lower bound by *committing* to maintain the policy rate at stimulative levels for longer than would otherwise be expected, which *lowers expectations* about future interest rates (both short-term and long-term).[1] This mechanism is the starting point for many academics and policymakers when studying forward guidance, so it is worth testing its assumptions.[2]

For example, do central banks really commit to particular monetary policy paths? After all, commitment risks time inconsistency and credibility loss. Given that risk, how beneficial is commitment? In theory, commitment may be most useful at the effective lower bound, but how powerful is forward guidance at that boundary?[3] Absent commitment, central banks often use various other attributes of forward guidance to shape their messages. These attributes—time-contingent, state-contingent, and qualitative forward guidance—have received a lot of attention in the literature, but do they actually change how forward guidance shapes expectations?

Numerous studies have found that forward guidance in a particular economy affects market interest rates in that economy (e.g. Gürkaynak et al. (2005), Moessner (2013), Hansen and McMahon (2016), Swanson (2019), Hubert and Labondance (2018), Altavilla et al. (2019)). Far fewer studies have focused on the effect of forward guidance on forecaster expectations. Those that have (e.g. Kool and Thornton (2015), Ehrmann et al. (2019), Jain and Sutherland (2020)) focused on forecaster disagreement and forecast accuracy rather than one of the most important objectives of forward guidance, which is the extent to which forecasters revise their forecasts in the intended direction. This is the first study to focus on es-

[1] Strictly speaking, the authors refer to a conditional commitment to keep the central bank policy rate low enough (Bernanke and Reinhart (2004)) to return prices to an output-gap-adjusted price-level target. Hence, the length of the commitment is conditional on realized exogenous shocks.

[2] "As with other unconventional monetary policies, the jury is still out on the effectiveness of FG, especially since we have little experience to date with exit from FG." (Blinder et al. (2017), p. 736).

[3] "With nominal short-term interest rates at or close to their effective lower bound in many countries, the broader question of how expectations are formed has taken on heightened importance." (Janet Yellen, speech, October 14, 2016).

timating how private-sector forecasters revise the level of their interest rate forecasts following a change in forward guidance. Even fewer papers have investigated how various *attributes* of forward guidance influence expectation formation (Ehrmann et al. (2019), Jain and Sutherland (2020)).

The baseline result is that, following a change in forward guidance, forecasters revise their one-year forecasts of the policy rate in the intended direction by about five basis points. That is, interest rate forecasts increase (decrease) by about 0.05% on average following each hawkish (dovish) forward guidance change. This estimate is consistent with estimates from studies that use high-frequency market data (Gürkaynak et al. (2005), Hubert and Labondance (2018), Altavilla et al. (2019)). Intuitively, the estimated effect drops to roughly zero at the effective lower bound, but only for short-term interest-rate expectations and not for longer-term interest rate forecasts. Interestingly, the estimated average forward guidance effect, five basis points, is surprisingly small given that changes in forward guidance frequently provide material updates to the outlook for the path of policy rates, which can occasionally imply numerous 25-basis-point movements. This suggests that perhaps noise (Sims (2003), Woodford (2003)), forecaster irrationality (Bordalo et al. (2020)), inattention (Gabaix (2019)), sticky expectations (Mankiw and Reis (2002), Coibion and Gorodnichenko (2012, 2015), Rossi and Sekhposyan (2016), Coibion et al. (2018a), Coibion et al. (2018b), Miranda-Agrippino and Ricco (2020), Giacomini et al. (2020)), or central bank credibility issues (Hommes and Lustenhouwer (2019), Bassetto (2019), Goy, Hommes, and Mavromatis (2020)) may constrain forward guidance expectation formation.

The main contribution of this paper is to delve much deeper into *how* forward guidance influences interest rate expectations. I describe how, when, and where forward guidance works and provide the first empirical evidence of the effects of forward guidance when a central bank makes a commitment. Commitment-based forward guidance is very rare, so our ability to study it is limited. Yet, the data suggest that it may amplify forward guidance. An important and ongoing debate is whether qualitative, state-contingent, or time-contingent forward guidance is most effective. Yet, it was not possible to detect any meaningful difference between the influence of each attribute despite ample data. When central banks use forward guidance, the language chosen commonly uses two or even all three of the qualitative, state-contingent, and time-contingent attributes rather than keeping to one approach only.

Using a large, novel central bank projections data set, I provide evidence that central bank information effects are unlikely to be very strong in interest rate expectation formation. This new evidence corroborates Hansen and McMahon (2016), who show that forward guidance is more important than central bank information effects. It also complements recent work on information effects (Hoesch, Rossi, and Sekhposyan (2020), Bauer and Swanson (2020)), which question other studies that argue that information effects influence the interpretation of monetary policy shocks (Campbell et al. (2012), Nakamura and Steinsson (2018)). This also provides insight into the relative importance of public versus private signals in expectation formation. Further, I show that forecaster disagreement is an important channel through which forward guidance operates.

This is the first paper to provide country-by-country estimates of how forward guidance influences interest rate expectations.[4] Of the countries studied in this paper, forward guidance had the largest influence on interest rate expectations in Canada, New Zealand, Sweden, and the U.S. These countries started using forward guidance in the late 1990s to early 2000s, which was when forward guidance was particularly influential. By contrast, the Bank of England and European Central Bank did not start using forward guidance until 2013, by which point each central bank was already at the effective lower bound. I also show that forward guidance can have country spill-over effects, although this is uncommon.

Two challenges account for the gaps in the literature to date. The first is an econometric challenge. Identification is difficult due to the endogeneity of forward guidance to policy rate forecasts. The econometrician must disentangle the effects of forward guidance from those of other macroeconomic trends and policy interventions (Besley et al. (2008), Dell'Ariccia et al. (2018)). Accordingly, most papers that study forward guidance take a high-frequency event study approach using hourly or minutely market interest rate data. Although indispensable as an identification strategy, this approach does have some drawbacks.

For example, markets and forecasters may take hours or even days to process the information content of central bank communication rather than merely minutes (Sims (2003), Coibion and Gorodnichenko

[4] Kool and Thornton (2015), Ehrmann et al. (2019), and Jain and Sutherland (2020) study the influence of forward guidance by country but instead focus on forecaster disagreement and forecast error rather than how forward guidance causes forecasters to revise their rate expectations.

(2015), Hansen and McMahon (2016)). Some results could partially be artifacts of financial markets (e.g. risk premia) and not necessarily reflect pure expectations (Hubert and Labondance (2018)). The effects of monetary policy shocks on asset prices are not necessarily persistent (Wright (2012), Miranda-Agrippino and Ricco (2020)).[5] Especially relevant here, studies such as Gürkaynak et al. (2005) cannot explain why or what aspects of central bank communication influence expectations (Campbell et al. (2012), p. 66). They may also confound monetary policy effects with information effects (Cieslak and Schrimpf (2019)). Finally, such studies must infer the use of forward guidance based on the co-movements of asset prices. In this paper, forward guidance is identified ex ante by evidence of its intended use by monetary policy committees (as in Hansen and McMahon (2016)) rather than ex post by evidence of its perceived use.

Of course, the major advantage of the high-frequency event study approach is that it offers much cleaner identification, which cannot be done with monthly survey data. Yet, high-frequency financial market data are not standard across countries and may suffer from liquidity problems, reporting issues, and short histories. The survey data used in this paper are standard across countries, stretch back to 1990, and reflect pure expectations. Nonetheless, the econometric approach is constrained by the survey data, which do not offer either as many points along the yield curve or as many forecast horizons as we might like.

The second challenge is a data gap. To provide estimates of the effects of forward guidance more generally requires a large forward guidance data set spanning multiple years and multiple countries rather than just isolated episodes, which is much more common. Yet it is not enough to simply record all the dates of forward guidance episodes by country. The data must incorporate the sign (dovishness or hawkishness) of forward guidance to be able to measure whether such guidance moved policy rate expectations in the intended direction (and by how much). The data must also include the effects of other central bank policies such as policy rate changes and asset purchase programs to be able to isolate the effects of forward guidance. To date, no such data set has been available. So, to conduct this analysis, I first construct a new forward guidance data set and then combine it with private-sector survey data.

The monthly central bank data set assembles over 30 years of hand-collected forward guidance, macroe-

[5]However, Hansen and McMahon (2016), Swanson (2019), Hubert and Labondance (2018), and Altavilla et al. (2019) show that the effect of Federal Open Market Committee (FOMC) and European Central Bank (ECB) forward guidance on market interest rates is indeed persistent.

conomic projections, quantitative easing, effective lower bound, and policy rate data. The data cover the Federal Reserve, European Central Bank, Bank of England, Bank of Canada, Reserve Bank of Australia, Reserve Bank of New Zealand, Sveriges Riksbank, and Norges Bank. It should prove useful for researchers studying central bank communication, central bank information effects, and all aspects of monetary policy. I combine the data with survey-based panel data containing *individual* private-sector interest rate forecasts and their full set of *matching* domestic macroeconomic expectations.

I also record whether the forward guidance used state-contingent, time-contingent (and its horizon), or qualitative attributes and whether it was commitment-based. It turns out that commitment-based forward guidance is exceptionally rare. Of the eight central banks studied over a period of 32 years in this paper, only half have ever used commitment-based forward guidance.[6] To understand why, it is crucial to distinguish between an *intended* commitment by the central bank and a *perceived* commitment by the markets, which is how empirical studies to date define forward guidance with commitment. Most studies focus on perception, but this paper focuses on intention.

Several studies have shown that forward guidance operates by signalling not only the future monetary policy stance but also the central bank's private macroeconomic outlook, i.e., through information effects (Campbell et al. (2012), Campbell et al. (2017), Nakamura and Steinsson (2018), Andrade et al. (2019), Miranda-Agrippino and Ricco (2020)). Some studies capture such information effects *indirectly* by inferring them from the comovement of asset prices (Nakamura and Steinsson (2018), Cieslak and Schrimpf (2019), Jarociński and Karadi (2020), and Andrade and Ferroni (2020)). Another important novelty of this paper is that I adjust for information effects *directly* by using the central bank projections publicly released alongside monetary policy announcements. I do so by collecting the macroeconomic projections released by all eight central banks in the study over the past 32 years. This allows me to contribute to the ongoing debate about the role of information effects in expectation formation.

Morris and Shin (2002), Amato et al. (2002), Morris and Shin (2005), and Bassetto (2019) showed the importance of considering both the public (central bank) and private signals that agents use in forming expectations. I control for private macroeconomic information by adjusting for each individual's

[6] Bernanke and Reinhart (2004) (p. 86) provide another example from the Bank of Japan in 2001.

matching macroeconomic forecast revisions. I follow Altavilla and Giannone (2017), who use individual revisions to *current-year* macroeconomic forecasts as an exogenous control variable. This also allows me to adjust for the macroeconomic shocks relevant to each forecaster that could confound the relationship between forward guidance changes and policy rate forecast revisions without introducing simultaneity bias. The remainder of this paper is structured as follows. Section 2 describes the data, Section 3 outlines the econometric approach and identification strategy, Section 4 presents the results, and Section 5 concludes. An online appendix provides additional data and methodology notes, robustness checks, further analysis, and numerous figures that plot the data.

2 Data

This study combines two types of panel data. First, I use monthly individual private-sector survey forecasts of interest rates, inflation, domestic output growth, and unemployment (see subsection 2.1). The individual private-sector survey forecast data come from Consensus Economics. Second, I construct a monthly central bank policy signal data set that includes, *inter alia*, forward guidance, policy rate decisions, quantitative easing, and central bank projections (see subsection 2.2). These data should be very useful for researchers and policymakers who study central banks and (unconventional) monetary policy. The data come from twelve countries (Australia, Canada, France, Germany, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, the UK, and the US) and span over 30 years (1990 to 2021).

The data are constructed so that central bank policy signals strictly precede private-sector forecasts chronologically. That is, a one-month period in the data is not the same as a calendar month. Rather, the end of each pseudo-month is considered to be the Consensus Economics survey deadline, which typically falls on the second Monday of each month. The beginning of each pseudo-month is considered to be the day immediately following the last month's Consensus Economics survey deadline, which is typically a Tuesday. All central bank data associated with a given pseudo-month was released to the public *before* that month's survey deadline but *on or after* last month's survey deadline. All of the data used in this paper were meticulously constructed using this logic.[7] Additional notes as well as figures depicting the data are included in the online appendix.

[7] All of the dates (forward guidance, central bank projections, policy rate decisions, etc.) are included in the data set so that it can be re-purposed for data sets other than the Consensus Economics data.

2.1 Private-sector forecast data

Each month, private-sector forecasters submit their forecasts for interest rates, inflation, real gross domestic product (GDP) growth, unemployment, and other macroeconomic data to Consensus Economics. Each forecaster provides his or her forecast for the domestic three-month Treasury bill rate and the ten-year government bond yield at two forecast horizons: three months and twelve months into the future. The interest rate forecasts are fixed-horizon forecasts and the other macroeconomic forecasts are fixed-event forecasts. For example, each forecaster also provides his or her forecast for the inflation rate for both the current year and the next year. To better match the interest rate forecasts, which are the outcome variables of interest, I create pseudo twelve-month-ahead macroeconomic forecasts. Continuing with the inflation example,

$$\pi_{ict}^{h=12} = \frac{13-k}{12}\pi_{ict}^{CY} + \frac{k-1}{12}\pi_{ict}^{NY}, \qquad k \in \{1, 2, ..., 12\} \tag{1}$$

where π represents a forecast of the inflation rate in twelve months ($h = 12$) by private-sector forecaster i in country c made in month t and calendar month k. The pseudo twelve-month-ahead macroeconomic forecast is a weighted average of the individual private-sector forecaster's current-year (CY) and next-year (NY) inflation forecast. The individual forecasts provide additional information beyond consensus forecasts only (see Bordalo, Gennaioli, Ma, and Shleifer (2020) and section 3). To track individual forecasters over time, I worked with the data provider to track firms through mergers and acquisitions across time by country. This allowed for the consolidation of many individual forecaster time series that were seemingly separate into fewer, harmonized individual forecaster time series. This decreased the total number of firms in the sample data and increased the number of observations per firm.

2.2 Central bank data

The central bank data set includes forward guidance, policy rates, quantitative easing, and central bank projections data (each described below) as well as effective lower bound and inflation-targeting data. The data cover eight central banks and span over 30 years (1990 to 2021). First, daily central bank policy rates were obtained from the BIS. For each pseudo-month, I use the end-of-day central bank policy rate as of the Consensus Economics survey deadline date. I take the first difference of each central bank policy rate and label this change $\Delta\tilde{p}_{ct}$. Throughout this paper, Δ denotes a first difference, $\sim$ denotes an action taken by a central bank, p denotes the central bank policy rate, the subscript c denotes country, and the subscript t denotes month. Intuitively, had a central bank, for example, raised its policy rate by 25 basis points, then one might reasonably expect a private-sector forecaster to revise his or her forecast of the future policy rate commensurately. Of course, any such revision would depend on a number of factors, not least how the central bank's change to its policy rate conformed with that forecaster's expectations. So, $\Delta\tilde{p}_{ct}$ serves not only as a control, but also as a baseline to approximate the transmission of changes in short-term policy rates to changes in expectations of policy rates in the future.

2.3 Forward guidance data

The second type of central bank data collected was forward guidance data. I took a narrative approach to forward guidance categorization that is similar in nature to that proposed by Shiller (2017) and that used in Istrefi (2016), Hansen and McMahon (2016), and Bordo and Istrefi (2018) (rather than Romer and Romer (2004)). The advantage of this approach is that it focuses on identifying forward guidance based on the intention of the monetary policy committee as judged by the choice of language in press releases. By contrast, the literature on forward guidance instead identifies forward guidance by making inferences about movements in market interest rates immediately following monetary policy announcements.[8] I analyzed about 32 years of monetary policy statements across eight central banks and, *inter alia*, identified all *changes* in forward guidance. The approach, which is described below, was as systematic as possible to avoid introducing any bias in the data. All forward guidance language (the relevant excerpts from press releases), dates, and metadata are included in the data that accompany this paper.

One seemingly apparent drawback of this approach is that it is subjective in nature, but this is a feature, not a bug. The forward guidance literature tends to identify forward guidance by analyzing the shifts in risk-free interest rates in a narrow window around monetary policy announcements. However, this detects forward guidance only when it was a surprise and misses forward guidance when it was not a surprise. By taking a more subjective approach, I can follow a central bank's forward guidance narrative and demarcate all shifts in that narrative (Shiller (2017)). I identify 238 shifts in forward guidance in the sample data, so no single forward guidance change carries undue weight.

[8]"Our approach identifies forward guidance using the term structure of overnight interest rate futures rates. As such we identify forward guidance as interpreted by market participants, which may or may not be as intended by the members of the FOMC." (Campbell et al. (2017), pp. 286-287).

An alternative approach that does not focus on market surprises but that is more objective would be to use machine learning. Many topics in the central bank communication literature are perfectly suited to computational linguistics, such as those that study lengthy transcripts (Hansen et al. (2018)), inflation reports (Hansen et al. (2019)), or every word in monetary policy statements (Hansen and McMahon (2016)). However, studying *forward guidance* changes is a task much better suited to human learning than machine learning. Indeed, Hansen and McMahon (2016) use computational linguistics to identify the topics in Federal Open Market Committee (FOMC) statements but use a research assistant to identify forward guidance sentences. Although I read hundreds of monetary policy statements, I am concerned only with forward guidance statements. Each statement typically only has one or two salient sentences that require very careful scrutiny. Once the forward guidance statements have been isolated, this amounts to less total content than a short novel. This content must then be read very carefully for *meaning* and, even more subtly, *shifts in that meaning*—a task much better suited to the human brain.

The process was as follows. The first stage was to gather all monetary policy communication for each country issued from 1990 to 2021. In many cases, older press releases and monetary policy reports were not available online so it was necessary to collaborate with the central banks to collect these archived documents. The vast majority of this communication takes the form of press releases that announce and explain a monetary policy decision. In rare cases, particularly in the 1990s, some central banks also included explanations of their monetary policy decisions in their accompanying monetary policy reports.

The second stage was to study each statement in chronological order, one country at a time. The purpose of doing so was to keep track of each central bank's evolving narrative and to detect shifts in this narrative, which often correspond to changes in forward guidance. Naturally, it is therefore crucial to establish some very particular definitions of forward guidance and its attributes. *I define forward guidance as a central bank statement that provides direct information about the probable state of monetary policy in the future*. This definition is consistent with central banks' own definitions of forward guidance as well as most definitions in the literature.[9]

[9] "Communication about the likely future course of monetary policy is known as 'forward guidance."' (Federal Reserve, 2019). "[F]orward guidance ... means communicating how the ECB expects its policy measures to evolve in the future and what conditions would warrant a change in the policy stance." (European Central Bank

The third stage was to label forward guidance as either dovish (-1), neutral (0), or hawkish ($+1$) (although these quantifications do not represent the variable of interest per se). The terms dovish, neutral, and hawkish forward guidance refer to the future path of monetary policy. Typically, hawkish forward guidance would suggest that the next change in the policy rate is more likely to be up than down. Dovish forward guidance would be the opposite. Neutral forward guidance would suggest that the next change in the policy rate is as likely to be up as it is down.

At the effective lower bound, dovish forward guidance is somewhat different because, by definition, the policy rate cannot (or, at least, is unlikely to) move lower. Hence, when a central bank uses forward guidance at the effective lower bound that is clearly intended to be stimulative in nature, it is labelled dovish. For example, if a central bank signals that it intends to keep the policy rate very low or at the effective lower bound for longer than might otherwise be anticipated, this is considered dovish forward guidance. In other words, low-for-long forward guidance is considered to be dovish.

The Reserve Bank of New Zealand, the Norges Bank, and the Sveriges Riksbank have used forward guidance the most often—each beginning in the 1990s. The Bank of England and the European Central Bank have used forward guidance the least frequently in the sample period, with neither beginning until well after the onset of the financial crisis. The Bank of Canada, Federal Reserve, and Reserve Bank of Australia lie somewhere in between.

Fourth, and most importantly, all significant *changes* in forward guidance were identified, which allowed for the creation of the main variable of interest in this study, $\Delta\tilde{f}_{ct}$, where $\tilde{f}$ denotes forward guidance. When a central bank significantly shifted the tone of its forward guidance, this change was recorded as either a -1 (a shift to a more dovish stance) or a $+1$ (a shift to a more hawkish stance). When the tone of forward guidance did not change, this was recorded as a 0. If no forward guidance was found at all, this

(ECB), 2018). "Forward guidance in monetary policy means providing some information about future policy settings." (Svensson (2015), p. 20). "Under FG, the central bank communicates not only about the current setting of monetary policy, but also makes explicit statements about the future path of policy." (Blinder et al. (2017), p. 732). "We define forward guidance as a situation in which central banks provide direct statements about the future path of their policy tools." (Bassetto (2019), p. 69).

was also recorded as a 0. Figure 1 charts $\Delta\tilde{f}_{ct}$.[10] At the effective lower bound, a shift to a more dovish stance might come in the form of a lengthening of the time-contingent forward guidance, for example. A major shortcoming of the data set is that highly complex information —forward guidance horizon, shape of the path, etc. —is consolidated into a trinary balanced indicator representing changes in the identified events of forward guidance. As such, I collected a great deal of metadata.

In the fifth stage, I recorded the *attributes* of the forward guidance: time-contingent, state-contingent, and/or qualitative; and, forward guidance with commitment. If and only if time-contingent forward guidance was used, the horizon of the forward guidance was recorded in the form of a date. When a policy rate projection was provided, which represents the majority of cases of time-contingent forward guidance in the data, the horizon was simply taken to be the furthest point of the projection. The policy rate projections were also collected. The rest of the time-contingent forward guidance was verbal. In some of those verbal cases, the horizon was provided; in other cases, the precise horizon had to be inferred. This horizon was also translated into a numerical vector calculated as the number of days between the end of the forward guidance horizon and that month's survey deadline. In a final stage, I reviewed the data to check for consistency across central banks and time.

2.3.1 Forward guidance with commitment

Standard forward guidance is a statement that provides direct information about the *probable* state of *monetary policy* in the future. Forward guidance with commitment is a statement that clearly indicates a *commitment* to a state of *monetary policy* in the future. The words *clearly indicates a commitment* must be used because it is very unlikely that a central bank would ever issue a legally binding commitment on the future state of monetary policy.

The history of forward guidance has been overwhelmingly noncommittal. Moessner et al. (2017) argue that there is a disconnect between the theoretical and the applied forward guidance literature. They observe that most theoretical studies of forward guidance assume commitment. In practice, however, central banks very rarely commit. Of the eight central banks studied in this paper, only the Bank of

[10] This approach to measuring a central bank policy signal was proposed in Amato et al. (2002) (p. 499) and was used in Hansen and McMahon (2016) (p. S120).

Canada (2009-10, 2020-1), Reserve Bank of Australia (2020-1), Reserve Bank of New Zealand (2020-1), and Sveriges Riksbank (2014-2015) have ever used forward guidance with commitment over a period of 32 years.[11] As such, there are not enough cases of forward guidance with commitment to provide robust estimates of its influence on interest rate expectations.

By way of example, on April 21, 2009, the Bank of Canada Governing Council made the following statement: "Bank of Canada lowers overnight rate target by 1/4 percentage point to 1/4 per cent and, conditional on the inflation outlook, commits to hold current policy rate until the end of the second quarter of 2010." More recently, on March 16, 2020, the Reserve Bank of New Zealand Monetary Policy Committee made the following statement: "The Official Cash Rate (OCR) is 0.25 percent, reduced from 1.0 percent, and will remain at this level for at least the next 12 months. ... And, the Monetary Policy Committee agreed to provide further support with the OCR now at 0.25 percent. The Committee agreed unanimously to keep the OCR at this level for at least 12 months."

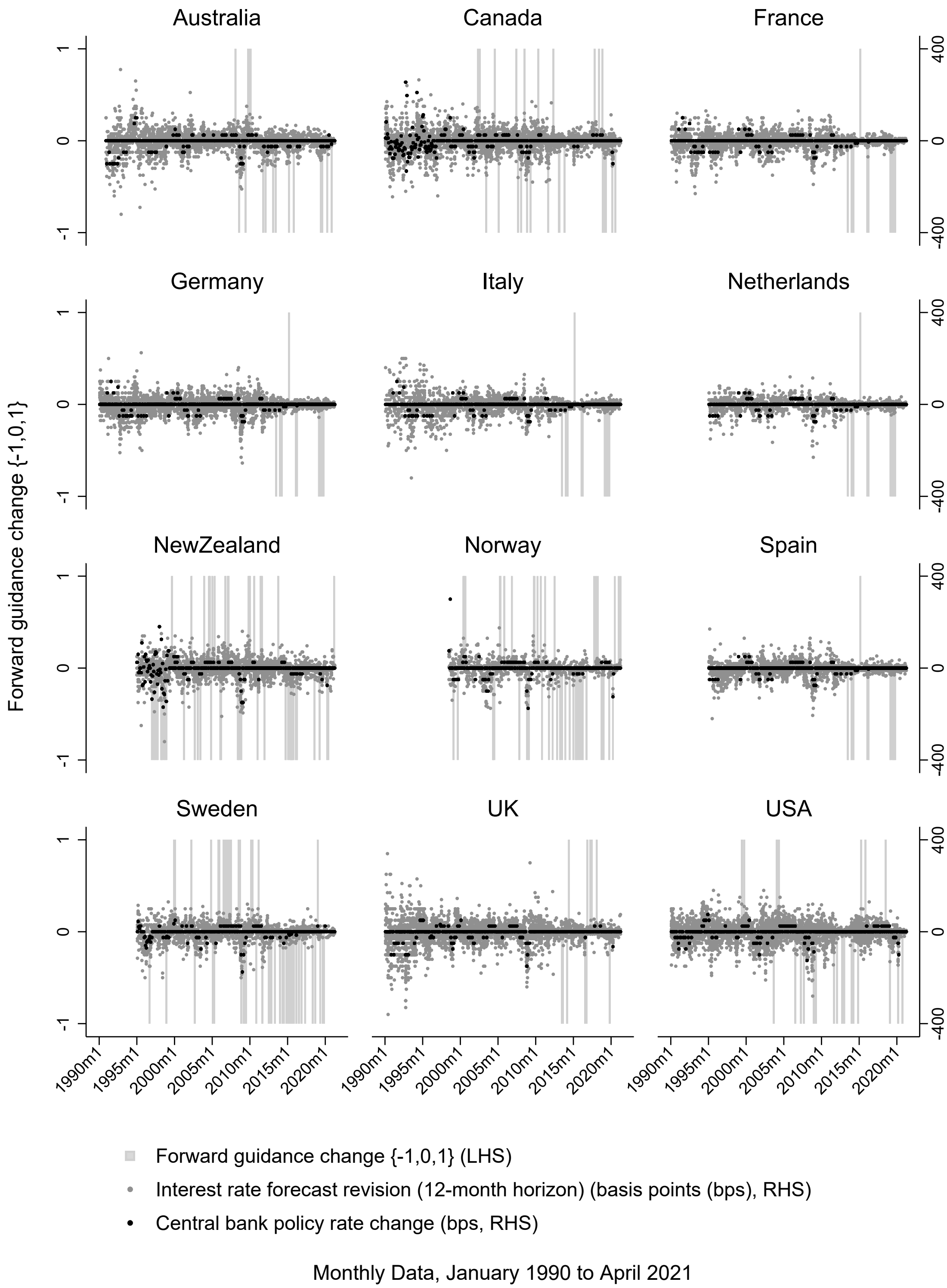
It is useful to distinguish between an *intended* commitment in forward guidance by a monetary policy committee and forward guidance *perceived* as a commitment by others, which is how the literature often approaches forward guidance with commitment.[12] Naturally, there is more ambiguity in the definition of forward guidance with commitment when it is defined by whether it is perceived as a commitment—not least because the definition would depend on the perception to which we refer (e.g. that of market participants, forecasters, journalists, the broader public). There is unlikely to be agreement on whether a particular case of forward guidance represents a commitment even within those groups let alone across them. By contrast, whether the central bank intended to make a commitment can be judged by the language used in the forward guidance and whether the central bank *states* that the forward guidance should not be perceived as a commitment, which happens. This could still lead to disagreement on what constitutes forward guidance with commitment, but less.

[11] Bernanke and Reinhart (2004), p. 86, provide another example from the Bank of Japan in 2001.

[12] "Since we use data on expected future federal funds rates to identify the policy signals, our methodology identifies forward guidance as interpreted by market participants. Consequently, we have no way of identifying the FOMC's true intentions." (Campbell et al. (2017), p. 327).

Figure 1: **Forward guidance changes and individual revisions to short-term interest rate forecasts**

Each figure charts forward guidance changes, central bank policy rate changes, and revisions to individual private-sector forecasts of the three-month Treasury bill rate (policy rate proxy) at the 12-month forecast horizon.



2.4 Quantitative easing, the effective lower bound, and projections data

I also collected quantitative easing data for each central bank over the sample period. The process was very similar to that described above for forward guidance. First, I checked each monetary policy decision press release for statements about quantitative easing (QE). This was done as part of the data entry for forward guidance. If a central bank initiated a quantitative easing program, this was considered a dovish *change* to quantitative easing. If a central bank made no change to its quantitative easing program or if it did not have one, this was labelled with a 0. If a central bank announced that it intended to end its quantitative easing program, this was labelled as a +1. Changes to quantitative easing were also recorded if a central bank announced a QE expansion (−1), a QE contraction (for example, a reduction in pace) (+1), provided new dovish balance sheet guidance (−1), or provided new hawkish balance sheet guidance (+1). These quantifications were consolidated into the variable *change in quantitative easing*, $\Delta\tilde{q}_{ct}$, where $\tilde{q}$ denotes quantitative easing. As with forward guidance, the dates and scoring were also crossed-checked with the literature (e.g. Gagnon et al. (2011), Krishnamurthy and Vissing-Jorgensen (2011), Altavilla and Giannone (2017), Swanson (2019)).

Effective lower bound periods are identified in a number of ways. First, if the central bank has made no statements about its views on the level of the effective lower bound, then the zero lower bound is considered to be the effective lower bound. If the central bank has made statements about its views on the level of the effective lower bound as only a few central banks have (the Bank of Canada, the Bank of England, the European Central Bank, the Sveriges Riksbank), then the stated level supersedes the zero lower bound from that point onwards (for example, from the date of the statement onwards, the effective lower bound might be considered to be a negative policy rate). In that case, an ELB dummy variable takes the value one whenever the central bank is very close to or at its stated effective lower bound. Many central banks ultimately later revised down their stated level of the effective lower bound (the European Central Bank, the Sveriges Riksbank). In that case, the definition of the effective lower bound is iteratively revised from the point of the new statement onwards.

Central bank projections data were hand-collected from the eight central banks' monetary policy reports. I focused on the key macroeconomic projections, which are mostly standard and common to each central bank: inflation, domestic GDP growth, and unemployment. To match the survey data and to maintain a common format, current-year and next-year projections were collected.[13] For empirical work, the data were transformed using Equation 1 to match the private-sector forecast data. Central bank policy rate projections were also collected at the one- and two-year projection horizons. The data are constructed so that the release of all central bank projections strictly precede the private-sector survey deadline.

3 Estimation

Estimation is performed using a two-way fixed effects estimator. Specifically, I use both individual (forecaster) and monthly fixed effects.[14] Standard errors are clustered by country (Bertrand et al. (2004), Stock and Watson (2008)).[15] Correlation of forecast revisions is much greater by country than by individual forecaster, and there is no significant evidence that there is any need to cluster by firm. If the standard errors were clustered by individual forecasters, then they would be biased downwards.[16] The benchmark econometric model is as follows:

$$\Delta r^h_{ict} = \beta \Delta \tilde{f}_{ct} + \gamma \Delta \tilde{q}_{ct} + \phi \Delta \tilde{p}_{ct} + \varphi \tilde{e}_{ct} + \delta_1 \Delta \pi^h_{ict} + \delta_2 \Delta g^h_{ict} + \alpha_i + \alpha_t + \epsilon_{ict} \tag{2}$$

Δr^h_{ict} is a revision (Δ) to a private-sector forecast of the three-month Treasury bill rate from forecaster i in country c at time t, $h = 12$ months in the future (less frequently, I will also use $h = 3$). I use the three-month Treasury bill rate as a proxy for policy rate expectations.[17] $\Delta \tilde{f}_{ct}$ is a change to forward guidance. The $\sim$ denotes a central bank policy variable. $\Delta \tilde{q}_{ct}$ is a change to quantitative easing. $\Delta \tilde{p}_{ct}$ is a change in the central bank policy rate. The individual forecasts provide a richer source of data than merely using consensus forecasts (Baker et al. (2020), Bordalo et al. (2020)).[18] $\Delta \pi^h_{ict}$ is a revision to a private-sector

[13] Some more distant projections were also available in some cases and were collected in those cases.

[14] Country-month fixed effects cannot be used because the forward guidance, policy rate change, and quantitative easing variables do not vary within country-month; their inclusion would create a multicollinearity problem.

[15] The results are robust to bootstrapped standard errors and Driscoll and Kraay (1998) standard errors.

[16] The standard errors are almost certainly too conservative (Abadie et al. (2017)), which is not a major problem in this paper given the large sample size. One drawback of this approach is that the standard errors will be estimated using only twelve clusters—one for each country (Bertrand et al. (2004), Cameron et al. (2008), Cameron et al. (2011)); however, in subsection 4.2 I re-estimate Equation 2 for each country, clustering the standard errors by forecaster, which eliminates the need to cluster by country and significantly increases the number of clusters.

[17] In some cases, the three-month Treasury bill rate could deviate marginally from corresponding policy rate expectations due to, for example, small term premia, asset purchase programs, Treasury bill supply, or month-end market frictions (see Sutherland (2017)).

[18] The results of interest do not vary by consensus or individual forecaster data, but the coefficients corresponding to individual forecasts are different from those corresponding to consensus forecasts (see online appendix).

forecast of the inflation rate in 12 months' time (i.e. $h = 12$). Δg^h_{ict} is a revision to a private-sector forecast of the domestic output growth rate in 12 months' time. Δu^h_{ict} is a revision to a private-sector forecast of the unemployment rate in 12 months' time.[19]

I include α_i to capture time-invariant, forecaster-level heterogeneity.[20] I also include month fixed effects, α_t. This allows me to partially control for the type of global shocks that might cause forecasters to revise their policy rate forecasts, such as the deteriorating macroeconomic outlook due to the global financial crisis.[21] Additionally, I include a dummy variable indicating periods in which countries' central banks are operating at or near the effective lower bound, $\tilde{e}_{ct} \in \{0, 1\}$. This variable allows for the possibility that revisions to interest rate forecasts are fundamentally different (or at least, biased) at the effective lower bound. As such, $\tilde{e}_{ct}$ is included as both a control variable and, later, an interaction variable with $\Delta\tilde{f}_{ct}$.

Altavilla and Giannone (2017) also condition on individual private-sector forecasters' matching macroeconomic forecasts to estimate the effect of unconventional monetary policy on interest rate forecasts. Accordingly, I condition on $\Delta\pi^h_{ict}$. Because central bank inflation projections ($\Delta\tilde{\pi}_{ct}$), for example, strictly precede $\Delta\pi^h_{ict}$ in the data-generating process and are publicly released, $\Delta\pi^h_{ict}$ should incorporate $\Delta\tilde{\pi}_{ct}$ and so $\Delta\tilde{\pi}_{ct}$ should contain no additional information about Δr^h_{ict} after conditioning on $\Delta\pi^h_{ict}$. Another major advantage is that $\Delta\pi^h_{ict}$ should incorporate private information and judgment, that is, time-varying idiosyncratic expectations, that could affect Δr^h_{ict}. This is because $\Delta\pi^h_{ict}$ comes from *the same individual forecaster*, i, as does Δr^h_{ict} in the private-sector forecast data. Nonetheless, in subsection 4.1, I add revisions to central bank projections ($\Delta\tilde{\pi}_{ct}$, $\Delta\tilde{g}_{ct}$) as additional covariates, both as a robustness check and to test for the presence of central bank information effects.[22]

Of course, private-sector forecasters may not consider just inflation *over the next year* when forming expectations of future policy rates, but they may also consider inflation beyond the next year. However, some inflation expectations are far enough into the future that they could be influenced by Δr^h_{ict}. That is,

[19] Δu^h_{ict} is only included in country-by-country panel regressions (subsection 4.2) because unemployment forecast data is not available for the Netherlands, Norway, Spain, and Sweden.

[20] This term is purely expositional as I estimate Equation 2 using the within transformation, which eliminates α_i.

[21] Additional types of exogenous time control variables, such as a dummy variable for inflation-targeting periods, were tested but were ultimately not included as they were seldom or never statistically significant.

[22] Note that central bank projections are available over only about half the sample period.

inflation substantially beyond the horizon $t + h$ could be influenced by the stance of monetary policy at time $t{+}h$ (as monetary policy operates with a lag). If such inflation expectations were to be used as control variables, it would introduce simultaneity bias. The approach to managing this problem is adapted from Altavilla and Giannone (2017), who argue that "Assuming that the effect of policy on the real economy is delayed and that policy decisions are not affected by current-quarter variations in long-term bond yields is tantamount to the recursive identification scheme used in structural vector autoregressions to identify standard policy (for recent implementations and critical discussions see Leeper et al., 1996; Bernanke et al., 2005; Uhlig, 2005; Banbura et al., 2010; Giannone et al., 2015)" (pp. 959-960). Yet, the inability to control for inflation and growth expectations beyond the twelve-month forecast horizon inevitably leads to some omitted variable bias. This econometric approach attempts to balance simultaneity and omitted variable bias as well as possible given the data constraints. Nonetheless, the main drawback of this econometric approach is that, to some extent at least, the exogenous component of a change in forward guidance may be confounded with macroeconomic shocks and central bank information effects that have influence beyond the twelve-month forecast horizon.

In this paper, model parsimony is critical because forward guidance variable, ($\Delta\tilde{f}_{ct}$), is necessarily measured with at least some error, which will tend to introduce attenuation bias to any β measuring the effect of $\Delta\tilde{f}_{ct}$ on Δr^h_{ict} (see the online appendix for derivations). Hence, this paper focuses on eight inflation-targeting central banks partly to constrain the number of potential causes of Δr^h_{ict}. Yet, some of the central banks in the sample do have important monetary policy considerations outside of inflation. For example, the Federal Reserve has a dual mandate of both stable prices and maximum sustainable employment. Recently, the Reserve Bank of New Zealand adopted a similar mandate. Therefore, in these countries, it is also important to consider the role that unemployment forecasts could play in the process of forming short-term interest rate forecasts. Accordingly, subsection 4.2 also provides country-by-country estimates that allows for the inclusion of individual forecasts of the unemployment rate, Δu^h_{ict}.

Swanson (2019) lists three identification challenges that apply to this type of study. First, it may be difficult to disentangle the effects of forward guidance and quantitative easing. After all, during the financial crisis, changes to forward guidance and quantitative easing happened simultaneously in some cases.[23]

[23]"To summarize, there seems to be more evidence pointing to FG being effective than not. However, it is

However, in the sample data, simultaneous implementation is the exception rather than the rule. The correlation between forward guidance changes and quantitative easing changes is low at approximately 0.15. Second, financial markets are forward-looking and so will incorporate expectations of policy rate changes, forward guidance changes, and quantitative easing changes before they take place. This is a major challenge for high-frequency event studies that use financial market data. The issue is much less severe for this study because the data are monthly and changes to central bank policy are considerably more difficult to anticipate one month in advance than, say, one day in advance.

Third, central banks can surprise forecasters by inaction because of the role expectations play. In this study, we are primarily interested in the ceteris paribus relationship between changes to forward guidance and revisions to interest rate forecasts. The hypothesis is that, all else equal, when $\Delta\tilde{f}_{ct}$ takes the value 1 (hawkish) we expect rate expectations to rise, when it takes the value 0 we expect rate expectations to hold, and when it takes the value -1 we expect rate expectations to fall. Central bank inaction can be defined by $\Delta\tilde{f}_{ct} = 0$. If forecasters were expecting a $\Delta\tilde{f}_{ct} = 1$, but ultimately observed a $\Delta\tilde{f}_{ct} = 0$, they may have revised down their rate expectations. If forecasters were expecting a $\Delta\tilde{f}_{ct} = -1$, but ultimately observed a $\Delta\tilde{f}_{ct} = 0$, they may have revised up their rate expectations. As long as this effect is fairly symmetric, that is, the expected change in forward guidance forecast error is approximately equal to zero, then this should not bias the estimates.

4 Results

Forecaster expectations of the three-month Treasury bill rate twelve months from now shifted by about five basis points on average in the intended direction following a change in forward guidance (Table 1, row (1), column [1]). In other words, an individual forecaster's interest rate forecast increased by about five basis points on average following a hawkish change in forward guidance. An individual forecaster's interest rate forecast decreased by about five basis points on average following dovish change in forward guidance. This result is remarkably well-aligned with the results in high-frequency event studies of the effect of forward guidance on market interest rates (e.g. Gürkaynak et al. (2005), Hubert and Labondance (2018), Altavilla et al. (2019), Swanson (2019)).

important to note that the various empirical studies are subject to substantial identification problems. Even event studies are contaminated by the fact that FG was typically used in conjunction with other unconventional policies." (Blinder et al. (2017), p. 735).

Forecaster expectations of the three-month Treasury bill rate twelve months from now shifted by about seven basis points on average following a *policy rate* change (somewhat analogous to the *target factor* or *level factor* in other studies; Table 1, row (2)). Again, this estimate is comparable to those in related studies such as Gürkaynak et al. (2005) and Swanson (2019). Because the policy rate data have been re-scaled, this provides an estimate of how much we can expect a private-sector forecaster to adjust his or her forecast of the three-month Treasury bill rate one year from now following a 25-basis-point policy rate change. It is difficult to compare the magnitude of the estimated coefficient for forward guidance to the estimated coefficient for a policy rate change without knowing the extent to which each policy action is anticipated (addressed in the online appendix), but it is reasonable to assume that policy rate changes at upcoming meetings are easier to anticipate than specific changes in forward guidance.

The interaction term, (1) x |(2)|, tests for any nonlinear effect produced by simultaneous changes in forward guidance and the policy rate. This term is estimated to be about negative four basis points. In other words, the estimated effects of a policy rate change and a forward guidance change are non-additive. Unlike in related studies that use principal component analysis (Gürkaynak et al. (2005), Altavilla et al. (2019)), in reality, the effect of a policy rate change is not orthogonal to a forward guidance change. Inevitably, a policy rate change provides a signal about the future path of policy rates that overlaps with any accompanying forward guidance.[24]

In column [1], the average effect of a quantitative easing change on short-term interest rate expectations is estimated to be negative [Table 1, row (5)]. That is, a dovish (hawkish) change in quantitative easing policy actually leads to an increase (decrease) in short-term interest rate forecasts. This is misleading, however. First, the coefficient estimate is positive and significant both at the effective lower bound and for expectations of the ten-year government bond yield (each about three basis points; see the online appendix).[25] Second, once the interaction variables used in column [2] are added, the counterintuitive negative effect disappears. Table 1 also suggests that forward guidance changes and quantitative easing changes reinforce one another [row (1) x |(5)|].

[24]See Hubert (2019) for a more detailed treatment of the nonlinear signalling effects of monetary policy.
[25]This pattern and the magnitude of the effects are also consistent with Swanson (2019) (see Table 3).

Crucially, the effects of forward guidance on short-term interest rate expectations are greatly diminished during periods at the effective lower bound [Table 1, row (1) x (6)]. Similarly, Swanson (2019) (Table 4) shows that the influence of a change in forward guidance on the six-month Treasury yield was lower in the U.S. between 2009 and 2015 (its effective lower bound period) as compared to all other periods. However, in Swanson (2019), the opposite is true for the two-year Treasury yield and other longer maturities, so this dampening effect likely only applies to short-term rates, such as the three-month Treasury bill rate studied here. Similarly, in this paper, the dampening effect does not hold for forecasts of the ten-year bond yield (online appendix). Hansen and McMahon (2016) reach a very similar conclusion. It is not surprising, then, that dovish forward guidance, which is frequently used during periods at the effective lower bound, should have a limited ability to incite forecasters to revise down their *short-term* interest rate expectations, as short-term interest rate expectations may already be at the effective lower bound. This implies that the effect of forward guidance at the effective lower bound is likely to be observed at maturities around two years and beyond.

One key advantage of the empirical approach in this paper is that we can exploit both the time-series variation and the cross-country heterogeneity of the data to parse the results more finely than related papers can to learn more about how forward guidance works. Column [2] of Table 1 provides evidence that forward guidance with commitment can be considerably more influential than the average forward guidance announcement. Specifically, row *[1] x Forward guidance with commitment* shows that forward guidance changes during the Bank of Canada and the Sveriges Riksbank commitment periods greatly increased the influence of forward guidance (an additional fifteen basis points).

The sample in column [2] ends in 2019 because three additional periods of forward guidance with commitment took place in the sample data. However, identification of the effects of the forward guidance during this time is extremely difficult. These announcements made by the Reserve Bank of New Zealand, Reserve Bank of Australia, and the Bank of Canada coincide not only with each other (RBNZ and RBA in the same pseudo-month) but also with unprecedented downward inflation and growth forecast revisions, policy rate cuts down to the effective lower bound for the first time, the introduction of quantitative easing for the first time, yield curve control in Australia for the first time, numerous new liquidity facili-

Table 1: **How do changes in forward guidance affect revisions to individuals' forecasts of the 3-month T-bill rate in 12 months' time?**

	[1]	[2]	[3]	[4]
(1) Forward guidance $\{-1, 0, 1\}$ change (+1)	5.33***	9.33***	9.64***	7.90***
	(1.06)	(1.59)	(1.74)	(1.47)
(2) Policy rate (PR) change (+25 bps)	6.93***	6.71***	6.76***	6.93***
	(0.77)	(0.74)	(0.73)	(0.77)
(3) Private inflation forecast revision (+25 bps)	3.37***	3.46***	3.35***	3.37***
	(0.40)	(0.42)	(0.39)	(0.40)
(4) Private GDP growth forecast revision (+25 bps)	3.13***	4.07***	3.09***	3.12***
	(0.23)	(0.25)	(0.22)	(0.22)
(5) Quantitative easing $\{-1, 0, 1\}$ change (+1)	-2.49**	-0.96	-0.34	-2.10**
	(0.87)	(0.90)	(0.79)	(0.71)
(6) Effective lower bound $\{0, 1\}$	0.72**	-0.36	0.09	0.67
	(0.24)	(0.29)	(0.28)	(0.41)
(1) x |(2)|		-4.34***	-3.61***	
		(0.93)	(0.73)	
(1) x |(5)|		3.19*	0.03	
		(1.67)	(2.26)	
(1) x (6)		-9.48***	-8.90***	
		(1.40)	(1.82)	
(1) x Forward guidance with commitment $\{0, 1\}$		14.88***	2.89	
		(2.89)	(4.21)	
(1) x Time-contingent forward guidance $\{0, 1\}$				0.07
				(1.88)
(1) x State-contingent forward guidance $\{0, 1\}$				-4.35
				(2.98)
(1) x Qualitative forward guidance $\{0, 1\}$				-2.56
				(2.06)
Adjusted R^2	0.20	0.20	0.20	0.20
N	48911	47251	48911	48911

This table shows summary statistics from panel regressions with both firm and month fixed effects.
Dependent variable: revisions to individuals' forecasts of the 3-month T-bill rate in 12 months' time.
Columns [1], [3], and [4] use all sample data (1990 to 2021). Column [2] omits the data from 2020-1.
Baseline effects for the interaction terms are included in the regressions but are omitted here for brevity.
Clustered standard errors (at the country level) are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

ties, and the enormous uncertainty associated with COVID-19. Column [3] of Table 1 shows the forward guidance with commitment estimates when these two episodes are included in the data. The coefficient is smaller and the standard error larger. As such, the forward guidance with commitment results must be interpreted with caution and as preliminary. There simply have not been enough examples of forward guidance with commitment to produce robust estimates yet, but this paper provides a first pass.

The results also suggest that there is no significant difference in the influence of time-contingent, state-contingent, and qualitative forward guidance (Table 1, column [4]). This adds to the evidence provided by Jain and Sutherland (2020) that there is also no significant difference in the influence of the three attributes on private-sector forecaster disagreement and forecast error.[26] In practice, when central banks use forward guidance, the language chosen commonly has two or even all three of the qualitative, state-contingent, and time-contingent attributes. Identifying the distinct influence of one attribute of forward guidance is therefore very difficult and may not be a meaningful distinction. This further emphasizes the point that we should not think of these as distinct *types* of forward guidance but rather as *attributes*.

Table 2: **T-bill and bond yield expectations at different forecast horizons**

	[1]	[2]	[3]	[4]
Forward guidance (FG) $\{-1, 0, 1\}$ change	3.69^{**}	5.33^{***}	2.83^{***}	2.83^{**}
	(1.52)	(1.06)	(0.83)	(0.92)
N	48844	48911	47217	47122

Dependent variable [1]: revisions to individuals' forecasts, 3-month T-bill rate in 3 months (bps).
Dependent variable [2]: revisions to individuals' forecasts, 3-month T-bill rate in 12 months (bps).
Dependent variable [3]: revisions to individuals' forecasts, 10-year bond yield in 3 months (bps).
Dependent variable [4]: revisions to individuals' forecasts, 10-year bond yield in 12 months (bps).
Regressions include all controls from Equation 2. Standard errors clustered at the country level.

Table 2 shows estimates of the average forward guidance effect across the term structure and at different forecast horizons. In column [1], at the shortest maturity and forecast horizon, the three-month Treasury bill rate at the three-month horizon, the estimated forward guidance effect is about four basis points. Extending the forecast horizon for the three-month Treasury bill rate to twelve months (column [2]), we

[26]In recent experimental work, Kryvtsov and Petersen (2021) find that "In the experiments, quantitative time-contingent forward guidance is somewhat more effective at stabilizing forecast dispersion and aggregate responses than qualitative state-contingent forward guidance." (p. 779).

see the peak forward guidance effect of five basis points. Column [3] shows the results from using the ten-year government bond yield at the three-month forecast horizon as the dependent variable, and the effect is smaller at about three basis points. Finally, column [4] shows the results for the ten-year government bond yield at the twelve-month forecast horizon, and the effect is also about three basis points.

Swanson (2019) provides estimates of the influence of Federal Reserve forward guidance on U.S. market interest rates. He estimates a peak effect of six basis points per one standard deviation forward guidance shock at the fourteen-month maturity. This implies a forward guidance effect of about six to twelve basis points. The estimated effect declines monotonically in either direction along the yield curve with an effect of about four basis points on the ten-year bond yield and one basis point on the two-month rate.[27] Again, the results in Table 2 are very similar to the ones in Swanson (2019).[28]

Hubert and Labondance (2018) estimate the European Central Bank (ECB) forward guidance effect on the one-year and two-year rates to be about two and three basis points respectively and the effect on three-year and five-year rates to be about four and five basis points respectively.[29] The peak influence of ECB forward guidance, which has been used entirely at the effective lower bound, had the same magnitude as in Table 1, albeit on longer-dated rates. This is consistent with the idea that the influence of forward guidance at the effective lower bound is pushed further down the yield curve and is consistent with the country-specific estimates in subsection 4.2.

Hansen et al. (2019) argue that central bank communication drives longer-term bond yields by operating through the uncertainty channel. They show that news about uncertainty surrounding economic condi-

[27] Altavilla et al. (2019) take a similar empirical approach for the euro area and show that the influence of ECB forward guidance follows the same hump-shaped pattern.

[28] First, the dependent variable in this study also roughly corresponds to a fourteen-month policy rate expectation. The Consensus Economics forecast is for the level of the three-month T-bill rate in twelve months from the end of the month and the survey is completed toward the beginning of the month (so $\approx$ 12.5 months). That forecast is for the three-month T-bill rate, which roughly corresponds to an expectation of the average policy rate over a three-month period (so akin to a $\approx$ 1.5-month policy rate expectation) plus a very small risk premium. Second, the forward guidance effect of five basis points in this paper is an estimate of the average of all the forward guidance changes in the sample data, so this matches well with the estimates in Swanson (2019).

[29] Altavilla et al. (2019) estimate that the peak effect happens at shorter maturities—somewhere between the six-month OIS rate and the two-year OIS rate. Altavilla et al. (2019) studies a longer period, 2002 to 2018. Hubert and Labondance (2018) focuses on 2013 and 2014 forward guidance; the results are driven by the July 2013 ECB forward guidance.

tions drives term premia. By contrast, forward guidance is defined here as communication about the probable path of monetary policy rates, which does not necessarily overlap with central bank communication about macroeconomic uncertainty. Similarly, Hanson and Stein (2015) argue that long-term real rates respond to monetary policy shocks through the term premium channel. In this context, it is not surprising that the effect of forward guidance on long-term bond yields is weaker. It is unsurprising, then, that the average estimated effect of quantitative easing, which should act on the term premium, tends to become larger (increasingly positive) the further out we move along the term structure and forecast horizon. These estimates are consistent with the literature on quantitative easing and market interest rates (e.g. Krishnamurthy and Vissing-Jorgensen (2011), Swanson (2019)).

Table 3: **How forward guidance affected interest rate expectations in different periods**

	[1]	[2]	[3]	[4]
Forward guidance (FG) $\{-1, 0, 1\}$ change	10.56^{***}	5.96^{***}	7.72^{***}	2.76^{***}
	(1.53)	(1.50)	(2.35)	(0.66)
N	12396	12293	11584	12638

[1]: 1990 to 1998; [2]: 1999 to 2005; [3]: 2006 to 2012; [4] 2013 to 2021.
Regressions include all controls from Equation 2. Standard errors clustered at the country level.

In Table 3, I divide the sample data into four roughly equal sub-samples to test whether forward guidance effects may be time-varying, as conjectured in Hansen and McMahon (2016). This shows that the influence of forward guidance has indeed diminished over time.[30] This trend is probably attributable to multiple factors. First, the tail end of this result is undoubtedly just a corollary of the result that the influence of forward guidance on short-term rates is dampened at the effective lower bound. Second, central bank transparency has increased steadily over time. As such, the marginal news contained in a forward guidance announcement has likely diminished over time. Third, and related, central banks try to avoid shocking markets. Their ability to avoid doing so has improved over time.

It is possible that the forward guidance estimate above is understated because forward guidance announcements are systematically anticipated to some extent. In the online appendix, I use news articles

[30]These results differ slightly from Swanson (2019) (Table 4). Although Swanson (2019) studies the U.S. only (though the sample period is virtually identical), this deterioration in forward guidance influence over time is a general phenomenon that applies to the U.S. as well.

to identify instances of forward guidance changes that were very unexpected. I find that the influence of unexpected forward guidance is almost twice as large on average. Hence, forecasters probably do anticipate forward guidance to some extent, but the effect is not so large as to invalidate the average forward guidance effect estimate. In related analysis, I show that the higher the ex-ante forecaster disagreement, the greater the influence of forward guidance. Ex-ante forecaster disagreement may be an important channel through which the magnitude of forecasters' responses to forward guidance is influenced.

4.1 Central bank information effects

Increasingly, the monetary policy literature has been distinguishing between information effects and monetary policy effects (Romer and Romer (2000), Campbell et al. (2012), Campbell et al. (2017), Nakamura and Steinsson (2018), Cieslak and Schrimpf (2019), Jarociński and Karadi (2020), Miranda-Agrippino and Ricco (2020), Andrade and Ferroni (2020), Hoesch et al. (2020), Bauer and Swanson (2020), Lunsford (2020)). Information effects refer to news provided by a central bank about the underlying state of the economy (Romer and Romer (2000)). Monetary policy effects refer to news provided by a central bank about the probable future state of monetary policy. Existing studies capture such information effects indirectly by inferring them from the comovement of asset prices (Nakamura and Steinsson (2018), Cieslak and Schrimpf (2019), Jarociński and Karadi (2020), Andrade and Ferroni (2020)). An important novelty of this paper is that I adjust for short-term information effects directly by using the central bank projections publicly released alongside monetary policy announcements.

One potential concern with this approach is that central bank projections are constructed using an endogenous policy rate. That is, for an inflation-targeting central bank, as inflationary pressures mount, the policy rate would endogenously respond over the projection horizon, thereby tempering inflation in order to meet the inflation target. Accordingly, central banks' inflation projections may not be a reliable policy rate signal. However, this argument is more applicable to inflation projections than to growth projections. Further, this endogenous relationship is more likely to dampen the signal value of inflation projections rather than to eradicate that signal. Finally, the results are robust to this concern. Jain and Sutherland (2020) find that the policy rate assumption used by central banks to produce their projections (endogenous, constant, or market-based) is not an important factor in determining how central bank projections influence private-sector forecaster disagreement and forecast error. I expand the data from that study and omit all periods from the sample data in which a central bank used an endogenous policy rate to produce its projections and then re-estimate all equations from Table 4 below.[31] Despite using a subsample of the data, the results yield the same conclusions (see the online appendix for details).

Another potential issue is that the interpretation of information effects and forward guidance may be time-varying (Rossi and Sekhposyan (2016), Hoesch et al. (2020), Lunsford (2020)). An important component of the information channel of monetary policy is that the central bank may have an information advantage, which would help explain why information effects may influence forecasters. This information advantage could be time-varying, however. For example, the forecast performance of the central bank relative to forecasters could vary over time (Giacomini and Rossi (2010)). Similarly, central bank projections could be unbiased on average over the full sample period but could be biased in sub-periods (Rossi and Sekhposyan (2016)). Hoesch et al. (2020) show that, historically, private-sector interest rate forecasts have not always been rational, while Federal Reserve interest rate projections have generally been rational. The authors conclude that the Federal Reserve has had insider information on the path of interest rates. Both Hoesch et al. (2020) and Andrade and Ferroni (2020) argue that the influence of information effects in the US and EU respectively have diminished or disappeared in recent years. Each set of authors also suggests that the disappearance of a central bank information effect may be attributable to the appearance of more transparent communication, including forward guidance.

Campbell et al. (2012) and Nakamura and Steinsson (2018) show that private-sector forecasters revised their growth projections in the same direction as the monetary policy shocks that preceded them. The authors argue that information effects explain why this revision is in the opposite direction to what New Keynesian theory would predict. Bauer and Swanson (2020) argue that the information effects results in Campbell et al. (2012) and Nakamura and Steinsson (2018) suffer from omitted variable bias. Bauer and Swanson (2020) argue that once they control for the macroeconomic news released between the date of forecasters' previous forecasts and the date of monetary policy shocks, the information effects disappear.

Forward guidance may actually blend monetary policy effects and information effects (Lunsford (2020)).

[31] Hubert (2019) focuses on the Bank of England for the same reason. That is, the Bank of England does not use an endogenous policy rate to produce its projections.

So, the estimated forward guidance effect in this paper could, to some extent, actually be attributable to information effects. Hence, we need to separate information effects from monetary policy effects as much as possible. To do so, I adjust for relatively pure information effects by adding central bank projections of inflation and domestic output growth to Equation 2. This allows me to disentangle the monetary policy signals from short-term macroeconomic information signals.[32] When I add central bank projections to the benchmark econometric model, the results are virtually unchanged, which suggests that the forward guidance effect is not attributable to short-term information effects at least (Table 4). Revisions to central banks' twelve-month inflation projections, which are released first, are positively correlated with revisions to private-sector forecasters' twelve-month Treasury bill forecasts, which are formed second (Table 4, column [1]). The main information effects result is in column [2]. I start with Equation 2 and add central bank projection revisions ($\Delta\tilde{\pi}^h_{ct}, \Delta\tilde{g}^h_{ct}$ in Equation 3). Once the controls are added, the correlation disappears. Accordingly, the forward guidance estimate is essentially unchanged.

$$\Delta r^h_{ict} = \beta\Delta\tilde{f}_{ct} + \gamma\Delta\tilde{q}_{ct} + \phi\Delta\tilde{p}_{ct} + \varphi\tilde{e}_{ct} + \psi_1\Delta\tilde{\pi}^h_{ct} + \psi_2\Delta\tilde{g}^h_{ct} + \delta_1\Delta\pi^h_{ict} + \delta_2\Delta g^h_{ict} + \alpha_i + \alpha_t + \epsilon_{ict} \tag{3}$$

Next, I heed the warning of Hoesch et al. (2020) that central bank information effects may be time-varying. Column [3] repeats the analysis from column [2] but for the pre-financial crisis period (1990-2006); column [4] for the financial crisis and euro crisis period (2007-2014); column [5] for the post-crisis period (2015-2021). In the online appendix, I test whether information effects vary by country or by the type of interest rate forecast used as the dependent variable. Overall, this paper does not find substantial evidence of information effects either in these sub-periods, or in particular countries, or across different interest rate forecasts, especially considering how strong the estimates are for those same forecasters' inflation and growth forecast revisions.[33] I am also unable to find evidence that central bank macroeconomic projection revisions influence private-sector macroeconomic projection revisions (online appendix). Interestingly, the results in column [6] show that in periods when a central bank did not

[32] "It's possible that the Blue Chip forecasters respond differently to different components of these FOMC announcements: for example, the change in the federal funds rate might be viewed as a 'pure monetary policy' shock, while the FOMC statement might have a significant informational component, and the [Summary of Economic Projections] might even be viewed as a 'pure information' shock, since it explicitly communicates the FOMC's own forecast of macroeconomic variables." (Bauer and Swanson (2020)), p. 26.

[33] There may be a negative relationship between interest rate expectation revisions and central bank growth projection revisions in the 1990 to 2006 subsample and a positive relationship between interest rate expectation revisions and central bank inflation projection revisions in the 2015 to 2021 subsample. Neither is highly statistically significant however. There is also some weak evidence (online appendix) that information effects influence longer-term interest rate expectations (see Nakamura and Steinsson (2018), Hansen et al. (2019)).

send a monetary policy signal by either changing the policy rate, changing its forward guidance, or adjusting its quantitative easing program, central bank projection revisions still did not carry much weight.

Table 4: **Interest rate expectations and central bank (CB) information effects**

	[1]	[2]	[3]	[4]	[5]	[6]
CB π revision (+25 bps)	0.68**	0.03	0.06	-0.27	0.35*	0.26
	(0.30)	(0.19)	(0.84)	(0.19)	(0.18)	(0.25)
CB GDP g rev. (+25 bps)	0.08	-0.03	-0.48**	0.14	-0.02	-0.03
	(0.06)	(0.07)	(0.18)	(0.21)	(0.03)	(0.09)
Indiv. π rev. (+25 bps)		2.17***	4.14***	1.50***	1.46***	1.83***
		(0.36)	(0.68)	(0.37)	(0.27)	(0.43)
Indiv. GDP g rev. (+25 bps)		3.15***	7.06***	4.22***	0.80***	2.65***
		(0.40)	(1.04)	(0.57)	(0.14)	(0.36)
FG $\{-1, 0, 1\}$ change		5.55***	6.64***	6.53***	2.90**	
		(0.86)	(1.31)	(1.81)	(1.13)	
Adjusted R^2	0.00	0.22	0.21	0.27	0.16	0.14
N	26359	26359	7692	9499	9168	18912

Dependent variables [1]-[6]: revisions to individuals' forecasts, 3-month T-bill rate in 12 months (bps).
Columns [1]-[2]: full sample (all 12 countries); [3]: 1990-2006; [4]: 2007-2014; [5]: 2015-2021.
Column [6]: sub-sample, periods with no policy rate change, no FG change, and no QE change.
Regressions [2]-[6] include all controls from Equation 2. Standard errors clustered at the country level.

Hansen and McMahon (2016) show that FOMC forward guidance shocks influence markets more than FOMC verbal communication about the state of the economy.[34] Table 4 corroborates this result and suggests that this is a general phenomenon, not just a FOMC one.[35] "Perhaps this is because the markets react more to other, more quantitative, information released by the FOMC or that they update their views of the economy in a similar way to the FOMC in response to economic releases such that there is little news in the FOMC view about the economy, but only news in how the FOMC intends to react to it (captured more by FG_t)" (Hansen and McMahon (2016), p. S130). Indeed, the evidence presented in Table 4 favours the latter interpretation.[36]

[34]Similarly, Hubert and Labondance (2018) find that controls for ECB Projections and SPF Forecasts are neither significant nor do they alter their estimates of the effect of July 2013 ECB forward guidance on market rates.

[35]"Finally, it would be useful to extend the analysis to other countries and thereby see if communication plays a similar role." (Hansen and McMahon (2016), p. S130).

[36]Another possibility is that the complexity of central bank projections is costly for forecasters to absorb (Kryvtsov and Petersen (2021)).

4.2 Country-specific estimates

I now estimate Equation 2 for each country and provide the results in Figure 2.[37] I add private-sector forecasters' revisions to their unemployment outlooks, Δu^{h}_{ict}, to Equation 2.[38] Overall, Figure 2 shows that forward guidance by the Bank of Canada, Federal Reserve, Reserve Bank of New Zealand, and Sveriges Riksbank moved private-sector forecasters' interest rate expectations in the intended direction. Conversely, forward guidance does not appear to have been as influential in the United Kingdom, Europe, or Norway. One simple explanation for this discrepancy is that both the Bank of England and the European Central Bank were comparatively late adopters of forward guidance. All of their forward guidance has taken place at or near the effective lower bound. As such, these central banks' ability to influence these short-term interest rate expectations with forward guidance would have been dampened.

The Norges Bank may represent an exception for a different reason. The Norges Bank is one of the most transparent central banks in the world (Dincer and Eichengreen (2014)). Norwegian monetary policy communication may simply be more predictable because monetary policy is so transparent in Norway and because the Norges Bank updates its forward guidance so frequently. In the online appendix, I provide a country-by-country discussion of the results in the context of the existing forward guidance literature for each country.

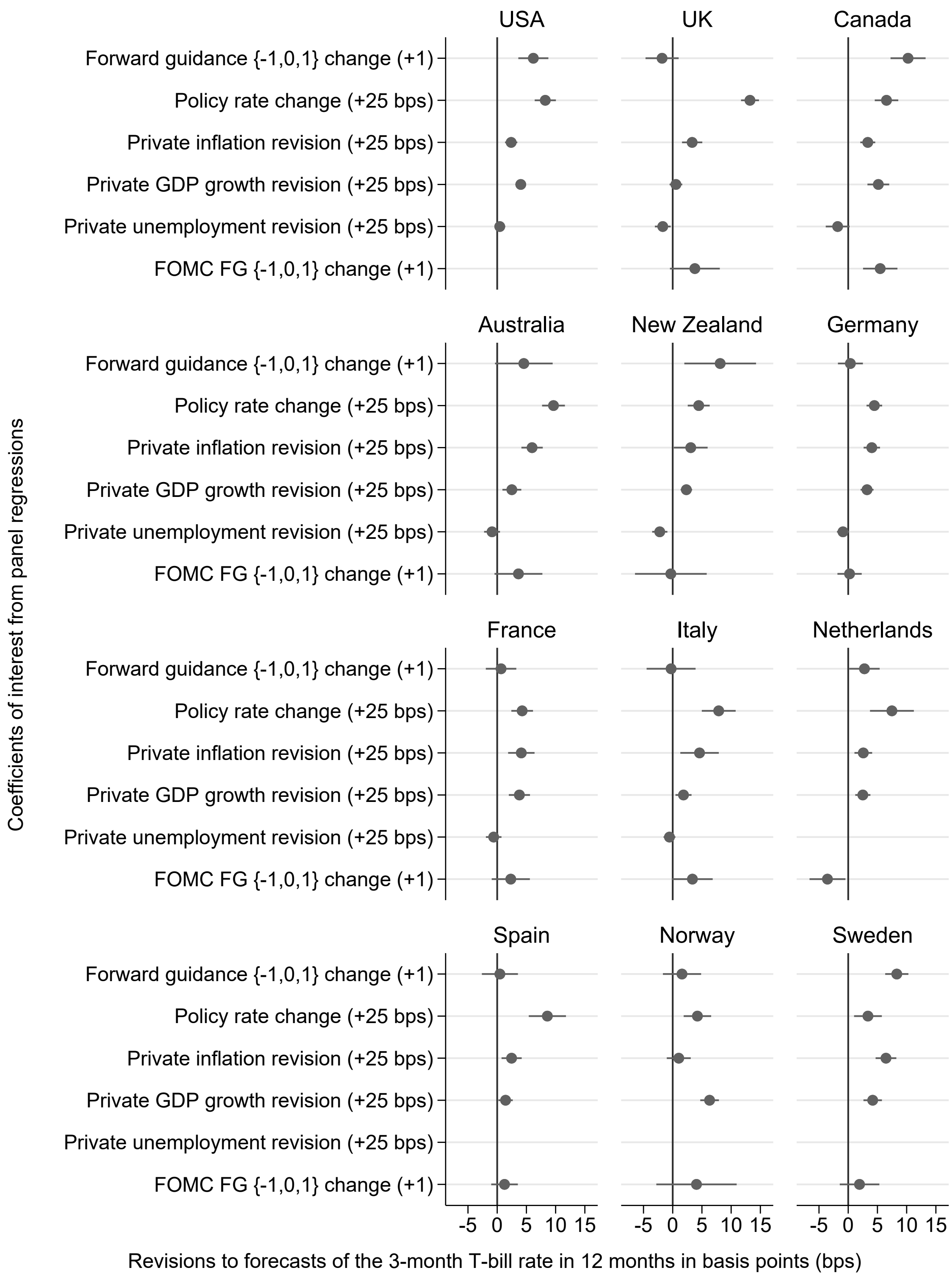
I also tested for any spillover effects from the Federal Reserve's monetary policy. To do so, I add another variable to Equation 2, $\Delta \tilde{f}^{US}_{ct} \in \{-1, 0, 1\}$.[39] We can see in Figure 2 that there are clear spillover effects from Federal Reserve (FOMC) forward guidance to Canadian interest rate expectations, but not to other countries' rate expectations. Unlike other countries, the United States is *by far* Canada's largest trading partner. As such, economic and financial cycles in the two countries are tightly linked, and as a consequence, so too is their monetary policy. Interestingly, ECB forward guidance (not shown here) also does not spill over to the other countries.

[37] I also must adjust α_t to avoid collinearity issues with $\Delta \tilde{f}_{ct}$. Instead, for the country-by-country regressions, I use yearly and calendar month fixed effects instead of a monthly fixed effect for each month in the sample data.

[38] These forecasts are not available, however, for the Netherlands, Norway, Spain, and Sweden.

[39] This variable simply takes the same value as $\Delta \tilde{f}_{ct}$ would if the country were the United States but does so for all countries. That is, this variable simply takes the value of $\Delta \tilde{f}_{ct}$ when $c = USA$ regardless of the true value of c. When $c = USA$, $\Delta \tilde{f}^{US}_{ct} = 0$ to avoid redundancy with $\Delta \tilde{f}_{ct}$.

Figure 2: **Country-specific estimates**



5 Conclusion

In this paper, I have shown that forecasters revise their one-year forecasts of the policy rate in the intended direction by about five basis points on average following a change in forward guidance. Forward guidance with commitment is very rare, but noisy estimates suggest that forward guidance with commitment can amplify the influence of forward guidance on expectation formation. It was not possible to detect any meaningful difference between the influence of qualitative, state-contingent, or time-contingent forward guidance despite ample data. Further, central bank information effects do not appear to be particularly important for interest rate expectation formation. In the appendix, I show that forecaster disagreement is an important channel through which the influence of forward guidance operates. Forecasters are more likely to be influenced by forward guidance the more they disagree beforehand, so forward guidance may be particularly useful in such times. Finally, forward guidance had the largest influence on short-term interest rate expectations in Canada, New Zealand, Sweden, and the U.S.

The data should also prove useful for future research. The monthly central bank data set collects over 30 years of forward guidance, macroeconomic projections, quantitative easing, and policy rate data from eight central banks. For example, the central bank projections data should prove useful for many different types of research, especially to the rapidly expanding central bank information effects literature. The most straightforward extension of this study would be to other countries. Consensus Economics, for example, provides data for over 100 countries, so the data construction and empirical approach of this paper could be extended to those countries. This would be especially useful for those countries that do not have access to the type of high-frequency data used in Altavilla et al. (2019) and Swanson (2019). The data could also be used to study the effects of forward guidance on other types of macroeconomic expectations, as in Campbell et al. (2012), Nakamura and Steinsson (2018), and Andrade and Ferroni (2020), or on other types of yields (e.g. corporate bonds). Finally, and perhaps most importantly, the data could be used to study the macroeconomic effects of forward guidance.

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